Lukman Raimi
Ibrahim Adekunle Oreagba *Editors*

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Trends and Prospects in the Digital Age

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Foreword

Going into the future in this digital age, medicine, healthcare, and entrepreneurship will experience accelerated convergence, emerging in a Siamese connection for disruptive new knowledge for the professional and practice field of endeavour. Medical entrepreneurship opens new windows for healthcare professionals and others from different disciplines, including business experts who are aware of the challenges, needs, tastes, preferences, changes, and gaps in the health sector and are able to connect entrepreneurially with market opportunities to provide relevant products and services that are smart and technologically driven.

The concept of medical entrepreneurship may be new to many. However, the reality is such that development is gravitational towards such a future and bracing ready for full exploration of the field by coming generations in the digital age. Medical entrepreneurship is an emerging and untapped gold mine in many developing nations. Its scope spread to cover medical devices and consumables distribution, nonemergency medical transportation, smoking cessation services, medical waste disposal businesses, medical logistics, medical practice management, remote site emergency support, healthcare and fitness, health financing solutions, medical escort, aesthetic medicine production service, medical gift items and jewellery, medical and healthcare practices resource mobilization, alternative medicine and host of others. It is noteworthy that business practices associated with healthcare are driving the industry stronger in the alphanumeric age.

This book has been combined to stimulate an expanded understanding of medical entrepreneurship. The various chapters in the edited book deal with fundamental issues, starting with conceptualization concerns, essence of medical entrepreneurship, and application of medical entrepreneurship in health care and service delivery. In addition, the economic models relevant to the business integration of medical entrepreneurship today and in the future are presented. The scholarly contributions from authors of diverse disciplines create a rich knowledge bank for newcomers into the sector of entrepreneurial endeavours. It also stimulates new views or horizons for young and old entrepreneurs who are ready players in the field.

I must commend the editors of this book for their deep enthusiasm and scholastic efforts to promote the discipline of entrepreneurship and innovation at a time many

in Africa, the Caribbean, South America, and developing Asia crave to engage the teaming young populations in the productive efforts and knowledge economy of the digital age we live in. In this way, I beseech readers to not only read but also drive the knowledge shared to practical translation and implementation. This book is a useful guide for would-be entrepreneurs and those motivated to be entrepreneurial in medicine and healthcare callings.

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Dr. Lukman Raimi holds a Ph.D. in Entrepreneurship & CSR from the Leicester Business School, De Montfort University, Leicester, UK (an accredited AACSB university), with over 20 years of teaching, research, mentoring, and consulting. Presently, he is an Assistant Professor of Entrepreneurship in the School of Business and Economics (SBE), Universiti Brunei Darussalam (UBD). Prior to joining the UBD, he was an Assistant Professor and the Chair of Entrepreneurship at the American University of Nigeria (AUN). Also, he was formerly the Coordinator of the Graduate Program in the School of Business & Entrepreneurship and the Director Centre for Entrepreneurship in AUN. Besides, he was a former Coordinator of Training and Part-Time Programme at the Centre for Entrepreneurship Development, Yaba College of Technology, Nigeria. His research interests include entrepreneurship, medical entrepreneurship, space tourism entrepreneurship, sustainability issues in entrepreneurship, innovation management, and venture growth strategies. He is an Entrepreneurship Educator trained at the Entrepreneurship Development Institute (EDI), Ahmedabad, India, under the World Bank-Step B Project. He had specialized training in Enterprise Education for Employability (EEE) at the Pan-Atlantic University, Nigeria, under the British Council's sponsorship. He was an alumnus of the Cumberland Lodge Residential Mentoring (2014), Windsor, UK. He attended 2019 Experiential Classroom XX organized

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Chapter 1
An Overview of Medical Entrepreneurship: Trends, Prospects, and Challenges in the Digital Age

Lukman Raimi and Ibrahim Adekunle Oreagba

1 Introduction

The healthcare industry is an important segment of the global economy when viewed in terms of its contribution to citizens' wellness, foreign direct investment, revenue generation, and employment creation. In fact, several health economists find a correlation or tradeoff between health and wealth because a healthy population creates wealthy nations (Bloom & Canning, 2000; Deaton, 2002; Lin & Meissner, 2020; Szreter, 2005). This assertion was empirically validated with national data sets of 16 countries, and it was found that the health of the population increases with a country's level of economic development and declines with the level of economic inequality because a country's economic resources increase the average health of the population and strengthen ties between wealth and health (Semyonov et al., 2013). Over four decades ago, Bloom and Canning (2000) opined that deliberate effort by policymakers to improve the healthcare delivery system has the propensity to fortify the economy with a direct impact on reducing poverty among the 1.3 billion people living on less than US$1 per day because the poor depend on their labour power for livelihood and wealth creation. Moreover, the medical tourism sector of the healthcare industry has indeed grown into a multibillion-dollar industry that provides jobs for healthcare providers and wellness to sick patients and diverse care seekers (Sandberg, 2017).

In pursuance of the targets of SDGs related to health and wellness, the global governments of high-income, low-income and middle-income countries have amplified their budgetary allocations on healthcare because of the prevalence of terminal

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diseases, an ageing population, and emerging middle class suffering lifestyle ailments such as cancer and obesity (Williams, 2019; World Health Organization, 2019). One of the creative responses at upscaling and enhancing the healthcare delivery system is the adoption of medical entrepreneurship. It is believed that medical entrepreneurship is a viable business model to redress the plethora of challenges facing the global healthcare industry because it is a novel paradigm in the global healthcare industry with innovative, cheaper, accessible, and affordable healthcare solutions for meeting the medical needs of diverse populations in both developed and developing countries. A fully funded global and national healthcare system cannot cope with the rising population and growing commitments of governments. Therefore, a collaborative effort between public and private sector organizations is imperative to reinvent and rethink the delivery of medical services to citizens. The current healthcare delivery system has failed to provide accessible, affordable, and sustainable healthcare delivery services for people across the globe. It is widely believed that developed countries have adequate healthcare facilities, including adequate personnel, to meet the healthcare needs and expectations of the people. Alas? This presumption is not totally correct. The devastating effect of the COVID-19 pandemic on the health sector and other sectors has further explicated the need for a sustainable model for upscaling the health infrastructure in all parts of the world. The above issues precipitated the idea to forge a marriage between medicine and entrepreneurship as a distinct field called medical entrepreneurship.

The term medical entrepreneurship, unlike other entrepreneurship terminologies, is not widely used in society. Medical entrepreneurship, such as mainstream commercial entrepreneurship, is a business-oriented mindset that inculcates in medical doctors, other healthcare professionals and policymakers the ability to create new business opportunities in the healthcare industry in response to the needs, tastes, demands, and changes in the fields of medicine, biotechnology, healthcare services, digital science and social entrepreneurship (Raimi, 2019). It is a field that has relevance across the globe (Al-Musawi & Houbby, 2019; Carroll et al., 2019; Raimi, 2019). The knowledge of medical entrepreneurship would help stakeholders in the health sector complement and sustain the functionality, quality, and performance of the healthcare system by developing new, creative, and alternative medical-oriented ventures to redress the deficits in the global health sector for dual benefits (economic return on investment and social wellness for the people). In view of the importance of medical entrepreneurship for upscaling healthcare delivery systems across the globe, there is an urgent need for medical universities and colleges to upgrade their medical curricula to prepare students in medical colleges and universities to become medical entrepreneurs who have the knowledge and capabilities to salvage failing public healthcare delivery systems (Tofighi et al., 2017).

The scope of medical entrepreneurship is broad and collaborative. It accommodates nuances such as medical tourism, healthcare entrepreneurship, medical courier services, medical writing services, medical waste disposal services, medical tourism, surgical innovation, surgical cosmetics, health and fitness centres, medical escort services, public health entrepreneurship, and digital health entrepreneurship (Badulescu & Badulescu, 2014; Cohen, 2017). New digital technologies and

disruptive innovations in ICT are being deployed for fast and effective delivery of medical services to patients at affordable cost. Additionally, medical entrepreneurship is attracting and arousing the interest of venture capitalists, commercial banks, and angel investors seeking to fund new business models in medicine to frontally tackle the health challenges facing the people. Unfortunately, the reception of medical entrepreneurship is mixed. Some view its emergence as commendable and a welcome development. Others view medical entrepreneurship as an aberration that may compromise medical ethics. Worse still, several people across a wide spectrum, including medical doctors, pharmacists, nurses, dentists, medical diagnostics professionals, laboratory technicians, medical directors, policymakers, medical researchers, and academics, have a peripheral understanding of the concept and hence are not fully comprehended, explored and embraced (Al-Musawi & Houbby, 2019; Niccum et al., 2017).

To create more awareness and extend the knowledge frontier in medicine and entrepreneurship, there is a need for rigorous conceptual, policy-focused, theoretical, and empirical studies on medical entrepreneurship from multidisciplinary perspectives. More specifically, the book will focus on the foregoing objectives and impacts:

1. Produce more insightful and valuable materials on medical entrepreneurship for corporate healthcare providers, hospitals, medical consultants, college of medicines, and universities to aid the application of these concepts in theory and practice;
2. Provide foundational knowledge about medical entrepreneurship to a broad spectrum of people;
3. Present medical entrepreneurship as an alternative model for funding the health sector in the face of dwindling public sector resources;
4. Create better awareness of the sustainable model of private sector financing mechanisms for health infrastructure development in the Asian continental region;
5. Enrich existing definitions and theories of medical entrepreneurship and related nuances, such as medical entrepreneurs, medipreneurs, and social medipreneurs;
6. Imbibe in the cross-section of readers the knowledge and abilities to connect entrepreneurially with market opportunities, especially the capacity to provide relevant health-oriented products, services, technologies, and other medical solutions for social impact in developed and developing countries;
7. Strengthen understanding about medical entrepreneurship to help policymakers to accelerate the attainment of sustainable development goal 3 (SDG3), which is ensuring healthy lives and promoting the well-being of all for all age groups.

The book titled '*Medical Entrepreneurship: Trends and Prospects in the Digital Age*' intends to bridge the knowledge gap of academics, entrepreneurs, medical practitioners, and policymakers by focusing on different aspects of medical entrepreneurship, such as conceptualization, scope of medical entrepreneurship, myths and resistance to medical entrepreneurship, convergence and divergence of medicine and entrepreneurship, dominant theories, digital health technologies, funding options,

and different investment opportunities. The book provides diverse readers with insightful and valuable materials on medical entrepreneurship that would be useful to universities, colleges of medicine, undergraduate and postgraduate students in the College of Medicine, development scholars and experts, international development agencies, medical enthusiasts, health economists, entrepreneurs, medical doctors, hospitals, investors and venture capitalists to aid the application of theory and practice of medical entrepreneurship. The book consists of 22 chapters. A brief description of each of the chapters is discussed below.

2 Overview of Book Chapters

The book 'Medical Entrepreneurship: Trends, Prospects and Challenges in the Digital Age' comprised 23 chapters. This first chapter provided an overview of medical entrepreneurship in general. The introductory chapter provides diverse readership with a concise but detailed understanding of medical entrepreneurship. This exploit is intended to bridge the knowledge gap of academics, entrepreneurs, medical practitioners, and policymakers by focusing on different aspects of medical entrepreneurship, such as conceptualization, scope of medical entrepreneurship, myths and resistance to medical entrepreneurship, convergence and divergence of medicine and entrepreneurship, dominant theories, digital health technologies, funding options, and different investment opportunities.

Chapter 2, titled 'Medical Entrepreneurship: Conceptualization, Perspectives, Scope, Dynamics, and Implications' by Lukman Raimi, Ibrahim Adekunle Oreagba, and Fatimah Mayowa Lukman, provided a solid background for the edited book by discussing medical entrepreneurship, perspectives, scope, and undercurrent dynamics to strengthen research and practice using a critical literature review (CLR). The chapter contributes to policy enrichment by explaining the practical implications of embracing medical entrepreneurship in medical colleges and society at large. Particularly, medical entrepreneurship would help accelerate the attainment of sustainable development goal 3 (SDG3), which is ensuring healthy lives and promoting the well-being for all at all ages.

Chapter 3, 'Business Model for Medical Entrepreneurship', written by Muazu Hassan Muazu and Shukurat Moronke Bello, further explained medical entrepreneurship and provided workable medical entrepreneurship business models, such as the Payers-next generation managed care model, Providers-reimagining care delivery beyond the hospital, Pharmacy value chain-emerging shifts in the delivery and management of healthcare and medical tourism, among others. The chapter affirmed that medical entrepreneurship business models would further instigate innovation in the healthcare value chain in developed and developing countries if embraced and supported to flourish.

Chapter 4, 'Medical Ethics and Entrepreneurship: Convergence and Divergence' by Iheanacho Chukwuemeka Metuonu, investigated the roles of medical ethics and entrepreneurship in innovative development, determined the ethical issues in

medicine and health promotion, and examined medical ethics and entrepreneurial principles, convergence and divergence. At the end of the qualitative investigation, the chapter found that medical ethics include respect for autonomy, beneficence, nonmaleficence and justice. Additionally, the convergence of medical ethics and entrepreneurship is based on innovation, services provision, engagement of technology, among others, while divergence of both concepts comes with an exception on issues such as social, religious, and economic implications.

Chapter 5, titled 'Reconciling Medical Ethics and Entrepreneurship: Convergence and Divergence Debates' by Abdullahi Adejare, Ahmed Oloyo, and Saheed Sanni, examined the problems with healthcare financing as well as the convergence and divergence between medical ethics and entrepreneurship. The chapter found that convergence and divergence exist in medical, ethics, and entrepreneurship with respect to goal, quality service delivery, employment of health professionals, charging of fees, care accessibility, management of limited resources, standardizing medical practice, extent to which the use of technology is allowed and community-based research.

Chapter 6, 'Investment Opportunities in Medical Entrepreneurship from a Global Snapshot' by Lukman Raimi and Fatimah Lukman, discussed and dissected investment opportunities in medical entrepreneurship from a global perspective. Specifically, twenty-five (25) investment opportunities in medical entrepreneurship were properly identified and discussed that aspiring medical entrepreneurs, venture capitalists, angels, and financial institutions could explore and exploit for long-term streams of revenue in the global healthcare industry.

Medical entrepreneurship is better actualized when funded by investors in both the public and private sectors. Therefore, Chapter 7, 'Funding Sources for Medical Entrepreneurship in the Digital Age (Middle East Perspective)' authored by Hani El-Chaarani, Lukman Raimi, and Zouhour El-Abiad, provided very useful insights into funding sources for medical entrepreneurship in the digital age. The chapter investigated the funding sources of 107 medical entrepreneurs from 8 countries in the Middle East region and found that the main financial sources for medical entrepreneurship investments are bank loans, personnel savings, funds from family members, and business angels. However, other funding sources, such as grants and venture capital, are not frequently employed in the Middle East region.

Chapter 8, titled **'**Funding Sources for Medical Entrepreneurship in the Digital Age (African Perspective)' by Badaru Abiola Abdul-Basit, discussed the traditional and conventional funding sources for medical entrepreneurship in Africa. It was found that African medical entrepreneurs and entrepreneurs have different sources of funding based on the complexity and peculiarity of the medical business models being targeted or explored.

Chapter 9, 'Future Health Care and Medical Entrepreneurship in the Age of Pandemic' by Muhammad Usman Tariq, dissected the future of the healthcare delivery system and provided justifications for the adoption of medical entrepreneurship that is going through revolution and evolution triggered by the ravages of the COVID-19 pandemic. The chapter explained that medical entrepreneurship is an innovative business model that comes from conventional telehealth services, a new

sort of solution that permits people to edge with an artificial intelligence system before a human doctor is contacted and has robust growth.

Regardless of the structural and functional benefits of medical entrepreneurship, if the idea is not embraced by medical schools and medical professors, the pace of its growth, adoption and application in clinics, hospitals and other medical contexts would be hindered. To tackle this foundational issue, Chapter 10, titled 'Medical Schools and Curriculum Enrichment in Entrepreneurship', written by Mogaji Ibrahim Kolawole, a medical consultant, advocated the need for curriculum review and enrichment in medical schools across the globe to retrain medical students to become medical entrepreneurs. He cautioned, however, that an enriched medical curriculum should not compromise the primary goal of medical education but should present a balance of medical education that meets social and economic goals in the healthcare industry.

Chapter 11, titled 'Social Entrepreneurship and Medical Entrepreneurship: Lessons from Nigeria' written by a veteran author, Ik Muo, discussed the connection between social entrepreneurship and medical entrepreneurship from the case study of Professor Nwosu and the Apex Specialist Hospital, which were founded in 1981 at Igbo-Ukwu, a rural community in Anambra state. The chapter found that social entrepreneurship (SE) and medical entrepreneurship (ME) are similar in many respects, as both play important roles in entrepreneurial alertness, the identification of opportunities, innovativeness and the deployment of people's funds in pursuit of dreams.

The process of teaching and learning entrepreneurship is enriched with case study and case analysis. To add value to the edited book, Chapter 12, titled 'Case Studies of Medical Entrepreneurship' authored by Fardeen Dodo[1], Muhammad Rabiu Balarabe and Maryam Abdulkader, provided valuable case studies on medical entrepreneurship. In particular, the chapter reviewed 50 examples of medical entrepreneurship to provide an exploratory understanding of how entrepreneurs use a combination of various aspects of business strategy to identify opportunities and address healthcare access gaps in various areas of the healthcare industry.

Chapter 13 'Healthcare Consumerism and Implications for Care Delivery' by Rajasekhara Mouly Potluri and Sophia Johnson discussed consumerism in general and healthcare consumerism implementation criteria, significance, opportunities, and challenges during the pandemic from the perspectives of diverse stakeholders in India. On the strengths of the views of stakeholders during the pandemic in India, the chapter proposed a complete overhaul of the healthcare system leveraging medical entrepreneurship. For quality assurance, the chapter also underscored the need to garner the opinions of all the stakeholders to know more about the complexities they identified before, during, and after patient care.

The traditional healthcare system has proven to be inefficient and insufficient to cope with new diseases and associated vulnerabilities. To provide empirical validation for medical entrepreneurship, Chapter 14, titled 'Empirical Analysis of Health Innovation/Digital Health Entrepreneurship) and Resilience in European Countries' written by Simona-Andreea Apostu, investigated the relationship between resilience and health innovation in contemporary times. In specific terms, the chapter addressed

whether resilience is significantly influenced by innovations in the health domain. In the final analysis, it was affirmed that at the European level, health innovation is significantly correlated with resilience, and resilience is explained by health innovation variation.

The sustainability of existing healthcare systems is endangered by several societal development factors, such as the increase in unmet medical needs and rising healthcare service costs. To make global healthcare systems more accountable, prudent and transparent for service providers and patients in the face of the threats enunciated above, there is an urgent demand for new payment systems. To provide more professional clarity on emerging and future payment systems, Chapter 15, titled 'Future Healthcare Payment Models in Medical Entrepreneurship' authored by Olumuyiwa Ganiyu Yinusa, Olusola Enitan Olowofela, and Mayowa Ebenezer Ariyibi, discussed the pros and cons of traditional healthcare financing models and nontraditional healthcare payment models.

The introduction of digital technologies and state-of-the-art smart devices and disruptive procedures would obviously enhance the operational performance outcomes of hospitals, clinics and other healthcare facilities and, in the long run, guarantee competitiveness. In shedding more light on these prospects, Chapter 16, titled 'Healthcare Innovation & Entrepreneurship, Digital Health Entrepreneurship', by Muhammad Usman Tariq, explained that healthcare innovation and entrepreneurship are new approaches for enhancing healthcare quality, effectiveness, sustainability, efficiency, affordability, and safety. Further intent of healthcare innovation extends to capitulate ascendable solutions and enhancements in health policies, delivery methods, technologies, products, services, and systems.

There is always an alternative in nature. The globalization wave has accommodated other paradigms and perspectives in arts, humanities, economics, culture, philosophy, and politics, and the healthcare sector has also accepted with caution the efficacy of an alternative medicine practised widely in developing countries. For a more robust understanding, Chapter 17, titled 'Alternative Medicine in Health Care: Is the Time Not Now to Standardize African Phytomedicine to Indigenize Health Care and Create Entrepreneurial Opportunities?' wrote Ahmed Adebowale Adedeji, Oretomiwa Emmanuel Talabi, and Farouk Oladoja, discussed the trends in phytomedicine practice Africa, reasons for the prevalence of alternative medicine, degree of efficacy and reliability, possible areas of cooperation and partnerships with orthodoxy medicine for sustainable impact, and key challenges of alternative medicine in the current state in Africa with regard to standard pharmaceutical practice and business opportunities.

It is an incontrovertible fact that all development blueprints, including those developed by the United Nations, emphasized partnership for progress and development. The reality of collaboration and partnership led to the conceptualization and adoption of the triple helix model (THM). The THM operationally brings together three critical actors for diving socioeconomic development agendas, such as wealth generation, novelty production, and normative control. Is this truly the case in a developing context? Chapter 18, titled 'Medical Entrepreneurship and Triple Helix Model in Nigeria Health Sector' by Jubril Olukayode Lasisi, empirically investigated and

reported the connection between medical entrepreneurship and the triple helix model in the Federal Medical Centre (FMC), Abeokuta, Ogun State, Nigeria. The finding indicated that there is a significant relationship between medical entrepreneurship and the triple helix model because the connection is beneficial in terms of unique healthcare products and services to diverse stakeholders in the healthcare sector.

In developed and developing countries, the life-threatening disease called diabetes is on the rise. Chapter 19, titled 'Diabetic Care Center and Nutrition/Dietetics in Nigeria', written by a seasoned food technologist and researcher, Olawale Paul Olatidoye, explored the current status of diabetes care and management, the effect of physical activity, diet, and lifestyle on the prevention of diabetes mellitus, areas of improvement and strategies to optimize the use of secondary data to accelerate the sustainable use of resources and the economic burden of diabetes and the use of technology in its management. A comprehensive narrative review based on local available healthcare data and publications revealed that high costs are incurred at various stages of screening, diagnosis, monitoring, and management of diabetes; hence, it is important for policymakers to implement cost-effective measures and quality treatment for diabetes care to reduce diabetes-related morbidity and mortality.

The rise in the cost of the healthcare delivery system and the prevalence of life-threatening diseases across the world calls for a sustainable model in medicine in terms of access, efficacy, alternative options, cost-effectiveness, and flexibility in procedures. In response to this clarion call, Chapter 20, titled 'Sustainable Innovation in Healthcare Delivery: The Role of Alternative Healthcare Practitioners' authored by Shukurat Moronke Bello, discussed the imperatives of sustainable innovation in healthcare delivery in the face of surge in demand for alternative healthcare delivery services. Particularly, the provided answers to the burning questions are as follows: (i) What complementary and alternative healthcare methods are available in the business of healthcare? (ii) How can patients be effectively served by healthcare practitioners to achieve sustainable innovation? At the end of the review, it was discovered that practitioners need to establish strategies for sustainable alternative healthcare delivery due to global awareness and the importance of alternative healthcare delivery to the global healthcare system.

Chapter 21, titled 'Alternative Medicine and Healthcare Delivery: A Narrative Review', written Ibrahim Adekunle Oreagba and Kazeem Adeola Oshikoya, carried out a systematic qualitative meta-analysis on alternative medicine practices otherwise called complementary and alternative medicine to evaluate the quality, efficacy, safety, and regulation of these range of therapies by combining all the available evidence in the literature. At the end of the review, it was found that there is subtle evidence supporting the quality, efficacy, and safety of CAM therapies and products; however, much of the evidence is inconsistent due to the varied CAM types and regulatory policies from country to country.

Advances in technological development have revolutionized the world. Chapter 22, titled 'Digital Innovation in Healthcare Entrepreneurship' authored by Ramat Mohammed-Nasir, Kazeem Adeola Oshikoya, and Ibrahim Adekunle Oreagba, discussed the application of digital innovation in healthcare entrepreneurship and its attendant advantages. Application of digital technologies has simplified

access to health, lower cost of diagnosis and treatments, and improved communication between doctors and patients in the areas of electronic health (eHealth), storage of and access to medical information and data, generating and storing of big data, improving lines of communication between patients and their doctors, electronic health records (EHRs), telemedicine and telehealth, mobile health (mHealth), online learning (eLearning), health applications and drones. Notable areas of challenges are reported.

3 Conclusion

In conclusion, the editors and contributors to this book are hopeful that this volume would make significant contributions in theory and practice to the field of medical entrepreneurship. While medical entrepreneurship and related concepts such as digital health technology, public–private partnerships in healthcare, and public health innovation are strategic areas that have attracted attention from governments, health-oriented nongovernmental organizations, and private sectors in recent times, there is an urgent need for vigorous sensitization and education on medical entrepreneurship through research, conferences, workshops, and summits to bridge the knowledge gaps and correct the misconceptions that a segment of society has about the emerging field of medical entrepreneurship. We trust that this volume will receive positive commendation, favourable reception and accolade from local, regional, and international academic colleagues, medical professionals, social entrepreneurs, medical students, and policymakers, who are interested in learning more about medical entrepreneurship in different contexts and countries.

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Chapter 2
Medical Entrepreneurship: Conceptualization, Perspectives, Scope, Dynamics, and Implications

Lukman Raimi, Ibrahim Adekunle Oreagba, and Fatimah Mayowa Lukman

1 Introduction

In the global healthcare industry, medical entrepreneurship has found its way into colleges of medicine and entrepreneurship ecosystems. It is a concept that is still largely misunderstood by a large spectrum of physicians, health professionals and nonhealth professionals. This chapter discusses medical entrepreneurship, perspectives, scope, and undercurrent dynamics to strengthen research and practice. New digital technologies and disruptive innovations in ICT are being deployed for fast and effective delivery of medical services to patients at affordable cost. The above trends suggest that the future of global health care can only be sustained through medical entrepreneurship. Adopting medicine entrepreneurship by all stakeholders within the healthcare industry would evidently aid the provision of cheap, accessible, and affordable innovative healthcare solutions to patients and help redress the challenges facing healthcare delivery systems in both developed and developing countries (Ahrari et al., 2021). Moreover, the digital health industry has developed new medical-oriented devices and digital healthcare solutions to support clinical operations and procedures that offer great incentives for passionate medical entrepreneurs (Lesonsky, 2020). Conservative physicians who are resistant to medical entrepreneurship are those with weak exposure to entrepreneurship and poor understanding of digital health technologies and medical business solutions (Ahrari et al., 2021).

Medical entrepreneurship is a field that provides a viable alternative to traditional medical practice by focusing on the most effective way of translating public health knowledge into sustainable and scalable healthcare solutions to improve the wellness

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of society (Becker et al., 2019). It has also opened new investment opportunities in the healthcare industry because of the readiness of venture capitalists, commercial banks, and angel investors to fund medical entrepreneurs that are ready to frontally tackle the health challenges facing the people.

In view of the importance of medical entrepreneurship for upscaling healthcare delivery systems across the globe, there is an urgent need for medical universities and colleges to inculcate medical entrepreneurship into the curricula of the College of Medicine to prepare undergraduate and postgraduate students in medical colleges and universities to become medical entrepreneurs who are better endowed with knowledge and capabilities to salvage failing public healthcare delivery systems (Tofighi et al., 2017). In actualizing this laudable goal, this chapter discusses medical entrepreneurship to strengthen research and practice using a critical literature review (CLR). In specific terms, the chapter provides answers to three questions: What are the functional definitions of medical entrepreneurship/entrepreneur? What are the perspectives on acceptance and resistance to medical entrepreneurship? What is the scope of medical entrepreneurship and emerging jobs?

Apart from the introduction above, the chapter is divided into five sections. Section 1.1 represents the methodology/approach. Section 2 defines medical entrepreneurship/medical entrepreneurs. Section 3 discusses the perspectives on acceptance and resistance to medical entrepreneurship. Section 4 highlights the scope of medical entrepreneurship and emerging jobs. Section 5 concludes with implications.

1.1 Methodology/Approach

This chapter simply follows the qualitative research tradition, with a preference for a deck-research technique. The process starts with the gathering of useful academic resources, such as articles, texts, policy reports, working papers, and online resources, from four research databases, Google Scholar, Semantic Scholar, Medline, and EBISCO, for academic publications on medical entrepreneurship. From over 97 publications generated by the databases, a sample of 37 relevant publications that cover the themes of investigation was selected, critically reviewed, evaluated, and synthesized on the basis of which integrated findings were reported. The term CLR refers to systematic appraisal and objective analysis and evaluation of research resources on a specific topic to gain enriched understanding and insights for making more inclusive and informed conclusions on the subject of inquiry (Saunders & Rojon, 2011).

2 Defining Medical Entrepreneurship/medical Entrepreneur

Defining medical entrepreneurship and medical entrepreneurs is expedient to enhance the peripheral understanding that medical doctors, pharmacists, nurses, dentists, medical diagnostics professionals, and academics have about medical entrepreneurship. At present, the concept is not fully comprehended, explored, and applied (Al-Musawi & Houbby, 2019; Niccum et al., 2017). The extant literature explains that medical entrepreneurship is a merger of medicine and entrepreneurship. Like mainstream commercial entrepreneurship, medical entrepreneurship is a business-oriented mindset that inculcates in medical doctors and healthcare professionals the ability to create new business opportunities in the healthcare industry in response to the needs, tastes, demands, and changes in the fields of medicine, biotechnology, healthcare services, digital science, and social entrepreneurship. It is a field that has relevance across the globe (Al-Musawi & Houbby, 2019; Carroll et al., 2019; Raimi, 2019). Medical entrepreneurship also describes a private sector model of the healthcare system that assists the government with preventive and curative measures that are relatively affordable, cost effective, and profitable for redressing worsening health issues (Entrepreneur Media, Inc., 2022). Moreover, a medical entrepreneur describes clinician, or inventor and innovation director who searches, defines the clinical need, and designs inputs and outputs in terms of medical products and services that meet the need of the clinical market, including raising funds for the actualization of medical discoveries (Gruionu & Velmahos, 2015). Therefore, teaching medical entrepreneurship and promoting its ideals would complement and sustain the effectiveness, quality and performance of the healthcare system by developing new, creative, and alternative medical-oriented ventures to solve deficits in the global health industry. When fully embraced, medical entrepreneurship gives dual benefits (economic return on investment and social wellness for the people (Raimi, 2019).

3 Perspectives on Medical Entrepreneurship

Despite the inherent economic incentives of medical entrepreneurship, the strict professional norms and culture in the medical profession have discouraged many physicians from pursuing entrepreneurial opportunities or exploring newly emerging entrepreneurial activities in the healthcare industry; they simply stick to their professional practice on several grounds (Carlos & Hiatt, 2022). First, many physicians reject medical entrepreneurship because of professional norms, beliefs, and behaviors that reflect and permeate medical professions (Giorgi et al., 2015). Such conservative physicians hold the belief that they may sacrifice the tenets of empathy and compassion, which are the core fundamental values in the art of medicine if they embrace medical entrepreneurship and new public management in the healthcare industry (Bertuzzi et al., 2020; Bloom, 1989; Kristanto et al., 2021; Merlo, 2021). To these

antagonists, medical entrepreneurship is akin to commercialization of medicine, commodification of medical and health care, and profiting from healthcare delivery systems (Herzlinger, 2006; Pellegrino, 1999; Timmermans & Oh, 2010). A powerful statement that explicates the resentment against medical entrepreneurship was that given over 3 decades ago by Dr Relman (1986, p. 209). He warned: "As a physician, we believe the medical profession's first responsibility is to serve as a trusted agent and adviser for patients. Physicians should be adequately compensated for their time and effort but not as businessmen. Unfortunately, too many physicians currently are succumbing to the lure of easy profits and are becoming entrepreneurs." However, these strict professional norms held by physicians have been found to change when they are alternative cultural forces in other regions, organizations, and professional institutional fields where the creation, discovery, and exploitation of entrepreneurial opportunities are encouraged and promoted (Carlos & Hiatt, 2022).

Third, the fear of abandoning the oath of the medical profession deters several physicians. According to a number of scholars, Hippocrates, the Father of modern medicine, counseled, "Wherever the Art of Medicine is loved, there is also a love of Humanity" (Bertuzzi et al, 2020; Rowe & Kidd, 2018). Furthermore, the updated Hippocratic Oath of 1964 obligated medical practitioners to swear that "{WE)… will remember that there is art to medicine as well as science and that warmth, sympathy and understanding may outweigh the surgeon's knife or the chemist's drug" (Hajar, 2017).

Apart from the threat to medical ethics, some physicians and medical associations doubt the effectiveness of telemedicine and other digital health solutions, fearing that these digital health innovations may compromise the tenants of empathy and compassion, as envisaged by Hippocratic (Bertuzzi et al, 2020). For instance, the American College of Surgeons (ACS), a specialty professional association for surgeons, supported the medical solution of ambulatory surgery centers, but the American Medical Association (AMA) was vehemently against the innovative idea. The support given by ACS was hinged on three grounds. First, the American College of Surgeons cherishes physician specialization and the desire to advance the cultures and practices of surgeons through the establishment of independent surgery centers because the purpose fits the broader culture of medicine. Second, the innovative idea of ambulatory surgery centers as an alternative to the traditional hospital surgical model has saved the US government Medicare of more than $3 billion per year and provided a lower cost option for out-of-pocket patients who require surgical procedures (Carlos & Hiatt, 2022; Hoyt, 2011). Third, ambulatory surgery centers provide patients with better access to safe, fast, and quality surgical procedures, including postsurgical care, in an efficient and cost-effective manner than traditional surgeries in hospitals (Giorgi et al., 2015; Kellogg, 2011).

In the furtherance of support for medical entrepreneurship, the reality across the globe shows that a healthcare system fully funded by governments cannot cope with the growing population in different countries, and worsening incidences of life-threatening diseases and associated pressure have forced governments to enact changes in the healthcare system through the adoption of PPPs (Widdus, 2017; Yusuf,

2014). Private sector investors are massively funding health care because of its long-term profitability. The prospect of increased employment is high with the adoption of medical entrepreneurship. It projected that employment in the healthcare industry in the US would grow by 18%, and the growth would account for nearly 20% of the GDP by 2026 (Lesonsky, 2020). In addition, a paradigm shift is expedient in the field of medicine and healthcare industry to embrace medical entrepreneurship for the following reasons. All countries of the world need a more accessible, affordable and quality healthcare system in the face of rising cases of life-threatening diseases, infant mortality and epidemics, and recently, the COVID-19 pandemic. The rising concerns over the problems faced by an overburdened public healthcare system across the globe have heightened the relevance of medical entrepreneurship as a new approach for achieving a self-sustaining model that guarantees and balances the social responsibility of physicians and the profitability of entrepreneurs (Entrepreneur Media, Inc., 2022). In the US, the health care system faces serious challenges, as the costs expended on healthcare exceed $3.6 trillion, which translates to 17.7% of the country's GDP (Centers for Disease Control & Prevention, 2019).

Furthermore, medical entrepreneurship is a bridge between socialized medicine of the public sector and commercialized medicine of the private sector, although the latter deployed medical innovative solutions as an alternative, cost-effective, and quality healthcare delivery that can best redress weaknesses in traditional hospitals (Barro et al., 2006). Unlike traditional physicians, medical entrepreneurs, as social entrepreneurs, are better trained to identify new opportunities and keep up more proactively with the changing trends, needs, and technologies in the healthcare industry (Entrepreneur Media, Inc., 2022).

From the foregoing, the fears of physicians and some medical associations are genuine; however, medical entrepreneurship and its digital health solutions are effective, beneficial, empathetic, and compassionate to humanity because unlike traditional medical solutions, the various digital solutions provide speedier, affordable, and quality healthcare services to a growing population of sick people. For instance, outpatient procedures in ambulatory surgery centers are a radical departure from traditional inpatient surgeries. The former makes it possible to reduce the operating time per surgery and enables patients to recover quickly in the comfort of their homes, including eliminating huge medical bills of staying in clinics (Carlos & Hiatt, 2022). Consequently, medical entrepreneurship and the disruption technologies it brought should be acceptable and welcome as long as they promote a holistic healthcare model guided by Hippocratic philosophy.

4 Scope of Medical Entrepreneurship and Emerging Jobs

At the moment, the field of medical entrepreneurship is in its infancy but is growing by the day. Medical schools are also ill equipped at the moment to teach this new field of knowledge. For traditional medical schools to inculcate principles and

models of medical entrepreneurship, a curriculum review and enrichment are necessary. The scope of medical entrepreneurship is broad and collaborative. It accommodates nuances such as medical tourism, healthcare entrepreneurship, medical courier services, medical writing services, medical waste disposal services, medical tourism, surgical innovation, surgical cosmetics, health and fitness centers, medical escort services, public health entrepreneurship, and digital health entrepreneurship (Badulescu & Badulescu, 2014; Burning Glass Technologies, 2020; Cohen, 2017). New digital technologies and disruptive innovations in ICT are being deployed for fast and effective delivery of medical services to patients at affordable cost. Medical entrepreneurship is inevitable in view of the growing population across the globe, the emergence of deadly pandemic diseases, and the readiness of venture capitalists, commercial banks, and angel investors to fund medical entrepreneurs who are ready to frontally tackle the health challenges facing the people. If the broad field of medical entrepreneurship is fully developed, it would present the following impact and value to the medical entrepreneurship ecosystems.

1. The field of medical entrepreneurship would provide an alternative model for funding the health sector in the face of dwindling public sector resources.
2. Medical entrepreneurship presents an opportunity for the implementation of the triple helix model, which is a sustainable model for public–private partnerships for upscaling the healthcare infrastructure in developing and developed countries.
3. The disruptive business models of medical entrepreneurship would enrich the knowledge and abilities of medical doctors and healthcare professionals to connect entrepreneurially with market opportunities, especially the capacity to provide relevant health-oriented products, services, technologies, and other medical solutions for social impact in developed and developing countries.
4. The field of medical entrepreneurship would help policymakers to accelerate the attainment of the sustainable development goal 3 (SDG3), which is ensuring healthy lives and promoting the wellbeing for all at all ages.

Furthermore, the broad scope of medical entrepreneurship makes it a driver of employment and labor force integration in the healthcare industry that is witnessing progressive automation and flexible ways of working, including reskilling, upskilling, and relearning. Charlton (2021) explained that massive jobs will emerge across all professions, but almost 40% of the projected job opportunities will come from the healthcare industry because of the growing demand for diverse healthcare services. To be able to take up new opportunities in the healthcare industry and other emerging sectors, professionals need three key competencies, namely, critical digital and cognitive capabilities, (b) social and emotional skills, and (c) adaptability and resilience (Agrawal et al., 2020). A number of recent articles reported that robots, unmanned **aerial** vehicle (UAV) smart devices, drones, and other disruptive technologies are used in the healthcare industry to deliver medical supplies and enhance service delivery to patients (Euchi, 2021; Kumar & Sharma, 2021). These medical devices, although very expensive, have operationally proven to be potent and effective in developed and developing countries, as they are helpful in disinfection, delivery of medical supplies, surveillance, consultation and screening, and diagnosis of patients

(Mbunge et al., 2021). In Slovenia, the Czech Republic, and Slovakia, every thousand workers are to be replaced with two robots (Kilic and Marin, 2020). Table 1 provides the list of emerging jobs that medical entrepreneurship would trigger in the coming years.

Table 1 Emerging jobs and new skills in medical entrepreneurship

Emerging jobs	New skills
Medical transcription services	Artificial intelligence
Electronic medical records management	Aerial technology management
Physical/occupational therapy center	Robotics
Multipurpose mobile health care	Business model development
Diabetic care center	Machine learning and big data
Home healthcare service	Project management
Rehabilitation center for drug addicts	Design thinking
Fitness trainers and aerobics centers	Guidance and counselling
Physical therapist aides	Caregiving
Medical tourism	Mobile apps development
Occupational health and safety	Sterile procedures/techniques transcription
Disposable syringe manufacturing	Radiation treatment
Medical equipment preparers	Medical dosimetry
Alternative health care	Nutritionist/dietitian
Childbirth services	Exercise physiologists
Medical tailoring and sewing	Recreation workers
Medical supply sales and deliveries	Personal care aides
Blood banks	Respiratory therapists
Ambulance service	Vital signs measurement
Spam banks	Simulation
Medical waste disposal services	Medical machine maintenance technicians
Medical esthetic clinic	Radiologic technologist
Online pharmacy and dispensary	Healthcare support workers

Source Compiled by the authors from the review of literature

5 Conclusion and Implications

The chapter discusses medical entrepreneurship, perspectives, scope, and undercurrent dynamics to strengthen research and practice. Leveraging a critical literature review (CLR), the authors affirmed that medical entrepreneurship as a medical-oriented business model has the possibility of creating new business opportunities in the healthcare industry that meet the needs, demands, and changes in the fields of medicine, biotechnology, and social entrepreneurship. It is a field to be embraced and promoted because the scope covers medical tourism, healthcare entrepreneurship, medical courier services, medical writing services, medical waste disposal services, medical tourism, surgical innovation, surgical cosmetics, health and fitness centers, medical escort services, public health entrepreneurship, and digital health entrepreneurship.

To make medical entrepreneurship a reality in the global healthcare industry, the chapter explicates that multiple stakeholders in entrepreneurship and medical ecosystems need to collaborate in several respects. At present, the working knowledge about medical entrepreneurship is in its infancy. More education, sensitization and advocacy is required in the medical profession. Similarly, the global healthcare industry requires private sector intervention because a fully funded healthcare system cannot cope with the rising population and numerous priorities of governments. Therefore, a collaborative effort between public and private sector organizations would be useful to reinvent and rethink the delivery of medical services to citizens. More importantly, medical entrepreneurship as a timely intervention in the healthcare delivery system has proven to be a more accessible, affordable, and sustainable model. The devastating effect of the COVID-19 pandemic on the global health industry has further justified the value of medical entrepreneurship as a sustainable model for upscaling the health infrastructure.

A number of implications have arisen from the foregoing discourse. First, the chapter has provided foundational knowledge about medical entrepreneurship to guide corporate healthcare providers, hospitals, medical consultants, colleges of medicines, and universities and other users on the concept and practice of medical entrepreneurship. Second, medical entrepreneurship represents an alternative business model and private sector financing mechanism for strengthening and financing the healthcare industry in the face of dwindling public sector resources. Third, the intellectual resources contained in the chapter would imbibe in readers the knowledge and abilities to connect entrepreneurially with market opportunities by providing relevant health-oriented products, services, technologies, and other medical solutions for social impact in developed and developing countries. Overall, understanding medical entrepreneurship as detailed in this chapter if embraced by policymakers would help accelerate the attainment of sustainable development goal 3 (SDG3), which is ensuring healthy lives and promoting the wellbeing for all at all ages.

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Chapter 3
Business Model for Medical Entrepreneurship

Muazu Hassan Muazu and Shukurat Moronke Bello

1 Introduction

There is a new social entrepreneurial movement underway that aims to find cures for some of the world's most difficult diseases. 'Medical entrepreneurship is the best hope for speeding up the discovery of medical cures' (Tjan, 2010). Milken has taken an entrepreneurial approach to providing capital and human resources to accelerate the pace of cancer research, particularly prostate cancer research. The death rate for prostate cancer fell by 25% between 1999 and 2006. There is no doubt that Milken's leadership has been one of the most significant catalysts for this improvement. Henry McCance, who co-founded the nonprofit Cure Alzheimer's Fund, is another figure in medical entrepreneurship. Another example of a cure accelerator is the Cure Alzheimer's Fund, an organization that takes a venture approach to medical research. While health care is deeply concerned with diseases such as Alzheimer's, many people are optimistic that a more maverick VC-like business model applied to the search for medical cures will be a better approach to addressing some of the major medical challenges we face today.

The current medical research model is inoperable. Why? Three words describe the situation: insufficient, inefficient, and ineffective. This is both a major issue and a significant opportunity for medical entrepreneurs. Today's model is insufficient because only approximately 1% of the money spent on diseases goes toward cure research, with the rest going to care for people who have the disease. Alzheimer's disease, for example, costs countries hundreds of millions of dollars each year, but only one cent out of every $4.00 available is spent on finding a cure. That is an incredible 400× delta. Diabetes and cystic fibrosis have similar features. While healthcare is obviously critical, more funds must be directed toward finding a cure—or the

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country will be jeopardized. Henry McCance and Professor Bill Sahlman of Harvard Business School recently gave an excellent overview of this at Venture Summit East, and many elements were drawn.

Pioneers of the medical entrepreneurship movement are taking larger risks with researchers, asking them to focus their efforts on initiatives with the greatest potential impact rather than those that would receive traditional grant funding. They are also doing so at a faster rate. For example, Milken's Prostate Cancer Foundation makes awards based on applications that are no more than five pages long and have a 90-day turnaround time. FasterCures has evolved into a think tank and resource-sharing hub for this novel approach.

Focus on the big ideas that can lead to the big goal of curing a disease, eliminate bureaucracy, and give smart people more capital, faster, and you have got a change formula. What evidence do you have that the change is positive? The advances in prostate cancer understanding made by medical innovators in that field have saved thousands of lives. The Cure Alzheimer's Fund was named one of the top ten medical breakthroughs of the year by Time Magazine last year for work that identified over 100 genes associated with the disease. A number of other dynamic organizations, such as the Harvard Stem Cell Initiative and the Myelin Foundation, are contributing significantly to cures.

Researchers have been conditioned to make progress with bond-like returns across a wide range of diseases. While some of this is needed, it cannot suffice. We cannot maximize returns in any portfolio if we put all of our eggs in one large conservative basket. Medical practitioners must put more money into higher-risk initiatives that can produce equity-like returns and, hopefully, real cures (Tjan, 2010).

2 Literature Review

2.1 Business Model for Medical Entrepreneurs

Today, new and innovative business models are showing promise in terms of providing better medical care while also generating higher returns on investment. The existence of these emerging models, as well as their potential and actual success, reflects what has been observed in the market in recent years: some of the leading organizations in the healthcare sector are not content to simply play in attractive segments and markets but are instead proactively and fundamentally reforming how the industry operates and how health care is delivered. While the recipe varies by vertical, these new business models all share a greater alignment of incentives, typically involving risk bearing, better integration of care and use of data, advanced analytics, and continuous innovation (Clark et al., 2021). Innovations in healthcare delivery models are a necessary step toward a more market-like environment in which competition among providers results in better value for money. The traditional business models of general hospitals and doctors' practices are insufficient for all types

of tasks, which explains a portion of the healthcare system's sustainability issues. New business models are emerging that shed light on this claim, but they vary in terms of standardizability and separability, as well as patient-centeredness.

Payers—Next-Generation Managed Care Models

For payers, the new and innovative business models that can generate superior returns are those that incorporate healthcare delivery and advanced analytics to better serve individuals with increasingly complex healthcare needs. As chronic disease and other long-term conditions require more continuous management supported by providers (for example, behavioral health conditions), these next-generation managed healthcare models have garnered notice. In the healthcare delivery space, nine of the top ten payers have made acquisitions. Such models aim to reorient the traditional payer model away from an operational focus on financing health care and pricing risk and toward more integrated managed care models that provide higher-quality, better-experienced, lower-cost, and more accessible care (Clark, et al., 2021).

Providers—Re-imagining Care Delivery Beyond the Hospital

For health systems, through an investment lens, the ownership and integration of alternative sites of care beyond the hospital has demonstrated superior financial returns. Between 2013 and 2018, the number of transactions executed by health systems for outpatient assets increased by 31%, for physician practices by 23%, and for post-acute care assets by 13%. At the same time, the number of hospital-focused deals declined by 6%. In addition, private equity investors and payers are becoming more active dealmakers in these non-acute settings.

As investment is focused on alternative sites of health care, it is observed that health systems pursuing diversified business models that encompass a greater range of healthcare delivery assets (for example, physician practices, ambulatory surgery centers, and urgent care centers) are generating returns above expectations. By offering diverse settings to receive health care, many of these systems have been able to lower costs, enhance coordination, and improve patient experience while maintaining or enhancing the quality of the services provided. Consistent with prior research, systems with high market share tend to outperform peers with lower market share, potentially because systems with greater share have greater ability not only to ensure referral integrity but also to leverage economies of scale that drive efficiency.

Traditional players have an opportunity to integrate innovative new technologies and offerings to transform and modernize their existing business models. Simultaneously, new (and often nontraditional) players are well positioned to continue to drive innovation across multiple subsegments and through combinations of capabilities (roll-ups).

Pharmacy Value Chain—Emerging Shifts in the Delivery and Management of Health Care

The profit pools within pharmacy services are shifting from traditional dispensing to specialty pharmacy. Profits earned by retail dispensers (excluding specialty pharmacies) are expected to decline by 0.5% per year through 2022 in the face of intensifying competition and the maturing generic market. New modalities of health care, new care settings, and new distribution systems are emerging, although many innovations remain in the early stages of development.

Specialty pharmacy continues to be an area of outpaced growth. It is expected that by 2023 and beyond, specialty pharmacies will account for 44% of pharmacy industry prescription revenues, up from 24% in 2013. In response, both incumbents and nontraditional players are seeking opportunities to both capture a rapidly growing portion of the pharmacy value chain and deliver better experience to patients. Health systems, for instance, are increasingly entering the specialty space. In previous years, the share of provider-owned pharmacy locations with specialty pharmacy securing accreditation doubled the long stand, which creates opportunities for operators to directly provide more integrated, holistic health care to patients around the world.

Medical Tourism Model

Travel for health purposes is not a new phenomenon. Ancient stories, legends, and fables contain many stories of journeys taken by heroes seeking portions and cures for another, often their kings or queens. There were quests in search for the 'fountain of youth' or for other equivalent rewards to seek immortality or perpetual beauty. These ambitious activities are not confined to one culture and stories for the search for the mysterious and supernatural span of all cultures. Similarly, these quests also include a search for wealth and wealth that can guarantee or purchase a comfortable lifestyle and well-being. It thus becomes a business opportunity for medical entrepreneurs to tap from.

Over time, things have not changed much except that this idea or concept has evolved to become more acceptable to the new generation. People still travel for health reasons and seek cures for their ailments and take measures to preserve their well-being. For example, people travel to health spas, especially to bathe in special mineral waters, to alleviate the symptoms of arthritis (e.g., Rotorua, New Zealand), to travel to warmer climates to escape the winter months (e.g., Monte Carlo), and to avoid winter illnesses such as colds and flus. Pilgrims continue to travel for religious purposes, some in search of miracle healing from certain blessed locations, such as in Lourdes, where there is a history of miracles that have occurred in the past. Hence, those organizations and businesses that capitalize and cater to such markets can prosper and grow as the demands for their products and services continue to increase.

There is no one definition for medical tourism. However, it is generally accepted that this term is used to refer to travel activity that involves a medical procedure or

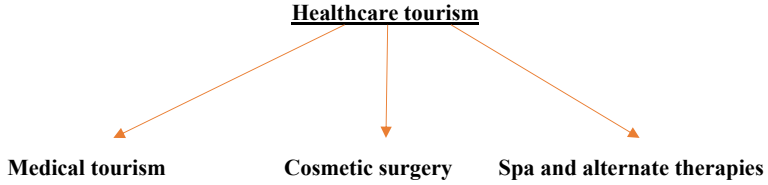

Fig. 1 Scope of healthcare tourism (Henderson, 2004)

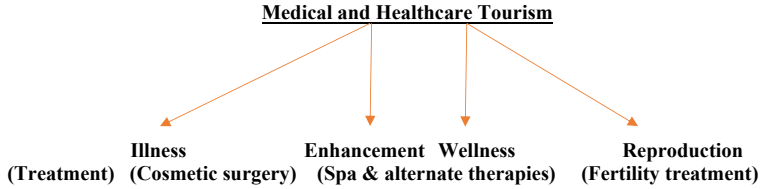

Fig. 2 Medical tourism segments (TRAM, 2006)

activities that promote the well-being of the tourist. For example, the term 'healthcare' tourism has been used to cover travel and tourism that are related to medical procedures, health and well-being purposes. The scope of healthcare tourism is illustrated in Fig. 1.

This definition has since been slightly modified. Figure 2 illustrates a revised framework for medical tourism. This framework reflects the interchangeable use of the terms 'medical tourism' and 'healthcare tourism'. In addition, a new category is introduced to accommodate new 'reproduction' procedures. The previous terms used in the categories in Fig. 1 have been included in Fig. 2 to illustrate where these correspond in the first diagram.

Using the framework in Fig. 2, the medical procedures that are classified under 'illness' include medical check-ups, health screening, dental treatment, joint replacements, heart surgery, cancer treatment, neurosurgery, transplants, and other procedures that require qualified medical intervention. Medical enhancement procedures also require qualified medical personnel, but much of this work is nondisease-related (unless disfigurement is caused by disease) and done mainly for aesthetic purposes. Examples of such procedures include all cosmetic surgery, breast surgery, face-lifts, liposuction, and cosmetic dental work.

The 'wellness' segment of medical and healthcare tourism promotes healthier lifestyles (Bennett et al., 2004). Therefore, these products can include spas, thermal and water treatments, acupuncture, aromatherapy, beauty care, facials, exercise and diet, herbal healing, homeotherapy, massage, spa treatment, yoga, and other similar products. Under 'reproduction' tourism, these patients seek fertility-related treatments such as in vitro and in vivo fertilization and other similar procedures. Birth tourism is also classified under this segment (TRAM, 2006). This involves a pregnant mother who travels to another country to give birth to her baby to utilize the services,

which are often free or obtain an advantage from having an offspring gain citizenship in another country. Referring to the medical tourism framework in Fig. 2, there is opportunity for different entrepreneurs to capitalize on these varied medical tourism segments. The provision of surgical procedures would require specialized staff, but the provision of leisure spas does not require medically trained staff. Therefore, there is a range of personnel expertise that is required to support this industry that can be provided by the host country.

3 Methodology

The methodology used in this research was a desk-based approach. We searched periodicals, relevant association databases, and academic databases such as Science Direct, Google Scholar, and Web of Science for peer-reviewed journal articles published in the English language. Data were collected on study characteristics, definitions, terminology, theoretical frameworks, and empirical reviews of medical entrepreneurship business models.

4 Insights

4.1 Key Elements for Medical Business Model Innovation

In the practice of medical care, there are some chains of activities that are interconnected for service offerings in healthcare delivery, also known as elements. It could be maintained that standardizability is an important element enabling innovations in business models followed by separability from hospitals and, finally, patient-centered innovation. These are the elements that could be tailored toward having some of the categorization of the entrepreneurial business model in medicine as propounded by Castano (2014), as found in the works of Smolen et al. (2010), Govindarajan and Ramamurti (2013), and Thomas (2014).

Standardizability

Standardizability depends on knowledge about how a process can be structured to achieve an outcome with minimal uncertainty. Therefore, the stronger the scientific evidence explaining how A causes B, the more likely the process will be standardized: the best way to ensure that the expected outcome (B) is achieved is to ensure that process (A) is strictly followed. Standardization is a necessary condition for task-shifting. A complex task that is surrounded by uncertainty requires judgment based on expertise and experience. Therefore, it must be performed by a highly skilled

worker. In the opposite sense, a simple task with little or no uncertainty requires little judgment and can be written in a protocol, which can be delegated to a less skilled worker. The most extreme case of delegation is an automatic task that is delegated to a computer or a machine. A good example of an entire process that has been standardized, and therefore delegated, is the application of an immunization schedule for a baby. However, standardization is not a sufficient condition for delegation. Not all that is standardizable can be delegated to less skilled workers. For example, placing a stent in a coronary artery or performing a total hip replacement requires a learning process that cannot be leapfrogged by learning a protocol.

Separability

Separability is the principle whereby a given process does not depend on a wide array of equipment, supplies, and workforce and can be set up in a separate facility with dedicated resources that can be efficiently used, i.e., with little or no idle capacity. Interdependencies in hospital-based processes are typical of complex patients, which makes these processes less separable (Berwick et al., 2008). For example, a given patient with metastatic lung cancer will require many diagnostic and therapeutic processes and surgical and nonsurgical procedures, all requiring a wide variety of specialties, equipment, and consumables. Another patient with the same type of cancer might need a different mix of inputs, depending on the particular characteristics of that patient. Therefore, interdependencies make it very difficult to separate care for patients with metastatic lung cancer in a freestanding facility.

A process of care that is highly standardized and highly separable from a hospital or a doctor's practice is more likely to be arranged in an innovative business model that widely differs from these two traditional business models. Examples of this are cataract surgery or hernia repair, as performed at Aravind Eye Care System and Shouldice Hospital, respectively (Berwick et al., 2008). Nevertheless, these two models have been on stage for several decades, which hardly makes them innovative. The interesting question is why they are not more pervasive in healthcare systems. One business model that is enabled by both standardizability and separability is that of specialized community health workers. In this model, lay people apply highly standardized protocols for following up patients in the post-acute phase and patients with chronic conditions in their community setting. Community workers do not make clinical decisions; they are supervised by doctors or nurses, who make clinical decisions and use them as their 'extensors'. Nonetheless, nonstandardizable and nonseparable processes can also be reshaped with innovative business models, as will be shown below. This means that business model innovation is also possible within the current hospital and doctor's practice models.

Patient-Centeredness

Patient-Centeredness is the third key element for innovation, or more broadly, person-centeredness. As said above, the supply-side mindset of healthcare providers makes it difficult for them to understand patients' needs, expectations, and preferences and to see them as opportunities for innovation. The farthest that most providers go into this realm is to focus on patient satisfaction with facilities and interpersonal skills of staff. However, patient-centeredness goes far beyond this oversimplifying approach. A case in point is care for rheumatoid arthritis. Two therapeutic goals are key in caring for these patients: prevention of structural damage and control of symptoms; abrogation of inflammation achieves these two goals (McGlynn et al., 2003). According to the author's own unpublished research in Bogota, Colombia, from many doctors' perspectives, it is enough to see the patient every one to three months to keep track of levels of disease activity.

However, when a patient has a flare, he or she wants to see the doctor immediately. However, the typical business model of an ambulatory care center is not adequate to deal with nonscheduled visits and to deal with the processes and activities required for the short-term management of flares. Therefore, patients must attend an emergency room or visit another doctor, with the consequent fragmentation of the cycle of care and coordination problems. Managing short-term symptoms is much more important from the patient perspective than from the doctor's perspective. However, a business model that is designed from the doctor's perspective to achieve long-term goals does not meet patient needs, expectations, and preferences in the short term.

This case illustrates the gap between a supply-sided mindset and what consumers need, expect, or prefer. It does not matter how well the staff treats the patient in terms of interpersonal manners or how sympathetic they are to patient complaints. It does not matter how convenient the facility is designed in terms of physical access, waiting rooms, and amenities. The real problem is that the whole business model must be redesigned to be able to deal with how the patient experiences illness. The traditional supply-sided mindset of doctors and healthcare providers is, in fact, a tremendous opportunity for business model innovation, as illustrated with the rheumatoid arthritis case. Most other industries have become very sophisticated in anticipating consumer's needs, expectations, and preferences to come up with new value propositions to win the race for consumer votes. This head-to-head race has led to repeated disruptions that have yielded much better products and services at lower prices. Health care lags far behind those industries, so the opportunities for innovation are immense, just by turning back to patients and understanding their needs, expectations, and preferences in a much deeper way than the oversimplifying traditional approach to patient satisfaction.

4.2 Six Approaches/Business Models in the Traditional Medical Care Model

The process of health care can be simplified into three steps: diagnosis, treatment, and self-care/self-management. Each of these steps has both standardized and nonstandardized components. A simple way to understand how standardizable and nonstandardizable processes allow for innovation in healthcare delivery models is to depict them as six separate blocks that can be rearranged into different patterns. These six blocks are mixed in the current traditional healthcare business models of hospitals and doctors' practices, which is partly the source of their dysfunctionality.

Medical Conditions

Medical conditions for which diagnosis and treatment are highly standardized. This category includes diarrhea, minor sunburns, athlete's foot, etc. These conditions are currently the focus of retail clinics in the United States and telephone assistance business models (Jha, 2011). In these two models, the process of care is standardized, can be delegated to nonphysicians, and operates outside hospitals and doctors' practices. The business model of community health workers cited above is another example of this category.

Medical or Surgical Treatments

Medical or surgical treatments that are highly standardized, such as hernia repairs, cataract surgery, or kidney transplantation. In this category, some or all activities are highly standardized, and some of the most standardized activities are delegated to nonphysicians. Although cataract surgery and hernia repairs are highly separable from general hospitals, kidney transplantation is not separable, particularly the surgical procedure (Porter & Teisberg, 2006). The high level of standardization of these processes has deserved them the name 'focused factories'. When the process is not separable from the general hospital, the figure of 'a hospital within a hospital' allows for keeping interdependencies while avoiding the interference of nonstandardized processes.

Diagnostic Processes

In this category, the idea is to separate the diagnostic process from the treatment decision. This separation aims to avoid the framing bias that makes it more likely that a doctor interprets signs and symptoms through the lens of those medical conditions he or she knows how to treat or is familiar with. Although it could be argued that a diagnostic algorithm is in fact a standardized process, it is clear that, for a given

patient, it cannot be anticipated which of the diagnostic possibilities she has until the process of hypothesis testing advances through the algorithm. To avoid framing bias, the diagnostic process should be performed in an interdisciplinary way, and an explicit process must be put in place to force clinicians to share their perspectives before making a decision about diagnosis.

Self-Care and Self-Management

This category includes many processes that are highly standardized, such as taking medications, applying nonpharmacological therapies, changing habits, and adopting healthy lifestyles. Other processes, such as responding to the particular psychological or social needs of a given patient, are not standardizable. Both processes can be dealt with more effectively through peer-support communities. Christensen et al. (2009) propose the business model of facilitated networks: web-based or real groups of people who share common interests. In this case, the common interest is a medical condition, and the network members support themselves to reinforce positive behaviors and discourage negative ones. The classic example of this category is Alcoholics Anonymous, but modern-time facilitated networks have become pervasive thanks to the internet.

Integrated Care of Medical Conditions

This category derives from Porter and Teisberg's proposition of Integrated Practice Units, which are meant to create value around medical conditions, covering the complete cycle of care, including comorbidities. In this category, standardized and nonstandardized processes are mixed but focused on a given medical condition or set of cooccurring conditions. However, risk stratification of patients typically shows that a large share of patients with a given condition are highly and moderately standardizable, and their outcomes are relatively predictable, while a minor share of the patients are more complex and nonstandardizable. Chronic conditions, such as diabetes, heart failure, or chronic obstructive pulmonary disease, are more likely to benefit from this business model.

Nonstandardized Processes of Diagnosis and Treatment

These are the typical processes that made the bulk of the workload at hospitals and doctors' practices, when most health care was highly uncertain because of a lack of evidence. As scientific evidence allows for better predictability of outcomes in some areas of health care, standardization is more likely to be achieved. If standardized processes of care can also be separated from hospitals and doctors' practices, these latter two business models will end up focusing on nonstandardized, nonseparable processes. It is obvious that these two pillars of healthcare delivery will not

disappear, but it could be argued that their business models will be reshaped and their strategic focus will shift from 'everything-to-everybody' to a narrower focus on those processes of care that exhibit a larger degree of uncertainty and a lower degree of separability.

4.3 Challenges of Operating a Model

Medical entrepreneurs should be wary of implementation barriers to improve and better understand the innovation performance of business models in practice. Disruptive technologies, shifting consumer preferences, and shifting competitive landscapes put constant strain on firms' business models. Broekhuizen et al. (2018) identified four critical challenges that managers face when implementing new business models: autonomy vs. integration; roadmap planning vs. trial-and-error approach; rebellion vs. status quo; solid vs. fluid logic.

Autonomy vs. Integration
The first challenge concerns the organizational structure in which the new business model will be implemented. In this context, a critical trade-off is how much independence and autonomy is granted to the responsible business unit. Business model innovators assessed the degree of unpredictability and disruptiveness of the innovation to determine where they fit on the dependence–independence continuum. When BMI is highly disruptive, independence allows the innovator to explore and develop the new model while avoiding cannibalization issues.

Roadmap Planning vs. Trial-and-Error Approach
The second challenge is determining whether the innovator should prioritize roadmap planning or begin testing the new business model as soon as possible. This challenge incorporates well-known management concepts such as 'lean' and 'agile'. The study found that business model innovators should use a trial-and-error approach because new business model patterns are difficult to predict, but planning can help when markets are somewhat predictable and stable.

Rebellious vs. Status Quo
Business model innovators take a daring position that challenges the status quo to differentiate their offering from existing offerings. Our cases show that firms, particularly start-ups, have more leeway in taking a rebellious stance to clearly differentiate the concept from existing offerings. Innovators in business models, particularly those that serve customers are remarkably outstanding in their deliverables and how they relate with clients during and after transactions. In regard to scarce-resource start-ups, trust is crucial—warn that rebelliousness can be harmful. In new and emerging markets, a lack of rules about how to play the game contributes to the ability to leverage rebelliousness. However, in more mature markets with stronger social norms

about acceptable behavior, such a rebellious stance may be severely limited in its appropriateness.

Solid Versus Fluid Logic
Managers of new business models frequently struggle to adhere to the initial value proposition logic and adjust their initial value proposition—although such changes undermine message clarity to their clients and other stakeholders. As the exploration or modification of the business model becomes more difficult over time, fluid logics may appear to be an effective—and sometimes necessary—response to changing market conditions. Business model innovators make deliberate decisions about when and how to change their business model's value proposition logic. It was able to effectively migrate its clients from the more expensive branch channel to the low-cost internet channel by allowing them to familiarize themselves with and try out the online channel. Although a solid value proposition appears to be the most expedient way for a new business model to emerge and provide a clear and understandable value proposition to customers, in practice, firms may initially rigorously implement the simple rules while later allowing for conscious adjustments of their business models, indicating a more fluid stance to ensuring long-term viability or reflecting on their previous plans for changes.

5 Conclusion

The medical entrepreneurship business model was found to be very inspiring, as it revealed some of the inner practices in healthcare value chain core activities that engender care innovation in medical entrepreneurship value offerings. The findings from this work have further strengthened hopes in the medical profession of having branches to lean on as businesses to generate new value streams and possible sustainable cash flows. The elements discussed in this work, such as standardizability, separability, and patient-centered innovation, are important drivers enabling innovations in business models, which must not be ignored. The six approaches to business modeling of medical entrepreneurship show the various branches of healthcare service delivery needed for successful operational undertakings as a system because of their interconnectivity. It is therefore argued that medical entrepreneurship business models would further instigate innovation in the healthcare value chain. It will also encourage innovation in care delivery that would eventually translate into patient satisfaction, as they would be treated as customers who are known to be 'kings'. That is, the degree of entrepreneurial opportunities physicians have depends on how they view their offerings as either a fee-for-service or who provides certain services, such as examining patients, diagnosing problems, prescribing medicine, providing simple treatment, and referring patients to specialists for a monthly salary.

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Chapter 4
Medical Ethics and Entrepreneurship: Convergence and Divergence

Iheanacho Chukwuemeka Metuonu

1 Introduction

Entrepreneurship and medicine are duo concepts that are governed by ethics and subsumed under Medical Entrepreneurship. Both concepts also have their convergence and divergence points. Ethics is considered one of the four branches of Philosophy, which include morality, culture, and norms. According to the United Nations (2012), every organization needs to be governed by some culture, norms, philosophies, beliefs, and traditions that align with their expectations and global standards. In another study, NatureServe (2010) stressed that organizations often focus on the process of making profits from their activities rather than considering the ethical implications of their actions. Hence, standardized principles and guidance are key issues in ethics. That is, the code of conduct attainable in an organization is governed by many principles; however, when these codes are broken, different questions come to one's mind. However, an action is always considered right or wrong without considering core issues such as culture, traditions, aims and objectives of companies, consequences of actions, and many more. When discussing the concept of ethics, medicine, health, and health promotion cannot be undermined. Medicine is a profession that began approximately 2400 years ago and was initially known as homeopathy, allopathy, and Ayurveda (Benjamin et al., 2016). The role of medicine is to ensure that people are in the perfect state of well-being—that is, socially, emotionally, and physically. Unhealthy living has been seen from different perspectives; it has been seen as a form of unease or depression faced by people in line with their negative experiences. It can also be described as the emotional and mental suspension or strain that disturbs the normal mental and psychological processes of human beings.

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Health promotion on the order hand is some of the involvement of health workers, nongovernmental organizations (NGOs), religious bodies, and individuals in the propagation of information about medical challenges. Childress and Beauchamp (2013) argued that health promotion is not the duty of health workers alone, as it needs to be a joint effort in fighting against the spread of diseases and creating preventive measures for people. A good example of this is the roles that nongovernmental organizations (NGOs), religious bodies, individuals, social media, and broadcast media are presently playing in the reduction of COVID-19 spread. For example, the Nigerian government, through the aid of the Nigeria Centers for Disease Control (NCDC) Health Protection, has a designed social policy on how the spread of the virus can be reduced; this social policy includes pandemic protocols, mandatory compliance with the protocols, and penalties to face when such protocols are broken (Nigeria Centers for Disease Control [NCDC] Health Protection Regulations, 2021).

Medical ethics is, however, an interesting subject that has raised different arguments in scholarly discourses. It addresses the standards and principles that are attainable in the medical field. Some of these principles include respect for autonomy, beneficence, non-maleficence, and justice. Thomas (2020) argued that although medical practitioners also need to act in patients' best interests, this has not been best practised in all cases. According to Riddick (2003), for every medical ethics, there are always exceptions; these exceptions are what create the convergence and divergence between medical ethics and entrepreneurship. Entrepreneurship, according to Bula (2012) and Garcia and Alvarez (2017), is, therefore, a multidimensional concept that entails the act of taking risks to identify business opportunities. A good entrepreneur should be able to identify opportunities and solve problems. It must also be noted that entrepreneurship is a field that can be applied to other fields, such as education, medicine, and social work.

This study is therefore an investigation into the point to which entrepreneurship and medical ethics meet. Some of the scepticism that needs certainty is to discover where medical entrepreneurs should make profits, focus mainly on care and public health, attend to their medical tasks, and many more. It is on this ground that this study critically investigates medical ethics and entrepreneurship and their convergence and divergence. The specific objectives of the study are: (a) to investigate the roles of medical ethics and entrepreneurship in innovative development; (b) to determine the ethical issues in medicine and health promotion; and (c) to examine medical ethics and entrepreneurial principles, including convergence and divergence. Ultimately, the chapter provides answers to the following questions in the main discourse: What are the roles of medical ethics and entrepreneurship in innovative development? What are the ethical issues in medicine and health promotion? What are the convergence and divergence points of medical ethics and entrepreneurial principles?

2 Literature Review

The section shows the list of literature that was reviewed in the study, which includes conceptual, empirical, and theoretical literature. These include the concept of ethics and its theoretical models (utilitarianism and deontology); medicine, health, and health promotion; the concept of medical ethics; the concept of entrepreneurship and theories (neoclassical model, functionalism theory, O-ring theory, and the optimum triangle theory) as well as entrepreneurship and medicine.

2.1 Concept of Ethics and Its Theoretical Models

Ethics is a branch of philosophy that addresses what is wrong or right in a given setting or environment. The actions that are considered right in some societies are seen as wrong in other environments (NatureServe, 2010). Hence, ethics is a consistent way of life that aligns the culture, norms, philosophies, beliefs, and traditions that are attainable in an organization (United Nations, 2012). Ethics is seen as the way of carrying out activities in an organization; it is a form of morality, principles, and guidance available for actions and inactions of people to work in an organization (Crane & Matten, 2007; United Nations, 2012).

From another view, ethics is from the code of conduct that is attainable in an organization, which ranges from the way of dressing, method of attending to customers and other employees, timing and nature of work, and many more (Crane & Matten, 2007; United Nations, 2012). Some of the qualities and features of ethics include respect for justice, autonomy, and equity (NatureServe, 2010). Other features of ethics include lawful conduct, acceptable standards in society, and interpersonal behaviour, which includes sexual propriety, honesty, and truthfulness. Ethics are developed based on the expectation of an organization; however, the interest of workers must be considered in the same accord (United Nations, 2012).

For instance, in medical settings, ethics implies that the information of patients needs to be treated confidentially without exposing them to a third party. In business ethics, certain ways are expected from employees to behave and react to customers (NatureServe, 2010). This is the process of ensuring that basic customer services are rendered, which will make customers keep coming to patronize the company (Traer, 2013). It must also be noted that morality is a concept that is connected to ethics; morality is the process of applying the culture, norms, philosophies, beliefs, and traditions that are exhibited in a social, general, and specific environment to work realities and culture (Crane & Matten, 2007).

Therefore, ethics are everyday philosophies that guide human activities at work and off work. It is the process of doing what is right and avoiding what is wrong in some given settings (Crane & Matten, 2007). However, wrong and right actions can be seen from the perspective of the philosophical terms tagged utilitarianism and deontology. For the utilitarianism model, an action is right based on the consequences

of such action as well as the number of people involved. In other words, an action is correct when there is a higher number of people who will benefit from such action, that is, when an action brings a greater level of job for the higher number of people. The deontology perspective is rule-based, as Immanuel Kant noted that action is bad or wrong based on designed principles (Traer, 2013). This is the case that utilitarianism model application in a hospital setting is when an abortion is permitted when the life of the mother is at risk. On the other hand, the deontology model has it that in a setting where abortion is wrong, even if the life of the woman is at stake, abortion should and will not be committed (Worldwatch Institute, 2012; Wraight, 2011).

2.2 Medicine, Health, and Health Promotion

Medicine is a concept that has existed since immemorial times, that is, approximately 2400 years. Some of the names that were used synonymously to represent medicine in the past included homeopathy, allopathy, and Ayurveda (Benjamin et al., 2016). It must also be noted that, however, the concept became more viable in the twenty-first century, when people started to depend largely on it to maintain a healthy lifestyle (Barry & John, 2015). Medicine is not a pure science that implies that it is a probability science that includes the healing of people through drugs, treatment, therapy, and other forms of physiological approaches (Benjamin et al., 2016).

Benjamin et al. (2016) submitted that people tend to face psychological health challenges when they are not allowed to express their creativities and interest in act cities going on in their environment, place of work, or even their relationships. This is a pointer to the fact that workplaces are meant to be designed to engage workers' creativity and give room for their expressive opinions and interests. Another very common aspect of medical issues is when people are battling illnesses that have been caused by diseases.

Medicine is therefore the treatment of illness and diseases, which has become more evolving through the practice of public health and health promotion. Henceforth, the use of drugs, plant substances, and medications are part of the famous way to attend to the illness of people (Benjamin et al., 2016). According to Barry and John (2015), medicine over the years has developed into surgical intervention when the body of patients can be accessed for operations by medical experts. Medicine is also concerned about the prevention of diseases, and it is often said that "prevention is better than cure".

Looking at health and health promotion, health implies the ability of people to be at the right state of mind, that is, social, emotional, psychological well-being, and many more. It is when human beings fit mentally and physically. Health promotion is therefore the process of ensuring that people are in the right state of mind through awareness programmes, adoption of social policies, and many more. Briggs et al. (2016) asserted that public health has a lot to do with medicine, meaning that when emergent issues in health are projected to the public as a way of reducing the spread, the field of medicine faces fewer challenges.

In tandem with the aforementioned is the case of the COVID-19 pandemic, which is far becoming the norm at a global level. The role of public health is to educate the people on some of the protocols to follow to reduce its spread. People also need to learn about how not to get contacted by the virus as well as what to do and where to go when they start feeling the symptoms of the virus. In this regard, Ezeibe et al. (2020), and Abdul (2020) asserted that the well-being of people is best promoted when they are educated on emergent health developments. In this same stance, the field of medicine is aided by nongovernmental organizations (NGOs), religious bodies, and individuals in the propagation of information about medical issues (Childress & Beauchamp, 2013).

2.3 Conceptualizing Medical Ethics

Medical ethics has its history in 1803 by Thomas Percival, who saw the need for expectations from medical experts. It was noted that Medicine, unlike every other discipline, is highly connected with the lives of people; hence, the need to ensure that human lives are well guided socially and morally (Riddick, 2003). The medical code of ethics was first adopted and put into practice in 1847, and it was reinvented and revised in 1903, 1912, and 1947 (Riddick, 2003).

Medical ethics are therefore practised everywhere in the world but with little expectations in regard to society culture, norms, and values (UW Medicine, 2020). Medical ethics, therefore, include respect for autonomy, beneficence, non-maleficence, and justice.

Respect for Autonomy: This is the case when patients can decide whether to take treatments (Gillon, 1994). This infers that patients have the final decision to make in deciding what medical treatment they want or to reject all techniques as a whole. However, in cases where patients are unconscious to make a conscious decision, their immediate relatives can decide on their behalf.

Beneficence: This is the case where the best set of treatments is used on patients. Additionally, medical practitioners need to act in patients' best interests (Thomas, 2020).

Non-maleficence: This is the adoption of the utilitarianism model to medicine—it's the process of ensuring that the higher good is done to patients than bad. Medical actions here are carried out based on utility, that is, treatments that will yield a greater level of joy for patients (Thomas, 2020).

Justice: This is when "who" gets treatments with the availability of limited health resources are not chosen based on segregation (Thomas, 2020). Hence, the process of distributing scarce medical resources and facilities to treat patients equally.

2.4 Concept of Entrepreneurship and Theories

Entrepreneurship is a concept in the field of Economics and Managerial Sciences that deals with the process of buying and selling goods and services. Bula (2012) explained that entrepreneurship is a multidimensional concept that entails the act of taking risks to identify business opportunities (Garcia & Alvarez, 2017). Kalkan and Kaygusuz (2012) explained that the act of entrepreneurship can be applied to different fields, such as education, medicine, religion, and many other sectors, where services and goods are rendered for the sake of making profits (Garcia & Alvarez, 2017). It is also noted that entrepreneurs are people who are good in regard to the identification and management of opportunities.

A skill that has been identified by Kirzner (1979) and Shepherd and Patzelt (2011) as unique to entrepreneurs is "entrepreneurial alertness". This is a cognitive and affective-based skill that allows entrepreneurs to recognize business opportunities and take advantage of such opportunities. Some of the characteristics of a good entrepreneur according to studies by Kirzner (1979), Kalkan and Kaygusuz (2012), Shepherd and Patzelt (2011), and Bula (2012) are listed as follows: (i) The ability to continue to seek knowledge and new development—entrepreneurs are creative, innovative and they always seek changes. (ii) They are problem solvers—they embark on research that allows them to consistently carry out structure experimentations on business developmental processes. (iii) They are bold and decisive about their actions and then tend not to turn back when they are embarked on a project. (iv) Entrepreneurs are great leaders. They can build great teams and work with them, growing the strengths of people and managing their weaknesses. (v) They are not always comfortable with failure. Entrepreneurs always ensure that they get to the peak of a project. In other words, they do not give up easily.

The neoclassical model of entrepreneurship of Hébert and Link (1989) implies that entrepreneurship is a process that is based on the attitude of people involved as well as their managerial styles (cited in Audretsch, 2003). Another model is functionalism theory, which explains that entrepreneurship is an action that engages the processes, decisions, and instincts of the people involved. It is a collective action that involves different human and nonhuman resources that must be sustainably managed (Autio & Fu, 2015).

Another theory is the O-ring theory, which emphasizes the abilities of business management, products, services, tasks, marketing, and other forms of promotional activities (Fabel, 2004). In line with this theory, the resources and capabilities-based theory infers that every business must give room for competitive advantages that help in the management of the human and nonhuman resources engaged in such business. Like the optimum triangle theory, the three core business factors are the entrepreneur, business idea, and capital (see Fig. 1).

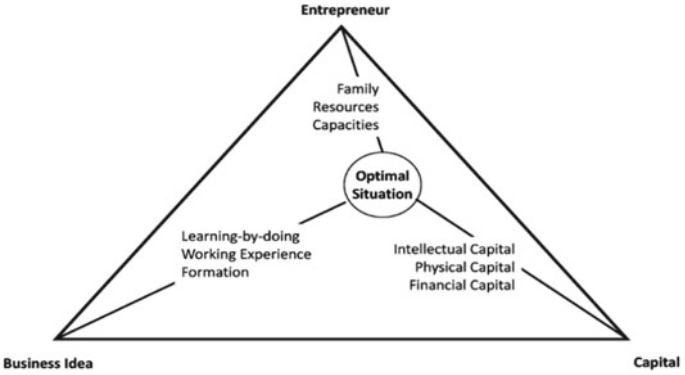

Fig. 1 Optimum triangle theory (Adopted from Garcia & Alvarez, 2017)

2.5 Entrepreneurship and Medicine

Entrepreneurship and medicine have a meeting point. Since entrepreneurship is an application field, medicine is one of the applications of this field and is referred to as medical entrepreneurship (Sharon & Arlen, 2020). This is the process by which medical experts create a business in the line of medicine as a whole (Autio & Fu, 2015).

Mostly, experts in the field of medicine have been seen to play active roles in this development. Some other related fields include healthcare services, biotechnology, ICT, social entrepreneurship, medical innovations, and many more (Steven, 2010). The main focus of medical entrepreneurship is to ensure the quality, functionality, and performance of the healthcare system of a nation (Sharon & Arlen, 2020). This ensures that there is wellness and making profits at the same time (Autio & Fu, 2015).

The field of medical entrepreneurship is often developed through the adoption of new technology in creating drugs, diagnosing diseases, treating, and many more (Steven, 2010). A medical entrepreneur is therefore a medical expert who has the intentional and technical know-how of solving problems and creating solutions to challenges in the health sector. Therefore, medical entrepreneurs have social and health impacts as well as profits (Steven, 2010).

Some of the investment opportunities in medical entrepreneurship include Pharmaceutical Company, Pharmacy Stores, Diagnostic Centre, and Lab, Hospital, and Clinics, Medical writing services, Medical Courier Services, Creche/Playgroup, Medical Waste Disposal Services, Medical Consultancy, Medical Tourism, Aesthetic medicine/Cosmetic Clinics, Medical College, Dental Services, Nursing College, Eye Specialist, Paramedical/Allied College, VIP weight loss clinics, and many more (Sharon & Arlen, 2020).

3 Design/Methodology/Approach

This study adopted a descriptive survey research design. This research design allows for the collection of information from extensive sources to be sorted and analysed in the same accord. Bowen (2009) stressed that the descriptive survey research approach is a basic research method that examines the situation as it exists in its current state. Data for the study were collected using secondary sources, that is, through Google Scholar, Google Search, peer-reviewed journals, textbooks, and many more viable sources. This further agreed with the study objectives to form discourse on the roles of medical ethics and entrepreneurship in innovative development, ethical issues in medicine and health promotion, medical ethics and entrepreneurial principles.

Hence, the use of secondary research was engaged in carrying out related literature in this study. This was done to provide an academic perspective for the subject discourse. These reviews were carried out to demonstrate the basics for consequent secondary research. Subsequently, the data collected were highlighted and finally analysed. In all, the limitations of the study as well as ethical considerations regarding the study were deliberated on. Since the secondary data collection measures are adhered to in this study, the study population will be inherent in the studies adopted for reviews. The main reason that limited the study to secondary data collection is due to the ongoing spread of the virus, which restricts movement. The data and information used in the study were obtained from a large range of documentaries, peer-reviewed journals, and books. Key concerns, issues, and subjects were discussed. Data were analysed using qualitative and content analysis. The thematic analysis was used for qualitative data where themes were drawn in line with the research questions to be answered. The qualitative and content analysis gives room for the analysis of different data with appropriate sorting in line with the study objectives.

4 Findings/Results/Insights

The findings of the study were discussed in line with the research questions using relevant data and information. The results of the study are as follows.

4.1 Research Question One: What Are the Roles of Medical Ethics and Entrepreneurship in Innovative Development?

Roles of Medical Ethics and Entrepreneurship in Innovative Development

Medicine and entrepreneurship play significant roles in innovative development. Creating solutions to medical problems comes in such ways that stakeholders need

to be creative, innovative, and ready to take risks (Audretsch et al., 2011; Merriam-Webster, 2022). Most of the large set of businesses that come with medicine and health services is to foster innovative development in clinics, hospitals, teaching universities, and many more (Galindo & Méndez-Picazo, 2013). Traditional medical systems demand the application of technological tools in the process of being creative (Galindo & Méndez-Picazo, 2013; Khan et al., 2020).

Taking a look at Fig. 2, some of the innovative mechanisms with technical entrepreneurship in medicine include artificial intelligence, drone, machine learning, mobile applications, robotic, sensor, and mobile applications. These technologies have been useful in combating the COVID-19 pandemic (Khan et al., 2020). However, some of the issues concerned with these developments that could go against medical ethics are listed below (Khan et al., 2020; Nemati et al., 2019):

i. **Inadequate technical and medical experts to operate the technology**: The technological tools used in the treatment of the pandemic might not be properly implemented by medical experts. In cases when experts who can operate the applications are limited, the health of patients might be threatened (Galindo & Méndez-Picazo, 2013; Khan et al., 2020).
ii. **Expenses and Cost**: Most of the time, these tools are very expensive and not easily affordable by underdeveloped and developing countries (Galindo & Méndez-Picazo, 2013). In other words, technological gadgets are expensive, and in cases when patients cannot afford the cost of these targets, they might be treated using a traditional method that might not yield the best health results.
iii. **Fraudulent Patients Data Access**: Cybersecurity and fraudulent breaking into patients' data can expose patients to vulnerability. When the data of patients are being exposed fraudulently, the medical ethics that are concerned with autonomy can be questioned.

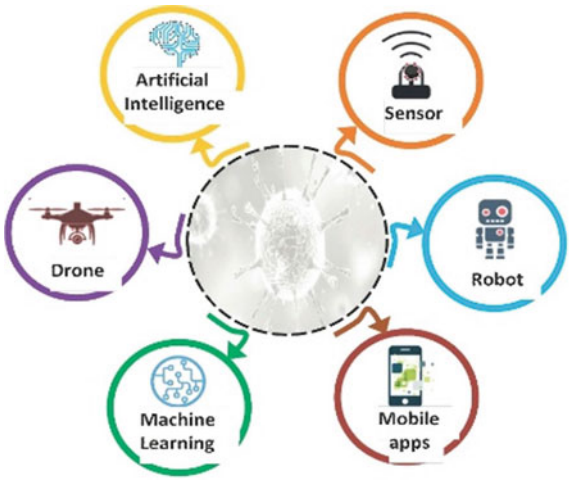

Fig. 2 Innovative and technological mechanisms in medicine (*Source* Khan et al., 2020)

iv. **Human to Machine Treatments**: Patients can feel bored when they need to constantly communicate with machines or technological gadgets instead of doctors (Nemati et al., 2019).

Niccum et al. (2017) noted that for quality improvement and innovative practices in the medical field, clinical scholarship should be encouraged to develop in the mind of scholars and individuals to learn under traditional systems. This form of professional education programme should be facilitated for health workers in developing societies to learn from developed societies (Niccum et al., 2017). Juzwishin and Bond (2012) asserted that the medical field needs much training and development in line with the changing technological development. In the same vein, more healthcare providers need to ensure that their health centres and public or private hospitals are well grounded with quality practices.

Figure 3 shows some of the impacts that technological innovations have been playing in solving the recent COVID-19 problems. These technologies, as highlighted earlier in Fig. 2, aid contact tracing, medical suppliers, planning and tracking, clinical management, screening for infection, quarantine, and self-isolation (Nemati et al., 2019).

According to a review by Niccum et al. (2017), medical schools and colleges across need to teach the subject of entrepreneurship and how not to break the medical code

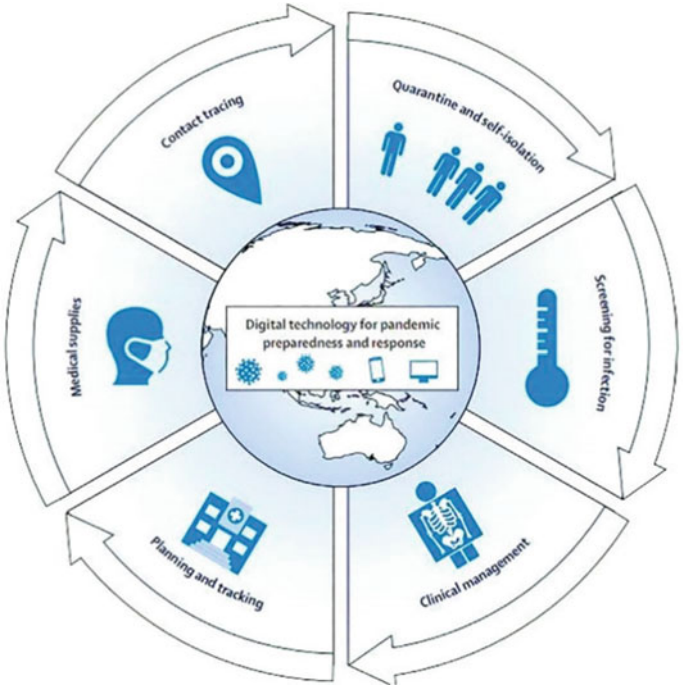

Fig. 3 Pandemic preparedness and reaction utilizing digital technology (*Source* Nemati et al., 2019)

in the name of making money. In a study by Majmudar et al. (2015), The American Heart Association once suggested that the teaching of medicine and health care in schools need to be done by redesigning the curriculum to inculcate medical realistic and practical innovative projects by students alongside mentorship structures. This is in alignment with the study of Boore and Porter (2010), which infers that the field of nursing and pharmacy have experienced more innovative patronages, unlike medicine and surgery.

To this end, the University of Medical Sciences, Ondo City in Nigeria, has also taken it upon herself to align entrepreneurship and innovation with the university curriculum. This has made it possible for all courses to be taught with some entrepreneurial and innovative outline. This initiative was encouraged and sponsored through the Innovation for African Universities Partnership Grant (IAU) as organized by the British Council (https://www.britishcouncil.org/education/he-science/opportunities/innovation-african-universities). The University of Medical Sciences, which is a university designated strictly for the study of medical courses, followed the view outlined by Edom (2020) and Pilon (2016), which maintains that generating course content therefore requires innovative ideas, and the following are some available medical entrepreneurship ideas taking shape in the university (Table 1).

According to the Advisory Panel on Health that was launched by the Canadian government in 2015, it was stated that innovation should be promoted in health care. For instance, countries such as the US, the UK, Canada, and many more in the promotion of medical entrepreneurs and medical ethics have formed a collaboration with companies such as Google, Microsoft, and Amazon to improve health care.

McCleary et al. (2006) found that the core factors that can aid the facilitation of medical ethics in medical entrepreneurship include the positive attitudes of health providers towards patients, the knowledge and skills of health workers, and the organizational culture of the hospitals they work with (Juzwishin & Bond, 2012). Other enabling factors include mentorship, available medical resources, and reinforcing factors, which include reward and autonomy. Carroll et al. (2004) revealed that in the process of fostering entrepreneurship in the medical field, professionalism alongside medical ethics should be put in place geared towards innovations.

4.2 Research Question Two: What Are the Ethical Issues in Medicine and Health Promotion?

Ethical Issues in Medicine and Health Promotion

Medical ethics are the principles and standards that medical workers must adhere to in carrying out their health roles and activities. These ethics apply to both public and private hospitals. Some of the common features expected from medical experts are commitment, loyalty, and motivation. According to a study by Muhammed and Venkataram (2016), medical workers need to be committed to the terms of their jobs

Table 1 Medical entrepreneurship ideas

S/N	Idea	Description
1	Therapist—home therapist	Therapists help patients recover from injuries to regain their full range of motion and to reduce pain
2	Rehabilitation centre	A centre to help clients struggling with drug addictions
3	Blood bank services	Collection of blood/plasma donation from people distributed to medical facilities when needed
4	Dietician/nutritionist	Experts in Dietetics who advise and regulate patients' diet to suit their medical condition and needs
5	Wellness centre (spa-massage)	This deals with manoeuvring of the muscles, ligaments, and joints, to promote and enhance a person's well-being and personal health
6	Medical supplies/equipment sales	Supplying medical equipment, utilities, and hospital consumables such as syringes and expensive medical machines
7	Uniform/scrubs designing	Supply and sales of medical gears for healthcare professionals
8	Medical waste disposal	Offering medical waste disposal services to hospitals in the most efficient way that would protect both public and environment
9	Pharmaceutical distribution	Distribution of drugs to retail pharmacies that cater to specific neighbourhood drug requests
10	Egg/sperm bank	A facility that collects and stores human sperm and eggs by donors used for people with fertility issues
11	Drug testing centre	A centre where screenings are done to analyse biological specimen like urine, blood, saliva, sweat, and hair
12	Medical transport (nonemergency)	Medical transport services dedicated to nonemergency transport of patients to the hospital
13	Medical laboratory	A clinical laboratory where tests are carried out to get adequate information about Patients' health
14	Scanning centre	Scanning centre provides services that help in effective diagnosis and treatment of several medical cases
15	Skincare centre	Skincare centre provides services that help to maintain the integrity of skins usually done by specialists called dermatologists
16	Fitness centre	A centre with various exercise equipment people use to work out to either build muscles or burn fat
17	Home care centre	Services provided by healthcare professionals to people who require special care directly at home

(continued)

Table 1 (continued)

S/N	Idea	Description
18	Weight loss centre	A centre dedicated to helping people lose weight through various methods such as diet and exercise
19	Health blogger	A website/blog aimed at offering advice on certain areas of health and overall wellness
20	Medical writer/bookstore	Writing and selling print publications, articles, journals, and books about health and wellness

Source Edom (2020) and Pilon (2016)

and carry out their duties without any form of manipulation or corruption whatsoever. In another study, Henn (2009) revealed that loyalty is one of the factors that makes a health worker a professional aside from the understanding of medical concepts and practices. Jakhotiya (2003) affirmed that being loyal in the medical field goes a long way in the way to which patients will be attended. A good example of this is when there is a manipulation of patients' results through corruptive processes.

In tandem with this, Tarim et al. (2015) found that loyalty is significantly related to medical organization performance. This confirms the study of Ahmad (2013) that it is unethical for medical professionals not to act in the best interest of their clients. Mabwe (2016), however, submitted that the unethical attitudes of medical workers do not just affect the patients, by the medical workers themselves, the organization, and the reputation of the nation at large. The implication for this is that the unethical attitudes of health workers will yield negative notions and societal underdevelopment. Accordingly, the following are some of the ethical issues in medicine and health promotion.

Persuasion

This is the process of internationally inducing individuals to carry out a particular action by making them see a reason for such action. People's values, traditions, and culture can be changed in this regard (Walters, 1988). Looking at this as a medical issue implies that the way by which health threats and implications are projected by health workers should be checked. Although it is good to create awareness of the consequences of carrying out some actions, the way this awareness is made should not be done to create fear in the mind of the people. From personal observation, although it is being said in the media that smoking cigarettes often reduces the life span of people, instead of just creating fear in the mind of the people, conscious practical steps should be taken in reducing the production of cigarettes. Looking at the issue from another dimension, if sales are reduced in cigarette companies, the workers there will definitely lose their jobs.

In another instance, when people are asked about their lifestyles, they might feel ashamed to disclose their information, especially when considering the kind of environment, they find themselves (French et al., 2009). For instance, it will be

difficult to open up the serious matter about one's life to a medical doctor who does not have sympathy and empathy for the patient in the first place. The use of authority to change the way a person behaves and what they eat and drink might also be challenging (Wrong, 2004). For example, a doctor based on the principle of autonomy can only advise and encourage patients to adjust their lifestyles and not change them.

Deception and Manipulation

Manipulation is the process by which the ideas and beliefs of people are altered nonpersuasively actions; it is a form of attitude manipulation. Deceiving patients and manipulating information is a major challenge in the health sector. In some cases, health workers made serious mistakes in results compilation, while some altered information due to their corrupt practices. Some tell lies, some withhold vital information about patients, while some also exaggerate information.

Other forms of manipulative acts include giving people excessive information, which might lead to confusion or reduce their understanding of such data. In some cases, patients might believe they have multiple health cases due to the complex nature of the information they have been given (Faden, 2002). (ii) Using panic tools such as pain, fear, and anxiety has a negative effect on people's cognitive processes. In this direction, some people tend to have more illnesses than they earlier had before visiting the hospital. One of the common illnesses people have is hypertension (Faden, 2002). (iii) Presentation of correct information to patients in a wrong way will make them not have a true picture of their health issues (Campbell, 1990).

Coercion

This is the process of using force to gain advantages over patients. When patients do not complain about basic health demands, they are told that they will face certain consequences (Anderson, 2012). These forces are mostly created by governmental factors such as the use of seatbelts, helmets, and many more for the safety of the people. However, there is legislation in place when these roles are broken; hence, some of these laws are largely not morally problematic. A good example is when a drug abuser is arrested and is forcefully made to undergo therapy. Being forced into psychotherapy seems problematic because it requires a process of self-awareness and readiness for the individual in question.

4.3 Research Question Three: What Are the Convergence and Divergence Points of Medical Ethics and Entrepreneurial Principles?

The Convergence and Divergence Points of Medical Ethics and Entrepreneurial Principles

The following are the convergence and divergence points of medical ethics and entrepreneurial principles.

Financial Issues, Remuneration, and Salary for Health Workers

It must be noted that medical care costs money and that healthcare services are always impossible when there is no financial commitment to health systems. Therefore, innovative development in the medical field is always facilitated when there are economic values to this end. The quality of healthcare delivery is dependent on the availability of funds and economic functions. Healthcare organizations always need to pay their members of staff the finances they receive in the process of providing health services to people.

Moreover, this is a common incident in the health sector of some countries. For example, in the Nigerian health system, medical workers will embark on incessant strikes because the federal government has refused to pay their salaries. Therefore, while workers are always protesting to get paid to attend to their financial needs, who looks after emergency cases in the hospital? This is in line with the report of Africanews (2021), which stated that doctors go on strike in Nigeria, the fourth time in the pandemic. Therefore, that healthcare services should be a moral course, should not always mean that monetary issues will not appear. In contrast, in cases when the emergence of integrated health care is necessary, there should be ethical considerations for patients.

Medical Research, Advancement, and People's Privacy

Taking a look at medical research, especially in regard to practice and the development of drugs, an old study by Weijer et al. (1997) noted that there can be a conflict of interest when using human subjects for the development of medicine. It can further raise complex legal, ethical, and social issues. Some of the international bodies that see such development include the Tri-Council of research funding agencies in Canada, the US Department of Health and Human Services, and the Protection of Human Subjects of Biomedical and Behavioral Research (NCPHS). Hence, in the process of innovative medical sciences, there should be ethical statements to guide individuals and their privacy.

Social and Religious Contemplations

Eaton (2004) found that the latest developments in bioethics and modern biotechnology for increasing entrepreneurship have facilitated activities such as DNA data banking, genetic food modification, stem cells, cloning, euthanasia, testing for genetic markers, genetic manipulation of human DNA, and many more. These developments, however, are ways of economic expansion that sometimes go against the social and religious beliefs of some conserved societies and people (Dhanda, 2002). An example is the multiple ways in which abortion is carried out, which keeps conflicting the interest of some cultural classes and religious beliefs. The divergence here is that regardless of the beliefs, it is more ethical to commit in the interest of individuals if such cases threaten their lives. This aligns with the study of Robbins-Roth (2000) that new technologies should rather been seen for our medical advantages and not the other ways around and that social and religious belief also have exemptions depending on the medical cases at hand.

Moral and Traditional Beliefs Versus Medication

The beliefs of some people are driven by their culture and traditions. In some African settings, it is believed that the use of traditional medicine should be more accepted than contemporary medicine. In some religious societies, medication is forbidden, and people keep losing their lives in this direction. Healy (2004) stressed that there is a need to market functional medicalization rather than social medicalization that was obtainable in the time past.

5 Discussion/Conclusion

The discussion of the findings of the study aligns with the study objectives as well as the literature that had been reviewed earlier. Findings on the roles of medical ethics and entrepreneurship in innovative development revealed that most of the large set of businesses that come with medicine and health services are to foster innovative development in clinics, hospitals, teaching universities, and many more. Thomas (2020), however, argued that although medical practitioners also need to act in patients' best interests, this has not been best practised in all cases. For the utilitarianism model, an action is right based on the consequences of such action as well as the number of people involved (Worldwatch Institute, 2012; Wraight, 2011). Additionally, the innovative mechanisms with technical entrepreneurship in medicine include artificial intelligence, drone, machine learning, mobile applications, robotic, sensor and mobile applications. It was further revealed that some of the issues concerned with these developments that could go against medical ethics are inadequate technical and medical experts to operate the technology, expenses and cost, fraudulent patients' data access, and human-to-machine treatments. Further

findings show that for quality improvement and innovative practices in the medical field, clinical scholarship should be encouraged to develop in the mind of scholars and individuals to learn under traditional systems. Therefore, medical schools and colleges across need to teach the subject of entrepreneurship and how not to break the medical code in the name of making money (Worldwatch Institute, 2012; Wraight, 2011).

The results on the ethical issues in medicine and health promotion revealed that medical workers need to be committed to the terms of their jobs and carry out their duties without any form of manipulation or corruption whatsoever. According to United Nations (2012), ethics is a consistent way of life with adherence to the culture, norms, philosophies, beliefs, and traditions that are attainable in an organization. Features of ethics include lawful conduct, acceptable standards in society, and interpersonal behaviour, which include sexual propriety, honesty, and truthfulness. Medical ethics, therefore, include respect for autonomy, beneficence, non-maleficence, and justice (Gillon, 1994). Therefore, the unethical attitudes of medical workers do not just affect the patients, by the medical workers themselves, the organization, and the reputation of the nation at large. It was further revealed that the use of authority to change the way a person behaves and what they eat and drink might also be challenging. Another ethical issue is deception and manipulation, which include giving people excessive information that might lead to confusion or reduce their understanding of such data, using panic tools such as pain, fear, and anxiety to create a negative effect on the cognitive processes of people and presenting correct information to patients in the wrong way, which will make them fail to have a true picture of their health issues. All these issues are morally included. It must also be noted that morality is a concept that is connected to ethics; morality is the process of applying the culture, norms, philosophies, beliefs, and traditions that are exhibited in a social, general, and specific environment to work realities and culture (Crane & Matten, 2007). The last is coercion, which is the process of using force to gain advantages over patients.

Findings on the convergence and divergence points of medical ethics and entrepreneurial principles include financial issues, remuneration and salary for health workers, medical research, advancement and people's privacy, social and religious contemplations, and moral and traditional beliefs versus medication. In tandem with the above, Crane and Matten (2007) stressed that morality is a concept that is connected to ethics; morality is the process of applying the culture, norms, philosophies, beliefs, and traditions that are exhibited in a social, general, and specific environment to work realities and culture. Looking at the study of Benjamin et al. (2016), medicine is a profession that began approximately 2400 years ago and was initially known as homeopathy, allopathy, and Ayurveda. This is the case when medicine developed from the traditional application of nature, which, however, has developed into a more systematic process. Benjamin et al. (2016) also added that modern medicine is not a pure science, which implies that it is a probability science that includes the healing of people through drugs, treatment, therapy, and other forms of physiological approaches. The implication for this is to create a balance between traditional and contemporary medicine. In the same vein, since modern medicine now

facilitates more finances for business people, the health of people should be taken seriously. Additionally, healthcare organizations always need to pay their members of staff with the finances they receive in the process of providing health services to people. Going by The Neoclassical model of entrepreneurship of Hébert and Link (1989), which implies that entrepreneurship is a process that is based on the attitude of people involved as well as their managerial styles, healthcare workers should be well motivated and remunerated.

It can therefore be concluded that medical ethics and entrepreneurship are two concepts that cannot be perfectly disconnected. However, in the process of carrying out health services, health workers need to ensure that the ethics of their profession are followed to the brim. In the same vein, the study concluded that the convergence of medical ethics and entrepreneurship is based on innovation, services provision, engagement of technology, and many more while their divergence comes with an exception on issues such as social, religious, and economic implications.

6 Implications of the Findings and Policy Prescriptions

The following are the implications of the findings for policy prescriptions:

i. Medical workers, irrespective of the claim to make money, should take the ethics of their job seriously. Patients should be treated in their best interests. This aligns with the study of Wraight (2011), Worldwatch Institute (2012), and United Nations (2012).
ii. The salaries and remunerations of health workers should be taken seriously. In cases where the salaries of workers are not paid on time, medical workers tend not to give their best towards the performance of their jobs.
iii. The provision of necessary human and nonhuman resources for medical centres should be given adequate attention. This will aid the easy facilitation of medical roles.
iv. Medical schools and colleges across need to teach the subject of entrepreneurship and how not to break the medical code in the name of making money (Worldwatch Institute, 2012; Wraight, 2011).
v. In societies where their culture and traditions do not comply with medical ethics, international health regulatory bodies should see into it for health compliance attitudes (Crane & Matten, 2007).
vi. There is a need for an alignment of Medical Ethics with I and E for better healthcare service delivery.
vii. The creation of awareness as a way of reducing unhealthy attitudes among individuals should not be done through coercion but by viable means that can convince people to put an end to such attitudes.

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Chapter 5
Reconciling Medical Ethics and Entrepreneurship: Convergence and Divergence Debates

Abdullahi Adeyinka Adejare, Ahmed Kolade Oloyo, and Saheed Babatunde Sanni

1 Introduction

Medicine is a profession whose primary aim is to provide the best care to patients. Medical ethics revolve round ethical values that must be strictly followed in providing the said quality care. These ethics guide the conduct of the parties involved in the health sector from the physician, to the health managers, to government and to nonprofit international organizations. However, poor care of patients and failed health policies and reform have led to the interest of investors in the business of medicine. There is an astronomical increase in the number of healthcare investments and the number of insured patients (AMA, 2015; Silverman, 2015). In fact, the dynamics of medical practice now place more emphasis on the business aspects of medicine, with the sole aim of commercializing medical practice (AMA, 2015; Silverman, 2015). The concern, however, is the conflicting roles of medical and business goals and ethics. For healthcare professionals, the goal remains to render quality care at an efficient cost, while the goal of healthcare entrepreneurs is primarily to make profit from their investments. Thus, medical entrepreneurs have obligations to their shareholders, while physicians have obligations to their patients (Starr, 1982). This conflict could not only weaken professional self-regulation and medical judgement of the health practitioners (Silverman, 2015) but could also encourage disproportionate treatment (Sulmasy & Bledsoe, 2019) of some patients based on incentives from them. Notwithstanding the extensive investigation that has taken place in both

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medical ethics and entrepreneurship, there remain some substantial overlaps and parallels in conceptual viewpoints in both fields. In this chapter, we review the convergence and divergence between medical ethics and entrepreneurship as it relates to the likely factors that should guide the conduct of these healthcare entrepreneurs in the business of health and policies on those to be involved in medical entrepreneurship (Kane, 2021). This is particularly important, as COVID disruptions have changed the dynamics of many things in healthcare delivery (DeCamp et al., 2021), and there is an urgent need to ensure quality service delivery at reasonably reduced costs for patients without compromising physician professionalism via guided investments in health.

2 Literature Review

Medicine is an ethical profession (Pellegrino, 1990) whose primary aim is to provide excellent patient-centred care (Sulmasy & Bledsoe, 2019) to patients. The ultimate goal is to render trust-based high-quality, innovative, well-coordinated and efficient patient care (Sulmasy & Bledsoe, 2019; Weeks et al., 2010). Medical ethics is the field of applied ethics that is concerned with moral decisions guiding medical practices and policies (Weeks et al., 2010). Medical ethics is based on the values of non-maleficence, self-effacement or altruistic beneficence, autonomy and justice (Pellegrino & Thomasma, 1993). Previous proposals for the allocation of resources in medical practice converge on four fundamental values of maximizing the benefits produced by scarce resources, treating people equally, promoting and gratifying instrumental value, and giving priority to the worst off (Biddison et al., 2014; Emanuel & Wertheimer, 2006; Persad et al., 2009). Each of the four values can be interpreted in several ways. Maximization of benefits can be understood as saving the most individual lives or as saving the most life-years by giving priority to patients likely to survive longest after treatment (Zucker et al., 2015). Treating people justly could be attempted by random selection or by a first-come, first-served allocation (Rosenbaum et al., 2011). Instrumental value could be promoted by giving priority to those who can save others such as the healthcare provider themselves or rewarded by giving priority to those who have saved others in the past (Persad et al., 2009; Zucker et al., 2015). In addition, priority to the worst off could be understood as giving priority either to the sickest or to younger people who will have lived the shortest lives if they die untreated (Christian et al., 2014). Consensus exists that an individual person's wealth should not be the main determinant of who lives or dies (Rosenbaum et al., 2011; Zucker et al., 2015). Although medical treatment in the United States and some other developed countries is dependent on the ability to pay (Rosenbaum et al., 2011; Zucker et al., 2015), this is not totally acceptable in the realm of medical bioethics. Recommendations for allocating medical resources in the COVID-19 pandemic, for example, are expected to be guided by the same principle: maximization of benefits; prioritization of health workers; allocation on a first-come,

first-served basis; responsiveness to evidence; recognizing research participation and applying the same principles to all patients.

Entrepreneurship, on the other hand, involves engaging in business with the sole aim of making profit. The investment in the business of health is termed medical entrepreneurship. Medical entrepreneurship involves the application of entrepreneurial skills to advance public health (Jacobson et al., 2015). Medical entrepreneurship represents the convergence of medical ethics and entrepreneurship. From all indications, the changing dynamics of medical practice continue to place greater emphasis on the business aspects of medicine. There are new and emerging areas in medicine where investments could be made, and there is an ever-growing competition in these investments. There are, however, no guiding principles in the real sense of controlling the conduct of these health investments. Private firms are acquiring medical practices in a new trend towards private equity investment in health care (Murphy et al., 2017). In the United States alone, as reported by Zhu et al. (2020), this trend increased to 136 in 2016 from 59 in 2013. Examples of such investments are the purchase of a large stake in a physician practice, establishment of state-of-the-art hospitals, investment of resources to expand the market share of the investment, cost adjustment measures to generate returns for the firm's investors (Casalino et al., 2019) without bothering on the implications of these on quality healthcare delivery to patients. Because of their current value and perceived future earning potential, medical diagnostics, radiology and ophthalmology practices particularly interest private equity firms (Sharfstein & Slocum, 2019; Tan et al., 2019). It should be noted that entrepreneurship is essential in times of crisis, as it provides a positive outlook on new challenges or conditions. This is necessary for turning a negative event into a positive one and bringing the best out of every situation. Medical practice requires functional, professionally and ethically minded health services and systems. When they are commercially financed and industrially managed, they strain the physicians' autonomy and ethics because the industry's profitability depends on commercial and clinical standardization. Commercial insurance companies at times to maximize profit reduce access to care while fragmenting and segmenting health systems (Unger et al., 2020).

There is thus a need to understand the convergence and divergence of medical ethics and entrepreneurship to better appreciate the factors that should be considered when trying to make investments in the business of health in this digital age (Hofmann, 2006; Wynia, 1999).

3 Methodology/Design

A literature review was conducted to identify papers that discussed principles of medical ethics, principles of business ethics, where these principles align and where they separate as their primary focus as indicated by the title from 1990 till date. We searched PubMed, Google and EMBASE for relevant articles using the terms

ethics, medical ethics, business, entrepreneurship, medical entrepreneurship, convergence, divergence, principles, guidelines, factors, review, journal, systematic review and meta-analysis in combination with the following medical terms and keywords: world health organization, coronavirus disease (COVID-19), health management organizations (HMOs), American guidelines on health, code of medical ethics, institutional review boards and health research ethics committee. We included any article that included previously unreported data regarding the association between medical ethics and business ethics and differences in principles between medical ethics and entrepreneurship. We also revised the indices of the included articles to identify additional studies that were not included in the original search. We were able to obtain 112 papers that were screened based on the Jacobsen et al. (2015) definition of the application of entrepreneurial skills to advance public health.

4 Results

Our review underscores some of the challenges of healthcare financing as it relates to medical ethics and entrepreneurship. It is on this basis that we discuss the convergence and divergence of the two later. Table 1 shows some of the emerging challenges of healthcare financing and the associated ethical and entrepreneurship concerns associated with it.

5 Discussion

It is obvious from the table above that the medical entrepreneur is faced with different arrays of concerns, among which is trying to comply with medical ethics while still trying to satisfy the stakeholders of his business. This calls for a good understanding of the link between medical ethics and entrepreneurship. This would thus prompt us to discuss the convergence and divergence of medical ethics and entrepreneurship, keeping in mind some of the concerns raised.

5.1 Goal of the Stakeholders

Considering the abovementioned ethical and entrepreneurship concerns, the first matter to be discussed is the set goal of the stakeholders. Enforcement of medical ethics among health professionals is primarily meant to satisfy the patient. Patient satisfaction is also one of the cardinal goals of medical entrepreneurs and health insurance managers. In essence, the patient satisfaction goal as advocated for by medical ethics is also part of the agenda of the investors. However, investors also have the goal of satisfying their stakeholders or shareholders. The investor's aim is primarily

Table 1 Emerging problems with healthcare financing worldwide

S/N	Problems identified	Ethical concerns	Entrepreneurship concerns
1	• Scarcity of resources • Appropriate use of Prognostic Scoring Systems • Increased exposure to risk especially during a pandemic like COVID • Hospital financial vulnerability • Financial burden of caring for patients with severe conditions • Crisis capacity in rural and remote communities (McGuire et al., 2020)	• Should treatment preference be given to the poor or the rich? • Should treatment be based on the severity of disease? • Should medical care be on first-come first-served basis? • Should the physician be given the overriding power to determine who among the patients receive treatment? • What level of risk should a health practitioner be exposed to?	• How can entrepreneurs be encouraged to invest into health to make resources available? • Should the cost of treatment be hiked or subsidized? • Should technology be employed in the allocation of the scarce resources? • Should severely ill patients be excluded in the coverage of health insurance plans? • Should resources be diverted to urban centres only?
2	• Upsurge in mental health issues and poverty due to COVID (Apostolopoulos et al., 2021; Kuckertz et al., 2020)	• How is informed consent meant to be obtained in mentally challenged individuals when conducting health research involving these patients? • How is the privacy of the patients going to be guaranteed? • How is confidentiality meant to be ensured among the health practitioners? • Should touts be allowed to sell blood or their organs in exchange for wealth?	• Who bears the cost of treatment for life-long mental health problems? • Should these category of patients be excluded from health insurance schemes because of high cost of treatment? • At what point should government aid be given to these patients? • How reliable is artificial intelligence (AI)-based diagnostic tools in the diagnosis of mental problems? • Should the training of health practitioners be financed by government or the healthcare organizations?

(continued)

to profit. Other concerns are secondary. This explains why the patient satisfaction goal would always be at odds with the profit-making goals of the shareholders. To increase the margin of profit made too, healthcare providers are overworked probably by deliberately under-staffing the medical facilities and hitherto overworking the few staff that are available, and in some cases, this has led to suicide (Molina et al., 2003). To worsen the matter, the increased workload is associated with reduced income and bureaucratization of medical practice (Unger et al., 2010), taking away the dignity that accompanies medical practice.

Table 1 (continued)

S/N	Problems identified	Ethical concerns	Entrepreneurship concerns
3	Pandemic and movement restrictions (Kraus et al., 2020)	• Is it ethically justified to restrict movement of the entire population in a pandemic? • Should home-based treatment be encouraged during a lockdown? • Would the movement restriction affect physician–patient relationship and confidentiality? • How long should the movement restriction last?	• What are the investment opportunities in health during a lockdown? • Who pays for online services during lockdown, the patient or the healthcare organizations? • What should guide the payment modalities for the physicians as some might be working from home and not necessary in the hospital?
4	• Understaffing in government health centres with shortages of medical, nursing and administrative personnel (Apostolopoulos et al., 2021)	• To what extent would understaffing affect the quality of care given by the health professionals? • Would there be a biased selection or preferential treatment of patients to treat during such a period? • Would the physicians be overworked under such conditions? • What would be the fate of patients with protracted disease conditions? • Does government have the wherewithal to regulate understaffing in government hospitals?	• Would understaffing in government health centres cause a drift of patients to the private centres for treatment? • Are there enough medical personnel to attend to the patients? • Should the patients without health coverage in government hospitals be allowed to register in private ones? • Should AI be employed to cater for the created gap? • What should be the ratio of physicians to patients? • Who bears the possible high cost of treatment?
5	• Management of do-it-yourself (DIY) labs and research centres (Sarpong & Rawal, 2020)	• Are studies conducted following the ethics principles? • What regulates the activities of the labs? • How is patient data or results protected? • What happens to vulnerable groups after a study? • Would the use of such labs improve the quality of care?	• What's the cost of establishing such labs? • To what extent should digital technology be used in the lab? • Are patients ready to pay for tests conducted? • Would there be undue inducement when a study is being conducted? • What determines the amount to be paid to participants in a study?

(continued)

Table 1 (continued)

S/N	Problems identified	Ethical concerns	Entrepreneurship concerns
6	• Pandemic-induced extraordinary demands on public health and health systems and on providers of essential community services (Emanuel et al., 2020)	• Should all patients be attended to or just those registered on health insurance schemes? • Should patients be allowed to carry out some simple tests themselves and send the results to their physicians without having to come to the hospital? • How many calls/shifts can a physician do in such a situation per week? • Should preference be given to health professionals when they are sick too or mentally exhausted? • In the case of COVID-19 for example, should vaccination be made compulsory? who should bear the cost of the mandatory testing?	• Should the number of healthcare facilities be increased to accommodate the increased demands? • Should the cost of tests and treatments be increased or reduced? • Should there be a separate healthcare facilities for the rich and the poor, e.g. private wing in public hospitals? • Should payment system be automated or through digital means to cater for the increased demands? • Would there be government aid for patients that could not afford the costs of treatments?
7	• Social trust in physicians' commitment to the public has continued to erode (Barondess, 2003)	• How can social trust in physicians' commitment be restored and confidence regained? • How can a physician engage the patient on the nature of his condition and the course of treatment? • Who should have access to information about the health status of a patient? • What informs the choice of prescriptions of drugs for patients? • How should a health professional manage the health status of close relatives?	• How can quality care be rendered to ensure continuous patronage? • Would there be training sessions for the physicians and patients to build necessary trust? • Could digital technology be used to aid communication and build necessary trust?

(continued)

Table 1 (continued)

S/N	Problems identified	Ethical concerns	Entrepreneurship concerns
8	• Mutual aid societies and public services being bureaucratic and costly (Hermesse & Bouvy, 2017)	• How could the process of getting aid be made less cumbersome? • Would there be preferential treatment for the less privileged? • Could there be policy amendments to favour easy access to aids? • Would the process be made easy for those registered with health insurance companies? • Which kind of medical condition should even be referred to tertiary hospitals?	• Could the use of technology aid the process of getting aid without necessarily increasing the cost? • Could there be special clinics for different medical conditions to help in the posting and distribution of health personnel to hospitals?
9	• Budgeting national health funds (Unger et al., 2020)	• How would there be enough fund to take good care of the health professionals? • Would there be fund to specially take care of the poor ones who could not afford to pay health bills? • What percentage of the budget should be allocated to the rural and urban healthcare centres?	• Could such funds be invested such that the proceeds would equally be used later? • Should all healthcare companies have percentages allotted to them from the budget? • Should part of the budget be used to finance research works that could equally benefit the patients?
10	• Lack of standardized information technology-based data sources and limited scientific evidence for mental health quality measures (Kilbourne et al., 2018)	• Should patient data be made available to the entire public or just the health personnel? • How should be ensure confidentiality and data protection of patients' information? • Can patient information be used for research without consent by the physician in charge?	• To what extent can patient data be used to make financial forecast of some medical conditions? • Can patient information be sold?

5.2 Delivery of Quality Service at Relatively Low Cost

The importance of ensuring quality service delivery cannot be overemphasized. Every patient wants and truly deserves excellent care. The healthcare provider is expected to conduct necessary tests, make the right diagnosis and manage the patient in whichever

way is best. Doctors are expected to provide care that is responsive to an individual patient's health goals, needs and values and to ensure that his or her values guide all clinical decisions. This is one of the fundamentals of medical ethics, and it would be nice to know that medical entrepreneurs also shared this view. However, the cost of delivery is germane in this respect. The expectation is that the cost should be reduced to the minimum, but this is not always the case. It is generally believed that for there to be quality, the cost must be high. Because of this singular factor, it is always difficult to obtain quality service delivery in government establishments because of underfunding. Private establishments are readily available to render quality service, however, at a relatively expensive rate. On an ethical level, the industry also undermines the quality of care through managerial efforts to shift the physician's motivation from qualitative to quantitative incentives without necessarily changing the healthcare outcomes (Ryan et al., 2016). The big question to ask then is how to ensure the delivery of quality care, fairness, humaneness and equity as preached by medical ethics in the face of profit targets and fair competition known with entrepreneurship. Additionally, in today's medical marketplace, consumer choice is advocated not only as a valuable freedom in itself but also as a means to force healthcare organizations to offer quality medical care. There is no doubt that the health insurance organization's primary relationship to its patients is that of an insurer to an insured, not of a healthcare provider to a patient (Mariner, 1995). Advocates of competition among health plans have argued that rational people will choose the health plan that suits their needs. It is assumed that when people choose a plan, they have purposefully chosen its doctors, nurses, practice patterns, administrative procedures and benefits package—everything about their health care. A choice to buy a cheaper plan entails assuming the risk that some services will not be covered.

5.3 Establishment of Health Facilities and Employment of Health Professionals

While the government is primarily responsible for building healthcare facilities, medical entrepreneurs equally establish and run healthcare centres. Both government and private facilities help to ultimately address the health needs of the communities where they are located. Both the interest of the patients and that of shareholders are taken care of. However, for private facilities, the activities of the owners must be checked so that the patients are not exploited. It is part of the statutory responsibilities of the government to also train and employ healthcare professionals. It is, however, not possible for the government to employ all healthcare workers. Some are usually employed by private facilities. Because these healthcare providers receive essentially the same training, their handling of patients would be in line with the ethos of their profession. Their decisions are made in favour of their patients. Unfortunately, in most clinical settings, the autonomy to make important decisions and the line of treatment are often compromised. Such healthcare professionals factor the want of their private

owners into what they tell or prescribe to patients. While the shareholders could be fine with this practice, it is known to be against established medical ethics. A major area of concern in this regard is the employment of health practitioners. While it has the advantage of providing financial stability to practitioners among several other benefits, there is the challenge of the potential for dual loyalty, as physicians would be expected to be accountable to both their patients and their employers (AMA, 2019). It is not out of place to have dual loyalty, but the guidelines in business models and medical practice are yet to be fully elucidated (Larkin & Loewenstein, 2017). Providing incentives to physicians could affect clinical integrity, intrinsic reasons or motivations of professionalism and the sense of medicine as a calling (Hartzband & Groopman, 2020; Wynia, 2009). In addition, it needs to be emphasized that medical ethics has its foundation based on respect for persons, beneficence and justice. This applies not only to the patients but also to the physicians. The right to say in decisions that affect patients may be influenced by the government, health systems and institutions. This can in turn affect how care is delivered. Studies have shown that employed physicians tend to have less control over how employer organizations respond to clinical priorities that directly affect patients, which is normally expected to align with those of individual patients and overall community health. This by extension can create challenges with respect to patient autonomy, justice, physician professional integrity and the primary obligation of beneficence. In essence, while the goal of these employer organizations is to make profit as entrepreneurs, the overriding goal of medical ethics as it concerns physician–patient relationships should never be compromised.

5.4 Fees for Medical Services

It is not unethical to pay for services rendered by healthcare providers. Both government and private healthcare providers charge patients fees which are commensurate with the nature of the treatment made. Insofar as there is justice and fairness in the amount charged, medical ethics is not against such payments. Physicians are not expected to recommend, provide or charge unnecessary medical services, nor should they make intentional misrepresentations to increase the level of payment they receive or to secure non-covered health benefits for their patients. Physicians should clearly notify patients in advance about policy and practice with respect to delinquent accounts. It is important to note, however, that the charges in private health establishments are usually very expensive. While this requires some level of regulation, it is absolutely beyond what ethics alone can handle. The shareholders need to equally make profits from their investments. Recently, there has been a paradigm shift in healthcare financing from volume-based fee-for-service to value-based health care to ensure better patient outcomes and reduced costs while reducing injustices in care (Doherty et al., 2020). Provided that there is an alignment between medical ethics and professionalism, value-based care incentives can help high-quality care delivery (Emanuel & Wertheimer, 2006). In pay-for-performance care (Snyder &

Neubauer, 2007; Wharam et al., 2009), there is the concern of inappropriately influencing patient or physician choice, failing to account for complex medical illnesses, failure to demonstrate appropriate respect for autonomy and creation of barriers to access for disadvantaged patient groups (Frakt & Jha, 2018). In value-based care, there are reports of doctors unnecessarily withholding care from patients and allowing preferential treatment of patients (Snyder & Neubauer, 2007; Wharam et al., 2009), even though they use resources efficiently (Snyder & Neubauer, 2007; Wharam et al., 2009). It is worth noting that fee splitting, i.e. payment by or to a physician or healthcare institution solely for referral of a patient, is unethical and should be discouraged.

5.5 Care Accessibility to All and Ensuring Mass Coverage

One of the overarching concerns of medical ethics is care accessibility to as many patients as possible in need. Medical entrepreneurs equally try to make care accessible to all. However, this common aim is strictly tied to the availability of funds and trained personnel. While government establishments try to reach as many as possible patients by slight reduction in the quality of care (Unger et al., 2020), private establishments and health insurance companies prefer to render high quality of care to only those that can afford to pay.

5.6 Management of the Available Limited Resources and Standardizing Medical Practice

The currently available resources for healthcare delivery are inadequate. In line with medical ethics, such resources should be managed adequately and should only be used for patients who are truly in need. Medical entrepreneurs equally believe in this concept of economizing the available resources. In entrepreneurship, however, there is a limit to how well those resources are managed. Because of their investment, they would rather make the resources available to the rich at the expense of the poor. Therefore, only rich or registered insurers would have access to the available resources. Physicians have a code of professional ethics, and this code must be updated regularly through jurisprudential discussions in health services and professional associations and dialogue with other professionals or patients (Unger et al., 2020). If there is one thing that should never be compromised, it is standardizing medical care. Medical ethicists are always at the forefront of advocating for this. In entrepreneurship, while standardizing care is important, the interest of the shareholders usually beclouds the need for standardization. To improve ethics quality in health care, healthcare organizations need assessment tools to measure whether ethical practices are consistent

with established norms, standards and expectations for the conduct of the organization and its staff (Fox et al., 2010). Such measures would enable comparisons across services, disciplines, settings and time. While a few instruments have been developed that focus on narrow areas of ethics quality, such as privacy and confidentiality, other areas, such as ethics consultation, ethical leadership and patient-centred communication (American Medical Association, 2008; Fox et al., 2007; Wynia et al., 2010), need to be considered.

5.7 Extent at Which Use of Technology and Artificial Intelligence (AI) Is Allowed

There are attempts to replace healthcare providers with machines. It is important to know that no computer programme, however sophisticated, will replace doctors in the near future, and this will hold true as long as ethics permeates medical practice (Unger et al., 2020). There are contrasting views on the need for and usefulness of artificial intelligence in health. In line with the goals of medical ethics, AI would help to augment the ability of healthcare providers to improve patient care, provide accurate diagnoses, optimize treatment plans, support pandemic preparedness and response, inform the decisions of health policymakers or allocate resources within health systems (Vinuesa et al., 2020). In health care, usable data have proliferated as a result of collection from electronic healthcare records, radiological images and even from hospital rooms (Flynn, 2020). AI can also empower patients and communities to assume control of their own health care and better understand their evolving needs. However, some of these benefits come at very high costs that are practically difficult for an average patient to bear. Even entrepreneurs are always sceptical in investing in AI, as the return on investment is not guaranteed, as it depends on so many factors, among which is the ability to train health workers so that they would be able to use some of the machines efficiently and effectively.

5.8 Conduct of Research and Operation of Do-It-Yourself (DIY) Labs

There are ethical principles that must strictly be followed when conducting medical research. Respect for persons, beneficence, non-maleficence, justice, fairness, avoiding conflict of interest, confidentiality and patient data protection are strongly advocated for by ethicists. Even though medical entrepreneurs believe in these principles, research funded by medical entrepreneurs or other funding agencies finds it difficult to adhere to these principles. Recently, there has been the emergence of do-it-yourself (DIY) labs, and the number of such labs for diagnostic purposes continues to increase (You et al., 2020). Medical ethics is not against the establishment of these

labs for research. Through their establishment as well, health research investors can establish state-of-the-art labs as a form of investment. However, there are ethical and entrepreneurial concerns about its regulation and operations (Ferretti, 2019), irresponsible use of science and patents (Tanenbaum et al., 2013), public health and environmental safety (Gorman, 2010; Revill & Jefferson, 2014), lack of clear ownership (Yoon et al., 2020), strict regulation by government authorities, unsustainable financial support and lack of dedicated leadership (Seyfried et al., 2014). All these would surely not be in the interest of the investors and may equally not be in line with extant ethical principles.

5.9 Physician Referral System

Business arrangements among physicians in the healthcare marketplace have the potential to benefit patients by enhancing quality of care and access to healthcare services. Medical ethics is not against such arrangements, as it is equally a common practice in business. However, these arrangements can also be ethically challenging when they create opportunities for self-referral in which patients' medical interests can be in tension with physicians' financial interests. Such arrangements can undermine a robust commitment to professionalism in medicine as well as trust in the profession. In general, physicians should not refer patients to a healthcare facility that is outside their office practice and at which they do not directly provide care or services when they have a financial interest in that facility. Physicians who enter into legally permissible contractual relationships—including acquisition of ownership or investment interests in health facilities, products, or equipment or contracts for service in group practices—are expected to uphold their responsibilities to patients first.

5.10 Conflicting Roles of Medical Care Organizations (MCOs) and Health Insurance Companies

MCOs perform both medical and business functions, taking actions to provide or withhold care that touch the traditional sphere of medical ethics and, at the same time, acting as ordinary business enterprises with no moral obligations or, at least, obligations that have little to do with traditional medical ethics. This functional duality gives healthcare organizations a foot in both the medical and business camps. Medical ethics, in contrast, assumes significant inequality in knowledge and skill between physicians and patients. For this reason, physicians have been found to have a type of fiduciary obligation to their patients. Business organizations do not have fiduciary obligations to their customers. Their fiduciary obligations are to their shareholders, in the case of investor-owned, for-profit enterprises or to the state, in the

case of nonprofit organizations. MCOs evaluate physician performance solely on the basis of quality of care, without regard to the quantity or cost of services generated. At the same time, the organization needs to preserve itself, and if the cost of providing appropriate care becomes unreasonable, even a principle requiring fair treatment of physicians might not override the financial imperative of self-preservation. MCOs face difficulties when achieving their mission to provide medical care conflicts with their obligation to preserve their assets.

5.11 Organ Procurement, Transplantation and Medical Tourism

Enabling individuals to donate non-vital organs is in keeping with the goals of treating illness and relieving suffering so long as the benefits to both donor and recipient outweigh the risks to both. There is nothing wrong in this based on established ethical principles. From the entrepreneurship angle, this is perfectly in order as long as the patient can afford the costs. Physicians' ethical obligations to contribute to the health of the public and to support access to medical care extend to participating in efforts to increase the supply of organs for transplantation. However, offering financial incentives for donation raises ethical concerns about potential coercion, the voluntariness of decisions to donate and possible adverse consequences, including reducing the rate of selfless organ donation and unduly encouraging perception of the human body as a source of profit. Medical tourists in their own case travel to another town or country to address what they deem to be unmet personal medical needs, prompted by issues of cost, timely access to services, higher quality of care or perceived superior services, or to access services that are not available in their country of residence. In many instances, patients travel on their own initiative, with or without consulting their physician, and with or without utilizing the services of commercial medical tourism companies. The care medical tourists seek may be elective procedures, medically necessary standard care, or care that is unapproved or legally or ethically prohibited in their home system.

6 Implications of the Findings and Policy Prescriptions

In this chapter, we reviewed the convergence and divergence between medical ethics and entrepreneurship as it relates to the likely factors that should guide the conduct of healthcare entrepreneurs in the business of health. Medical entrepreneurs and policymakers must have a good understanding of the factors explained above to ensure quality service delivery at reasonably reduced costs for patients without compromising physician professionalism via guided investments in health in this digital age.

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Chapter 6
Investment Opportunities in Medical Entrepreneurship from a Global Snapshot

Lukman Raimi, Fatimah Mayowa Lukman, and Raden Mas Muhammed Mukhriz

1 Introduction

The healthcare industry is an important segment of the global economy when viewed in terms of its contribution to citizens' wellness, foreign direct investment, revenue generation and employment creation. The industry is broad and comprises different types of hospitals, medical devices and equipment manufacturing, health insurance service providers, clinical trials, telemedicine and medical tourism, among others (Sarwal et al., 2021). Interestingly, the healthcare industry is massively growing because of causative factors such as the prevalence of terminal diseases and lifestyle diseases, an ageing population, the emerging middle class, the increasing intervention role of public–private partnerships in health care and the growing adoption of digital health technologies (Sarwal et al., 2021). The World Health Organization (2019) reports that global spending on health continues to rise faster than the global economy, a situation that provides promising support for the SDG target on health. The report noted that a total of US$7.8 trillion was spent on global health in 2017, which represents 10% of GDP compared to US$7.6 trillion health spent in 2016. Furthermore, the WHO explains that public spending represents approximately 60% of global spending on health that increased at 4.3% a year between 2000 and 2017. Similarly, healthcare spending in the United States was estimated at $3.3 trillion, approximately 18% of GDP, in 2017, and many US citizens enjoyed health insurance paid for by their employers and others through personal out-of-pocket commitments (Martin et al., 2019). However, the average health spending in low-income countries was US$41 in 2017, compared with US$2,937 in high-income countries, corresponding to 70 times (World Health Organization, 2019).

The above mixed trends suggest that the future of global health care can only be sustained through a marriage of medicine and entrepreneurship. The union of

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medicine and entrepreneurship would evidently lead to the development of cheap, accessible and affordable innovative healthcare solutions for redressing the challenges facing healthcare delivery systems in both developed and developing countries (Ahrari et al., 2021). At present, these are new medical-oriented devices, healthcare innovative solutions and technological advances in clinical operations that enhance health and wellness with great incentives for passionate medical entrepreneurs (Lesonsky, 2020). Unfortunately, many physicians lack the necessary skills in innovation development and implementation of entrepreneurship solutions because of weak exposure to entrepreneurship training in their medical education and postgraduate training (Ahrari et al., 2021). The emerging field of medical entrepreneurship, otherwise called public health entrepreneurship, has pragmatically opened new investment opportunities in the healthcare industry because it provides a viable alternative to traditional medical practice by focusing on the most effective way of translating public health knowledge into sustainable and scalable healthcare solutions for improving the wellness of society (Becker et al., 2019).

Despite the plausible benefits of medical entrepreneurship and the adoption of innovative digital health technologies in healthcare systems, the conservative belief that they may sacrifice the tenets of empathy and compassion are the core fundamental values in the art of medicine (Bertuzzi et al., 2020). It is stated that Hippocrates, the Father of modern medicine, counselled, "Wherever the Art of Medicine is loved, there is also a love of Humanity" (Bertuzzi et al., 2020; Rowe & Kidd, 2018). Furthermore, the updated Hippocratic Oath of 1964 obligated medical practitioners to swear that "{WE)… will remember that there is art to medicine as well as science and that warmth, sympathy and understanding may outweigh the surgeon's knife or the chemist's drug" (Hajar, 2017). Apart from the threat to medical ethics, the effectiveness of telemedicine and other digital health solutions is doubted, especially how these digital health innovations would not compromise the tenants of empathy and compassion, as envisaged by Hippocratic (Bertuzzi et al., 2020). It could be argued that the fears are genuine; however, medical entrepreneurship and its digital health solutions are beneficial, empathetic and compassionate to humanity because they provide speedy, affordable and quality healthcare provision to a growing population of sick people. Consequently, they would be acceptable and welcome in medicine as long as they promote a holistic healthcare model, applying standards and ethical rules that are the underpinning of Hippocratic philosophy.

Similarly, emerging digital health solutions provide opportunities for physicians and medical graduates to collaborate with innovators to co-create appropriate medical innovations by translating their ideas into beneficial medical products, transformative medical tools and therapeutic and clinical services that culminate in starting new medical enterprises (Ju & Nguyen, 2018). A number of scholars explained that traditional medical centres and medical schools in the US and other parts of the world have continued to resist medical entrepreneurship and other initiatives that deviate from these core mandates for a number of reasons, such as scarcity of operating resources, organizational structures and cultures in traditional hospitals, individual incentives and poor knowledge management and innovation-inhibiting attitudes (Ahrari et al., 2021; Phillips & Garman, 2006; Williams, 2011).

At the moment, fear and suspicion are growing because of the level of awareness about medical entrepreneurship. However, a number of new studies have affirmed that entrepreneurship in general medicine and veterinary medicine is growing as medical graduates take up different roles as medical-oriented businesses, either as employees or partners/owner-managers, and some have established fully owned new medical enterprises (Carroll et al., 2019; Henry & Treanor, 2010). However, the intensity of awareness needs to be enhanced and enriched with facts on investment opportunities in medical entrepreneurship and funding options for medical enterprises. Funding is connected with investment opportunities because the former is core for the adoption and diffusion of investment opportunities in medical entrepreneurship ecosystems. It is noted that academic medical centres or traditional medical practice in the US healthcare system focus on three areas: teaching, research and patient-centred clinical care. To avoid resistance to medical entrepreneurship, there is an urgent need to scale up information literacy training to introduce medical practitioners and medical students to concepts related to medical entrepreneurship and its investment opportunities, including medical device ecosystems comprising regulatory environments, intellectual property and medical billing and reimbursement structures (Carroll et al., 2019). To bridge the foregoing resistance to medical entrepreneurship, the current chapter discusses the various investment opportunities in medical entrepreneurship from a global context. In specific terms, the chapter provides answers to three research questions: What is the outcome of demand–supply gap analysis in the healthcare industry that necessitates medical entrepreneurship? What are the various investment opportunities in medical entrepreneurship? What are the requirements before investing in medical entrepreneurship?

The current discourse is apt and timely because the field of medical entrepreneurship presents countries with limitless investment opportunities to experiment with digital technologies and apply a lean approach in the healthcare industry for optimal efficiency and cost reduction (Costa & Godinho, 2016; Improta et al., 2019). Lean in health care particularly explicates how to use lean methodology and an associated entrepreneurial mindset to improve the safety, quality, access and morale of health workers while reducing costs, increasing capacity and strengthening the long-term bottom-line of hospitals, clinics and other medical business solutions (Graban & Toussaint, 2018). In view of the opportunity that lean offers, such as managing demand and organizational capacity, quality and safety improvement and cost reduction, at the peak of the COVID-19 pandemic, it was embraced and adopted. Key techniques of lean that make it expedient and irresistible in clinical operations in the healthcare industry include clear communication, careful planning, visual management and standard operating procedures (Leite et al., 2021).

Apart from the introduction above, the chapter is divided into five sections. Section 2 represents the methodology/approach. Section 3 discusses the demand–supply gap analysis in the healthcare industry. Section 4 explains twenty-five (25) investment opportunities in medical entrepreneurship from a global perspective. Section 5 highlights the requirements before investing in medical entrepreneurship. Section 6 concludes with implications, limitations and suggestions for further research.

2 Methodology/Approach

In developing this chapter, the authors found a qualitative research method useful, while relying on a deck-research technique. In particular, contemporary articles, newsletters, texts, policy reports, working papers and online resources were reviewed to unveil the investment opportunities in medical entrepreneurship from a global perspective. This was complemented with secondary data on the global health industry. The extracted data were systematically analysed using a critical literature review (CLR). Contextually, CLR requires that researchers demonstrate a comprehensive understanding of topical issues, raging debates on a subject and extant theories in relation to research objectives from which clear, logical and cohesive arguments are developed (Edirisingha, 2016; Mingers, 2000). However, CLR, with specific reference to this chapter, is a systematic appraisal and objective analysis and evaluation of research resources on specific topics to gain enriched understanding and insights for making more inclusive and informed conclusions on the subject of inquiry (Saunders & Rojon, 2011; Saunders & Thornhill, 2016). Learning from the insight of Ala'raj et al. (2022), the current CLR followed five stages as follows:

1. **Searching the database for suitable literature**: Three sources from which research articles were extracted are Web of Science, Scopus and Google.
2. Scholar. In particular, we searched for three themes: (a) investment opportunities in medical entrepreneurship, (b) global healthcare spending and (c) trends in digital technologies in the global healthcare industry.
3. **Defining geography of literature**: Searched articles covered developed and developing countries to gain richer insights on the subject of inquiry.
4. **Sampling and inclusion–exclusion criteria**: The decision on the number of articles to be included and excluded was based on a purposive sampling technique, which is found useful when population of the articles is very large, and randomization is impossible (Etikan et al., 2016).
5. **Appraisal of the literature**: The selected articles were appraised by critically comparing and contrasting the views to balance the emerging ideas and insights. This step is necessary to draw rich and meaningful information for making informed and evidence-based findings in line with the qualitative meta-synthesis tradition.
6. **Analysis and synthesis of ideas**: From the appraisal of articles, logical explanations and inferences were made on the investment opportunities in medical entrepreneurship.

3 Demand–Supply Gap Analysis in the Healthcare Industry

Before medical entrepreneurs and their collaborators pull financial and human resources into medical enterprises, there is a need to affirm based on facts and figures that their humongous investment opportunities truly exist. This due diligence process

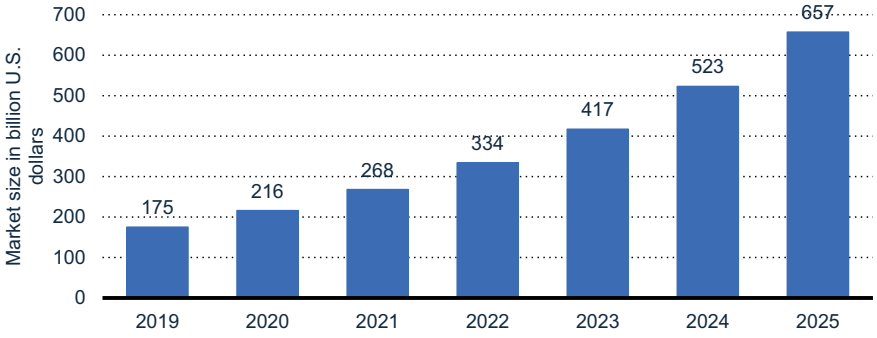

Fig. 1 Global digital health market size 2019–2025 forecast (*Source* Statista, 2019b)

is called a demand–supply gap analysis. The demand–supply gap analysis (DSG) enables managers, investors and policymakers to make effective and targeted strategies and decision-making that are grounded in data-driven evidence (Pennsylvania State System of Higher Education, 2016). Let us explore the global health industry for investment gaps. Globally, there is a rise in public health spending as a percentage of GDP in countries such as the US, France, Germany, the United Kingdom, Spain, Italy and others (Statista, 2020). Related to that is the rise in demand for digital health solutions. The projected global digital health market size from 2019 to 2025 is shown in Fig. 1. In 2019, the global digital health market size was worth $175 billion, and by 2022, it was worth $334 billion. By 2025, the global digital health market size is projected to be worth $657 billion. The growth in global spending on healthcare and digital health market size are an indication that the healthcare industry presents a good business opportunity for medical entrepreneurs and investors by disrupting business models.

Second, the growing population in different countries, worsening incidences of life-threatening diseases and associated pressure have forced governments to enact changes in the healthcare system through the adoption of public–private sector partnerships (Widdus, 2017; Yusuf, 2014). Private sector investors are massively funding health care because of its long-term profitability. The total digital health industry funding across the globe from 2010 to 2020 is depicted in Fig. 2.

Third, it is projected that employment in the healthcare industry in the US will grow by 18%, and the growth will account for nearly 20% of the GDP by 2026 (Lesonsky, 2020). Even the oil-rich Saudi Arabia is overwhelmed with healthcare expenditures, and the government has opened up the healthcare industry to private investors through public–private sector partnerships (Yusuf, 2014). The public and private sectors have individually managed the global health industry with different degrees of influence and efficiency.

Moreover, other governments are overburdened with different diseases and shortages of pharmaceuticals (especially drugs and vaccines); hence, the healthcare

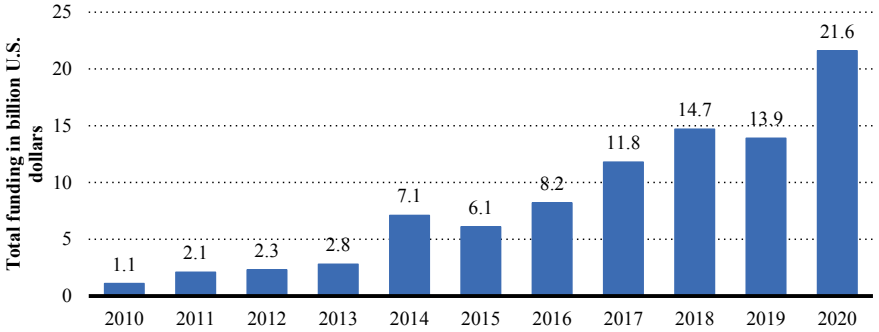

Fig. 2 Investor funding in the digital health industry 2010–2020 (*Source* Statista, 2019a)

industry is being liberalized to accommodate private sector pharmaceutical companies under the PPP model because of their expertise in product development, production process development, drug and vaccine manufacturing, disease control and valuable experience in the coordination of health services, marketing and distribution (Widdus, 2017).

Furthermore, obesity, as a life-threatening disease, presents a very good opportunity for medical entrepreneurship to introduce digital health solutions because people suffering from obesity require regular healthcare services in the form of specialty care visits, inpatient admission in clinics and surgery. Many companies have responded with this gap with different health solutions. The top nine (9) funded digital health solutions worldwide, as shown in Fig. 3, include telemedicine, data analytics, medical health apps, clinical design support devices, practice management solutions, wearable sensors, wellness, healthcare booking and social health networks.

Beyond a country-by-country gap analysis, the report of Economist Intelligence Unit (2019) also affirms that global health spending is growing across continents. The transitional economies recoded the highest growth of 10% in healthcare spending, followed by the Middle East and Africa with a 7.6% growth rate, Asia and Australasia

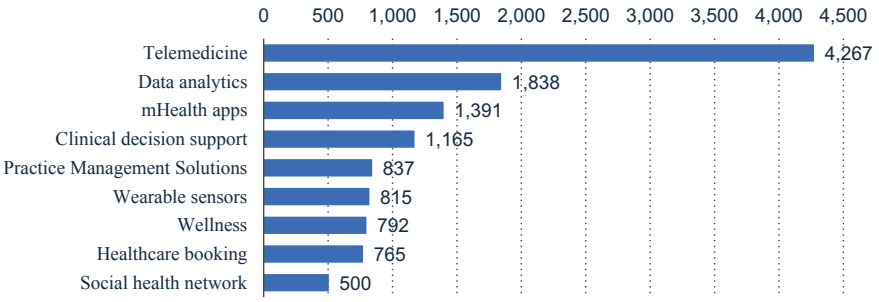

Fig. 3 Top funded global digital health categories 2020 (*Source* Statista, 2019c)

with 5.7%, Western Europe 4.8%, North America with 3.9 and Latin America with 2.0. The world average growth rate in health spending is 6.2%.

In addition, the emergence of the COVID-19 pandemic has further proven that the healthcare industry requires massive investment. At the peak of the pandemic, different countries encountered serious shortages in medical infrastructural facilities and human resources needed to proactively and effectively deal with the public health crisis. In Europe, the pandemic exposed weak health systems' capacities, especially workforce capacities and physical infrastructure, as many countries lack beds and medical equipment, pharmaceuticals, medical supplies, IT devices, personal protective equipment (PPE) and healthcare professionals to respond to the crisis (Winkelmann et al., 2021). The poor state of the healthcare systems in different countries, including the US, Europe, China, Africa and Latin America, predates the COVID-19 pandemic, and the deficiencies were veiled and kept away from the public. The OECD/European Union (2020) explained that before the pandemic, many countries in Europe had low infrastructural facilities: intensive care unit (ICU) bed capacity ranges from 2 hospital beds per 100,000 in Sweden to 8 beds in Germany and from 5 ICU beds per 100,000 in Ireland to 34 in Germany at different periods.

To move forward, Liu et al. (2020) opined that entrepreneurship can be a game changer because as a pragmatic disciple, it has creative solutions to the challenges facing the healthcare industry by pooling the knowledge and wisdom of entrepreneurs and innovators across geographical boundaries. The foregoing statement is an incontrovertible fact because at the peak of the pandemic, entrepreneurial and practice companies reinvented their business models to respond to the new needs of society caused by the pandemic (Kilic & Marin, 2020). A uniform factory in Argentina reinvented operations from sewing police uniforms to the production of surgical masks for dual purposes: preventing the spread of COVID-19 infection and safeguarding business operations (Duff, 2020; Raimi, 2021). Another large printing press in Latin America retooled the machines and reinvented its operations from book publishing to the production of 3D protective masks and hand sanitizers for the same dual benefits of life saving and business sustainability (Duff, 2020; Raimi, 2021). Moreover, a number of small and medium enterprises (SMEs) with agility and operational flexibility responded to acute market needs and rising demands during the pandemic by shifting operations to the production of personal protective equipment, surgical masks, shields, ventilators, infection control medication, innovative drive-through testing and testing kits (Liu et al., 2020; Sodhi et al., 2021; Xing et al. 2020).

4 Investment Opportunities in Medical Entrepreneurship

The foregoing discourse provides great incentives and justification in emerging markets for health-related businesses for passionate medical entrepreneurs. However, what are the various investment opportunities in medical entrepreneurship? Apart from hospital, pharmacy and veterinary clinic business models, the foregoing section discusses twenty-five (25) investment opportunities in medical entrepreneurship that

aspiring medical entrepreneurs could explore and exploit for long-term streams of revenue.

1. **Medical transcription services**: This is an IT business solution that enhances the process and quality of transcriptions in hospitals and clinics by developing the capacity of new crops of medical transcriptionists. The medical transcriptionists basically assisted in transcribing the voice recordings of doctors, nurses and other medical professionals into well-written and well-archived patient records. This is made possible through the use of speech recognition technology that improved the efficiency, security and accuracy of medical transcription, archiving and sharing of files. It is a novel service that could be offered to hospitals and clinics through outsourcing or consultancy (Lesonsky, 2020; Padminii et al., 2016).
2. **Electronic Medical records management**: In the digital society, medical records service providers are indispensable because they assist hospitals, clinics and other care-giving institutions in managing the medical records of patients and other doctors' documents independently in-house or through outsourcing if too expensive for healthcare organizations. Manual record management has proven to be defective in terms of storage and retrieval; hence, contemporary medical institutions must work collaboratively with medical records professionals and medical IT consultants to identify the best records management systems, install the systems and implement the systems practically with doctors, nurses and records officers to ensure usability and suitability (Lesonsky, 2020; Liu & Ma, 2003; Liu & Zhu, 2013).
3. **Physical/occupational therapy centre**: With growing incidences of accidents and fatal injuries leading to bone dislocation and permanent disabilities, the need for physical/occupational therapy centres is expedient. Unfortunately, many public and private hospitals lack this vital centre. Physical/occupational therapy centres scale up patients' recovery process from injuries and capacity to regain permanent healing through specific therapy, such as massaging, motion training, dressing and feeding practices and one-on-one therapeutic exercises (Lesonsky, 2020; Tenforde et al., 2020).
4. **Multipurpose mobile healthcare app**: As the global economy becomes increasingly digitalized, medical professionals who are skilled in app development can create new ventures in mobile healthcare apps. A typical multipurpose healthcare app is needed to connect healthcare providers, customers and other end-users in medical ecosystems. Such multipurpose mobile apps would be useful for healthcare providers to track, record and manage the medical conditions of their patients, and the patients would also have access to a list of healthcare providers for the purpose of switching if unsatisfied with services from existing providers (Lesonsky, 2020; Yee et al., 2019). The most popular mobile health apps, as shown in Fig. 4, are nutrition apps (50% growth rate), sleep tracking apps (37%), meditation apps (34%), mentation/facility apps

(31%), medication checkers/reminders (27%), apps for measuring body functions (23%), patient apps (22%), apps to set up routines for addicts (20%), apps for managing allergies (15%) and other apps with diverse functionalities (4%).

5. **Diabetic care centre**: One of the popular lifestyle diseases that cut across countries is diabetes. Therefore, medical graduates could help turn this health problem to a business solution by setting up a diabetic care centre to help diabetic and pre-diabetic patients to improve their nutritional and behavioural lifestyles through nutrition counselling on healthy eating habits, creating support groups for diabetic patients and providing facilities for dialysis and other medical services (Leichter et al., 2003; Lesonsky, 2020.
6. **Home healthcare service**: For families suffering from loneliness and ageing parents, home healthcare services are in high demand, are profitable and present strong business prospects. Medical entrepreneurs operating home healthcare services provide in-home medical care for seniors/aged parents, children living with disabilities, people with terminal out-of-hospital treatments, those recently discharged, patients with chronic health conditions and those who need personalized support assistance in managing their health (Lesonsky, 2020; Rest & Hirsch, 2022).
7. **Rehabilitation centre for drug addicts**: A rehabilitation centre is a viable business model because it provides an enduring solution to a serious behavioural problem of drug addiction that existing health centres do not have the capacity and infrastructure to manage and accommodate. With the rising increase in the number of adults and adolescents seeking treatment for their addictions and rebuilding their lives, moving medical entrepreneurs to open rehabilitation centres to help people suffering from drug addiction could be a profitable and strong business prospect (Lesonsky, 2020; Noor & Kumar, 2017).
8. **Childbirth services**: This is different from daycare because childbirth services are provided to expectant parents to coach them through all aspects of childbirth, leveraging the expertise of trained midwives and doulas or both. Midwives, as professional healthcare providers, assist pregnant women during the various stages of childbirth. The doulas, on the other hand, are pregnancy coaches who support couples in coping with nurturing their babies by providing all necessary

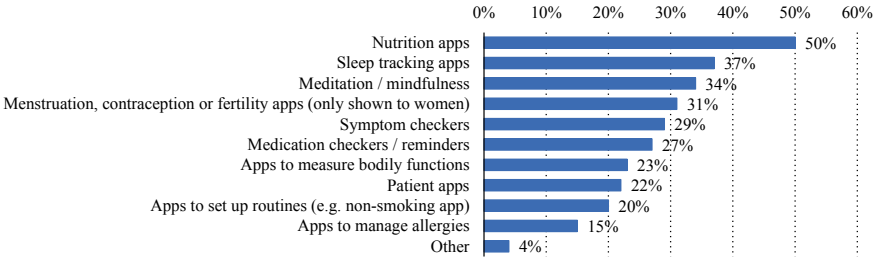

Fig. 4 Diffrent mobile health care apps in the market

support services at the birth and caring stages for the newborn (Duman, 2012; Lesonsky, 2020).

9. **Nutritionist/dietitian**: The global public healthcare system is promoting preventive health through promotion of healthy lifestyle nutrition and treating nutritional problems of patients. Therefore, setting up a nutrition/dietitian centre is a golden opportunity in a rapidly changing world where people have embraced sustainable healthy lifestyles. Dietitian centres can help improve clients' nutritional intake and habits or specialize in different types of health lifestyle advocacy, such as sports nutrition, nutrition for weight loss or holistic nutrition. The nutrition centre's services extend to providing direct and indirect access to organic products such as whole meal bread, vegetable soups, salads, vegan cheese, organic chickens, sandwiches, grass-fed beef, diabetic menus, natural fruit smoothies and traditional and continental desserts (Bolton, 2014; Lesonsky, 2020).
10. **Alternative health care**: In the furtherance of access to healthcare delivery services, the global community accommodates alternative healthcare options that are transparent and conform with medical ethics, although they vary across the country. Some of the alternative healthcare options that present golden opportunities for launching new businesses with viable revenue streams and providing enduring healthcare solutions include acupuncture, massage therapy, aromatherapy, Naturotherapy, Unani, herbal treatment and traditional medical treatments (Lesonsky, 2020).
11. **Medical supply sales and deliveries**: The success of fast-food sales and deliveries has provided a strong impetus for medical supply sales and deliveries. This unique business entails the supply of medical supplies such as prescribed drugs, food supplements, toiletries, injections, walkers, braces, bedpans, medical devices and health equipment to private users such as aged people, people with disabilities and those with chronic illnesses and others with difficulties in going to a physical store, keeping in mind that your target customers will often have difficulty getting to your location, so an online store is likely a better bet. Again, research here will be key so you can make sure that you're stocking the right products and marketing in the right places (Lesonsky, 2020).
12. **Medical tailoring and stylish sewing of uniforms**: In public and private medical centres, different uniforms are needed for doctors, nurses, pharmacists, health technologists and patients. Considering the cost of these uniforms, the management of hospitals seeks to reduce costs by looking for affordable and durable uniforms for healthcare professionals and patients. Therefore, developing a least-cost business model for medical tailoring for producing and suppling uniforms, comfortable shoes, lab coats and other gear for healthcare professionals in hospitals and health centres could be a game changer (Lesonsky, 2020).
13. **Ambulance Service**: Growing preference by pleasure seekers and corporate organizations for outdoor activities and events has made ambulance services very lucrative medical enterprises in contemporary times. Additionally, patients suffering from terminal ailments, life-threatening injuries and sudden illnesses

need emergency ambulance services. It is a business model with moderate capital investment that offers long-term profitability and impacts (Lesonsky, 2020).

14. **Blood Bank**: In rural and urban centres, people in critical health situations fall back on public and private blood banks for blood supplies during emergencies. The need for blood banks is particularly high and profitable in developing countries and rural communities in urban centres where there is a supply deficit of blood (Lesonsky, 2020).
15. **Counselling Service**: In households and workplaces, there is a surge in cases of mental health problems, especially depression and anxiety, which is part of people's overall well-being. To manage those with worsening mental health problems, depression and anxiety, medical entrepreneurs need to tap into a counselling service business model (Lesonsky, 2020).
16. **Dental Clinic**: Although it is an old capital-intensive medical enterprise, new dental technologies and medical equipment are changing the scope and delivery of dental services by dentists and dental technicians to patients (Lesonsky, 2020; Yu et al., 2018).
17. **Diagnostic Centre**: The emergence of digital health technologies has improved the delivery of diagnostic services. Therefore, one of the most lucrative and evergreen medical services is the diagnostic centre. Modern diagnostic centres with state-of-the-art facilities provide different services to patients, such as physical walk-in for tests and thirst-party delivery of sample doorsteps with physical and online reports to clients (Andrikov & Kuchin, 2021; Lesonsky, 2020).
18. **Medical Waste Disposal Services**: Solid and nonsolid medical wastes, such as paper towels, wipes, gloves, syringes, needles, surgical blades, expired drugs and blood-stained bandages, have become problematic because the traditional method of collecting medical wastes in polythene bags and plastic boxes in clinical settings for disposal, such as normal trash, has been ineffective and dangerous. To forestall the spread of diseases and viruses arising from medical wastes, the business model of medical waste disposal services using more effective procedures, such as incineration, autoclaving, microwaving, chemical neutralizing and biomedical waste treatments, is in high demand in hospitals across the world (Ho, 2011; Reinhardt & Gordon, 2018).
19. **Disposable Syringe Manufacturing**: Medical syringes are non-degradable medical wastes and one of the causes of secondary disease transmission. To solve the problem pragmatically, the business model of disposable syringes has huge market potential and moderate capital investment (Panizzolo et al., 2012).
20. **Fitness Centre/Fitness Equipment Selling/Gym**: This is a tripartite medical solution that provides fitness services, sales of fitness equipment and access to gym facilities. The fitness centre is a commercial health, recreational and social facility that promotes physical exercises, sports and wellness activities (León-Quismondo et al., 2020). Fitness equipment selling is a retail distributorship of making fitness and gym equipment and devices available to individuals and corporate organizations, while a walk-in gym allows users to make use of

state-of-the-art equipment periodically on a pay-as-you-go basis or on monthly subscription. Three services provide a regular and sustainable stream of income to medical entrepreneurs (Andreasson & Johansson, 2014; Kim et al., 2016).

21. **Medical Tourism**: In the fast-changing medical market, medical tourism refers to a unique cross-border tourism where tourists seek medical treatments, check-ups and surgical procedures abroad and afterwards enjoy conventional tourism experience, pleasure-seeking, leisure and relaxation in historical locations and places. The combination of medicine and tourism as a new nonexclusive niche tourism attracts large inflows of patients, supporting families and their physicians from different countries (Badulescu & Badulescu, 2014; Caballero-Danell & Mugomba, 2007). It offers a good opportunity for hospitals and tourism enterprises to collaborate to provide a wide range of first-class medical procedures and tourism services to medical tourists from countries with very expensive or weak healthcare systems (Connell, 2013; Junio et al., 2017).
22. **Medical Aesthetic Clinic**: This refers to a medical procedure carried out on patients to improve their cosmetic appearance and beauty. It encompasses removing skin damage, scars, spider veins, improving dermatological defects/conditions minimizing signs of ageing, such as wrinkles, age spots, or loose and sagging skin, unwanted hair and skin discolouration, among others (Crystal Clear Digital Marketing, 2019; Lewis, 2017). A medical aesthetic clinic is a very competitive business that requires modest capital investment, and promoters of this business model need an in-depth understanding of the customers, aesthetic clinic management, digital marketing and ethical issues involved to stay profitable (Lewis, 2017).
23. **Online pharmacy and dispensary**: The traditional physical pharmacy provides face-to-face services to patients and other end-users of drugs and medications. Online pharmacies and dispensaries have the capacity to serve diverse online communities and people living in remote locations because their operations are driven by digital technologies on digital platforms (Parekh et al., 2016). Apart from fear of misuse of drugs, the business model of online pharmacy is a positive novel development that has been described as Amazonification of growth of community pharmacy businesses (Royal Pharmaceutical Society, 2019). Online pharmacy also offers patients different needs and tastes the convenience of instant access to information about medicines (Radu et al., 2017). The COVID-19 pandemic has disrupted global health supply chains and has particularly affected pharmaceutical ingredients, shipping and procurements and has caused a scarcity of finished healthcare products, among others (European Pharmaceutical Review, 2020). Therefore, the emerging online pharmacy business model would speed up the procurement and delivery of drugs and medication to end-erasers. The business is, however, highly regulated by government and professional bodies, requires high capital investment and is strictly reserved for licensed pharmacists.
24. **Teeth Whitening Centre**: In the industrial society where people have poor dietary habits and eat all sort of food ranging from chocolates, black tea, beef, a wide variety of sweet breads and candies, teeth whitening service has elicited

high demand from patients, but where the teeth cleaning culture is high, the business becomes a luxury (Hu, 2005). Other causative reasons for teeth whitening services are poor tooth brushing routine, poor dietary habits and low socioeconomic status of people, resulting in oral health issues (Khan et al., 2021). Tooth whitening is a dental procedure that entails the application of concentrated bleaching agents on the teeth of patients for whiter teeth and perfect smile by professional dentists or tooth whitening technicians with minimal risks (Periyasamy et al., 2021).

25. **Yoga Centre**: In urban centres and industrial societies, there is a surge in sleeplessness, stress, emotional disturbance and lifestyle diseases among people. Yoga has been identified as a potent mind–body intervention with therapeutic potential to improve the emotional wellness of elderly people (Varsha, 2018). In the US and other places, yoga practice has been widely embraced by adults as a preventive medicine strategy because it improves general well-being and supports specific disease treatment (Zhang et al., 2021). Yoga, especially mediation, has also been described as a user-friendly stress management technique that immensely helps in the prevention and treatment of coronary artery diseases and controls several abnormalities of hypertension (Mittal et al., 2016).

5 Requirements Before Investing in Medical Entrepreneurship

Before leveraging the investment opportunities discussed above, aspiring medical entrepreneurs and collaborating investors must consider the following requirements that are the elements of an entrepreneurship architecture.

1. **Business Environment**: This is the first consideration and a key requirement. The extant literature clearly states that all companies interested in systemic service innovations need to understand the business environment or investment climate, that is, a sound understanding of the external conditions and impact of external stakeholders on operations in terms of networking, interfacing and cross-fertilization, market cultivation and legal imperatives and regulatory regimes (Chen et al., 2014). The business environment touches vital institutional elements such as government economic policies, sociocultural behaviours, state of infrastructure, political stability, tax burdens, protection of property rights, labour and entry regulations that clearly affect investors' returns (World Bank, 2005; Xu, 2011).
2. **Business Concept**: This is the unique idea that formed the basis for undertaking medical entrepreneurship. The business concept explicates applying alternative ideas that help to transform traditional buyer–supplier relationships into new exchange models of deliveries and payment (Chen et al, 2014; Lay et al., 2009). What exactly are innovative medical solutions or digital health applications being proposed? Are these novel concepts the same as existing medical solutions? What

makes the medical solutions different? What is the uniqueness of the new medical solutions for commercialization?

3. **Business Model**: This is a representation of the business concept that will work in reality. Barringer and Ireland (2016) define a business model as a structured plan on how a business creates, delivers and captures value for its multiple stakeholders. It is also a tool for the visual representation of strategy-related issues of a startup (Osterwalder & Pigneur, 2010). When applied to medical entrepreneurship, a business model describes how the proposed medical solutions would create, deliver and capture value to customers and turn transactions into profit in society (Teece, 2010). The process of business model construction and modification forms a part of medical entrepreneurship business strategy.
4. **Business Plan**: This refers to a written document describing the nature of the medical enterprises, the sales and marketing strategy and the financial background and contains a projected profit and loss statement (McKeever, 2018; Mullins & Komisar, 2010). A bankable business plan should include the following sections: (a) cover page, (b) table of contents, (c) executive summary, (d) business description, (e) management (f) market and business analysis, (g) business and market development, (h) marketing and sales, (i) financial analysis/data, (j) application of funds and (k) appendix (Nunn & McGuire, 2010).
5. **Business KSA**: For entrepreneurs to compete effectively in national and global environments, entrepreneurs and their team members need appropriate knowledge, skills and abilities (KSA) to survive (Prestwich & Ho-Kim, 2007). The KSA describes the academic and professional qualifications, including practical experience that promoters require to succeed in medical entrepreneurs. For pharmacists, medical doctors and those seeking to pursue medical entrepreneurship, the following list of KSAs is important: (a) ability to identify, create and pursue new opportunities; (b) ability to successfully implement new ideas and turn them into practice; (c) willingness to take financial and nonfinancial risks; (d) capacity to fill unmet needs; (e) ability to create new value through innovation; (f) responsiveness to change in the market domain; (g) ability to make sacrifices; (h) love for social and intrapreneurship; (i) ability to leverage existing knowledge, skills and resources; (j) capability to go beyond traditional/professional roles and (k) ability to improve patient care (Mattingly et al., 2019). Based on the foregoing, certified pharmacists, medical doctors, dentists, dietitians and nutritionists should ask themselves if they possess the required KSAs to venture into medical entrepreneurship (Table 1).

6 Conclusion and Managerial Implications

The chapter discusses different investment opportunities in medical entrepreneurship that aspiring medical entrepreneurs could explore and exploit for long-term streams of revenue in the global healthcare industry. At the end of the CLR, it was found that apart from hospital, pharmacy and veterinary clinic business models,

Table 1 List of Knowledge, Skills and Abilities (KSAs)

Knowledge	Skills	Abilities
Business plan development	Communication	Innovativeness
Strategy	Teamwork	Resilience
Project management	Dealing with failure	Determination
Legal	Risk assessment	Flexibility
Health system	Problem-solving	Futurism
Leadership	Adaptability	Risk-taking
Innovation cycle	Leadership	Curiosity
Communication	Negotiation	Responsibility
Accounting	Self-assessment	Passion
Implementation science	Organization skills	Proactiveness
Finance	Market analysis	Positivism
Human resources	Networking	Courage
Sales and marketing	Business plan development	Change agent
Core technical knowledge	Finance (applied)	Intrinsic motivation
Information systems	Managing people	Trustworthiness
Research methods	Patient care	Collaboration
	Data analysis	Energy
	Technology	Reflection
	Research methods	Self-restraint
		Empathy
		Cultural sensitivity
		Outgoing
		Altruism
		Humility

Source Adapted from Mattingly et al. (2019)

there are twenty-five (25) investment opportunities in medical entrepreneurship that aspiring medical entrepreneurs could explore and exploit for long-term streams of revenue. Four managerial implications have clearly emerged from the chapter. First, the demand–supply gap analysis affirms that the global healthcare industry requires medical entrepreneurship, especially the application of innovative medical solutions for the delivery of fast, efficient, cost-effective and quality services to the growing population of the world suffering from terminal and life-threatening diseases that have overwhelmed the government. Second, medical entrepreneurs,

IT experts and digital innovators and investors can forge collaboration to exploit the twenty-five (25) investment opportunities in medical entrepreneurship. Third, before exploring and exploiting the investment opportunities in medical entrepreneurship, promoters/investors must consider the five elements of an entrepreneurship architecture, namely, the business environment, business concept, business model, business plan and business KSAs. Finally, medicine entrepreneurship as a novel business model has the prospect of providing the global healthcare industry with innovative, cheaper, accessible and affordable healthcare solutions for meeting the medical needs of diverse populations in both developed and developing countries.

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Chapter 7
Funding Sources for Medical Entrepreneurship in the Digital Age (Middle East Perspective)

Hani El-Chaarani, Lukman Raimi, and Zouhour El-Abiad

1 Introduction

The COVID-19 pandemic period has affected socioeconomic conditions and human well-being mainly in developing countries (Vrontis et al., 2021). The long lockdown periods developed the inflation rate and unemployment. Firms from different sectors and mainly the medical sector suffered from the negative impact of the COVID-19 pandemic period. They were struggling with numerous financial problems due to the decreasing financial revenues and development of operational costs related to the treatment of COVID-19 (El-Chaarani & Raimi, 2021). The appearance of the COVID-19 virus also raised the need to employ an innovative digital strategy able to adapt to any epidemic period and provide effective medical solutions. For several information technology and medical specialists, the main problem of the last pandemic was the absence of an international data management system that could centralize, filter, and analyze the information of the COVID-19 virus (El-Chaarani et al., 2021). As a result, many recent studies have stated that the international healthcare system and medical centers must be upgraded through the employment of digitalization and new technology. Bragazzi (2020) and Pham (2021) recommended the implementation of artificial intelligence (AI) and big data management systems to detect and prevent the health effects of COVID-19. They indicated that a centralized data management system could help medical specialists and other stakeholders to optimize their decisions. For Attaran (2020), managers and new entrepreneurs

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in the medical sector have to use the new technology that is able to improve the quality of health. The author suggested employing new blockchain technology in the healthcare sector to develop communication between stakeholders, improve the decision-making process, and enhance healthcare outcomes.

Medical entrepreneurs in the digital age have no choice to not employ new technology in their new business to sustain a very competitive environment. In view of this digital issue, a new pertinent and fundamental question arises: what are the financing sources that could be used by medical entrepreneurs in the digital age? Are the digital technologies transforming the entrepreneurial financing strategy and sources of the medical sector in the Middle East region?

The first objective of this chapter is to present the traditional and innovative funding sources that could be used by medical entrepreneurs in the Middle East. The aim of this first objective is to provide for entrepreneurs in the medical sector a full guide showing all the available funding sources that could be employed in the Middle East region. The second objective of this chapter is to explore the different funding sources used by medical entrepreneurs in the Middle East region and the impact of the employed sources on their sustainability and financial resistance during the COVID-19 pandemic period. Apart from the introduction, this chapter is divided into four different sections. The first section defines medical entrepreneurship, presents the different funding sources accessible by medical entrepreneurs and analyzes the different trends and challenges of medical innovation in the Middle East. Section two explains the methodology of this chapter. Section three shows the empirical findings, and section four concludes this chapter.

2 Literature Review

2.1 Digital Medical Entrepreneurship in the Middle East: Trends and Challenges

Medical entrepreneurship in the digital age is the act of opening new investments or running a creative project to provide different healthcare services by employing new communication and information technologies such as virtual reality, telemedicine, robotics, and wearable tools. The objective of medical entrepreneurship is to satisfy market needs by upgrading and updating several fields, such as biotechnology and medicine. A medical entrepreneur is a person who bears the risk of leading new investments in the medical sector to enhance the quality of health outputs (Fig. 1). Similarly, Wulfovich and Meyers (2020) defined health entrepreneurship as the deployment of health innovations under a high level of uncertainty. They stated that medical entrepreneurs must satisfy health market needs and wants by improving the quality of healthcare outputs. Recently, medical entrepreneurship has developed quickly and attracted a large number of investors and innovators. Incubators, business angels, and venture capitalists are more interested in investing and developing digital health

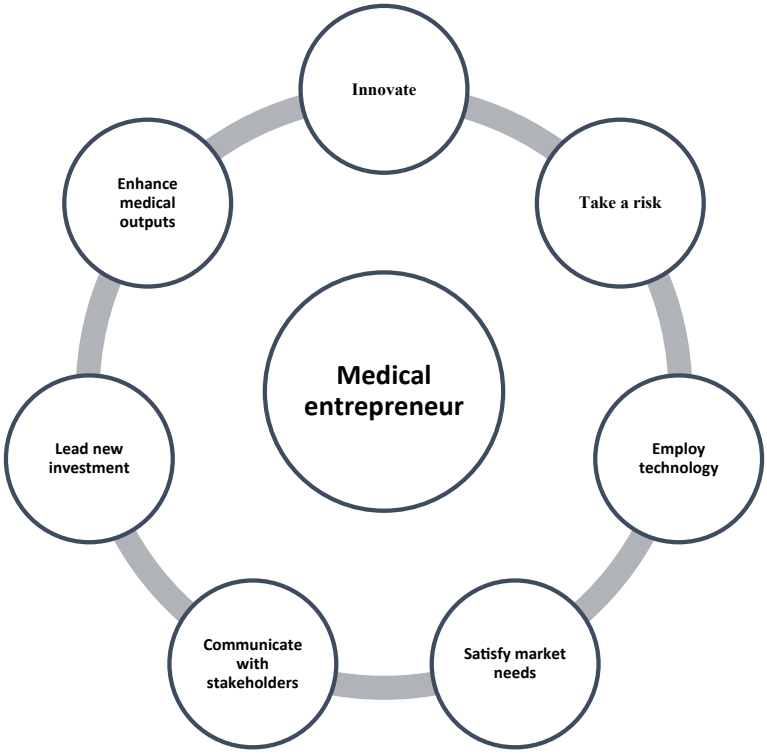

Fig. 1 Medical entrepreneur characteristics

products and services since a large number of patients, physicians, and users are becoming more familiar with the use of updated healthcare technologies.

Many international firms, such as Apple, Samsung, Google, Microsoft, Facebook, Viveo, InnVentis, and VRSano, have become directly and indirectly involved in this field. IT specialists, medical research centers, and investors are working in collaboration to develop new healthcare products and services.[1] They are employing updated technologies such as blockchain, virtual reality, the Internet of Medical Things (IoMT), cloud computing, 3D printing, genomics, artificial intelligence, mobile health, and big data management to enhance the decision-making process and the quality of healthcare services offered to patients and users. In the Middle East region, the weakness of the healthcare system, development of medical problems, and improvement of the entrepreneurship ecosystem have increased the number of digital

[1] Source: https://www.startus-insights.com/innovators-guide/top-10-healthcare-industry-trends-innovations-in-2021/.

medical entrepreneurs. Currently, there are many successful medical entrepreneurship examples, such as AlemHealth[2] in the United Arab Emirates, Sohati[3] in Lebanon, and Altibbi[4] in Jordan. The smart home care project introduced by the Dubai healthcare authority in 2018 is another successful example showing the development of digital health care in the Middle East region.[5] The market for healthcare technologies in the Middle East is projected to reach 31.6 billion dollars by the end of 2025.[6] On the other hand, several challenges are facing medical entrepreneurship in the Middle East region (Fig. 2). First, medical entrepreneurship projects must include physicians who are known for their lack of entrepreneurial knowledge, time, and innovation culture. This first challenge is the main barrier to the development of medical entrepreneurship. This problem can be resolved through the development of entrepreneurship education in medical faculties.

Second, it is very challenging to build a medical entrepreneurship team since this field must include different members from several majors, such as IT, medicine, and communication. The development of communication and interaction through scientific research centers and incubators could resolve this problem and create a solid infrastructure for medical entrepreneurship.

Third, this field of entrepreneurship must use and employ updated technology that can manage, clean, and save the big data generated from fixed and wearable devices. The privacy of patient information is another challenging issue in medical entrepreneurship that must be well protected and tracked by specialists in the IT and medical fields.

Fourth, the medical entrepreneur must interact and communicate with medical providers, patients, and healthcare regulators to obtain the approval of their medical product/service and thus lead his/her mission much more complicatedly. Therefore, medical entrepreneurs must consider the health risks by developing their clinical tests.

Finally, access to financing sources is another challenging problem that could face the development of medical entrepreneurship projects in Middle Eastern countries (El-Chaarani & El-Abiad, 2019). Several medical entrepreneurs suffer from the limited financing resources that exist in Middle Eastern countries. Some others do not know the different external financial resources available for the digital healthcare sector. Thus, medical entrepreneurs must enhance their entrepreneurial knowledge and develop their social support networks.

[2] Source: https://www.alemhealth.com/.

[3] Source: https://www.sohati.com/.

[4] Source: https://altibbi.com/.

[5] Source: https://insights.omnia-health.com/technology/5-digital-health-trends-middle-east.

[6] Source: https://www.bevanbrittan.com/insights/articles/2020/a-middle-eastern-healthcare-market-full-of-opportunity-and-some-challenges/.

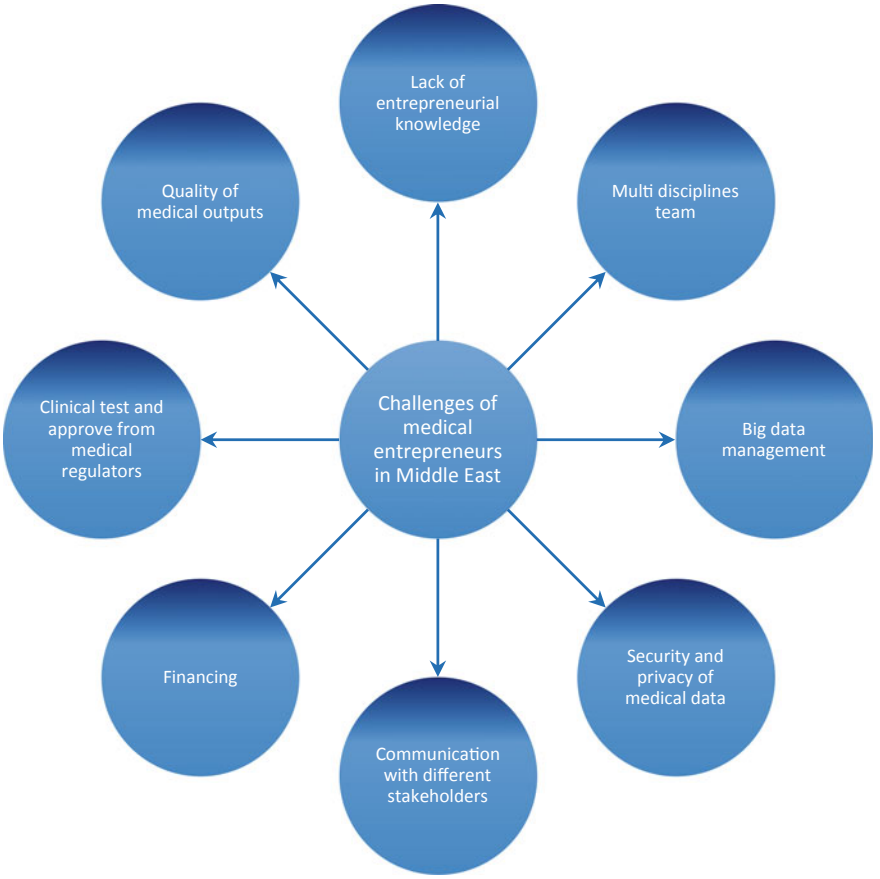

Fig. 2 Challenges of digital medical entrepreneurship

2.2 Financing Structure for Medical Entrepreneurs: A Theoretical Background

To initiate a new healthcare activity, medical entrepreneurs must optimize their financial decisions by choosing the appropriate funding source that could lead them to achieve success. Several financial theories have defined the different funding sources that could be selected by both entrepreneurs and existing firms that are looking to initiate new activities. For Modigliani and Miller (1958), there is no impact of the funding source on firms' performance. Thus, both levered and unlevered firms have the same value. However, the authors showed in their study in 1963 that when taxes are considered in their basic model, the value of the levered firm is enhanced due to the tax shield provided by interest payments (Modigliani & Miller, 1963). Medical entrepreneurs must develop their activities by using debts as a basic funding source.

Based on pecking order theory, medical entrepreneurs must finance their new investment in hierarchal order (Myers & Majluf, 1984). Thus, they must use their retained earnings as a first financing source followed by debt before choosing equity as the last source of financing. For Myers and Majluf (1984), this financing order is based on the concept of asymmetric information. External fund providers such as creditors and shareholders require a high level of return to compensate for the asymmetric information and the high level of risk that they make by investing in new business. In light of this theory, medical entrepreneurs must prefer to use personnel equity before they use debt or external equity.

Berger and Udell (1998) consider in their life cycle theory that firms use different types of financing sources based on growth levels. According to the authors, a new entrepreneur is informationally opaque, and he/she has more restrictions to obtain external sources of financing. In the development stage, entrepreneurs prefer debt rather than equity to stay as the ultimate owner of the firm.

For several other scholars, such as Jensen and Meckling (1976), Jensen (1986), and Stulz (1990), using debt as a financing source could decrease the free cash flow and thus lead to a reduction in the cost of overinvesting. The authors' debt financing also decreases the waste of free cash flows when the new investment is not managed by the owner.

The trade-off theory (Myers, 1977) considers that the optimal capital structure is based on a combination of both debt and equity. In this context, the medical entrepreneur could increase the debt level to a certain limit and thus lead to enhancing the financial return of his or her investment. If the entrepreneur develops the debt after a specific limit, then the risk of default increases, and the value of the investment decreases.

Vaznyte and Andries (2019) studied the financial orientation of entrepreneurs based on pecking order theory. They stated that entrepreneurs follow the hierarchical financial preferences defined by Myers and Majluf (1984). They argued that entrepreneurs have limited financing resources and thus lead them to use external financial resources provided by banks and new shareholders. They showed that the financial decision of an entrepreneur is affected by several factors, such as the start-up development phase, cost and benefits of financing resources, and risk level of the start-up sector.

Covin and Slevin (1991) argued that entrepreneurs are more willing to use debt as a financing source when they have a high entrepreneurial orientation level (EO) reflected through high innovativeness capacity and risky behavior. Moreover, Schwienbacher (2007) confirmed that the financial decision of an entrepreneur is affected by its characteristics (lifestyle, risk-averse level, personnel objective, nature of entrepreneurial project, education). He stated that different entrepreneurial types follow different financing strategies. At the early stage of start-up, the entrepreneur is more likely to seek funds from venture capitalists than business angels when he/she is looking to minimize the dilution of his/her capital. Thus, the financial decisions of medical entrepreneurs in the Middle East cannot be made based on financial theories and the trade-off between the cost and profit of financial sources. Many other

factors, such as the sector and personality of the entrepreneur, could affect the capital structure.

2.3 Financing Sources for Medical Entrepreneurs in the Middle East Region

Medical entrepreneurs in the Middle East region have access to many financing sources. They can use either their personnel savings or borrowed equity. Their financial decisions are based on several criteria, such as their willingness to open capital for externals, the risk involved in increasing capital, the nature of the medical project, and the existence of financial source options within the country. Financing sources available for medical entrepreneurs in Middle Eastern countries could be classified into internal and external sources (Fig. 3).

Regarding internal sources, medical entrepreneurs can use their personnel savings and retain earnings from their business or medical activities. In addition, they can

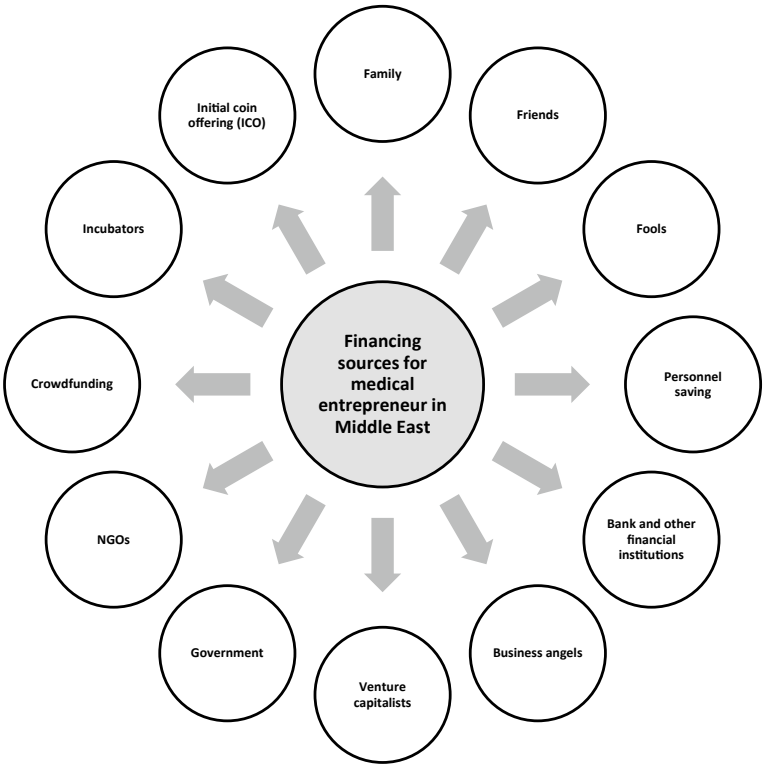

Fig. 3 Financing sources of medical entrepreneurs in the Middle East

sell their unused assets to raise money and develop their medical activities. These types of financing sources decrease the risk of losing control of medical investment. It also helps entrepreneurs avoid the payment of interests or dividends and thus leads to a decrease in the financial costs of new medical investment. On the other hand, the internal financing source has several disadvantages. First, the personnel savings and internal financing sources of medical entrepreneurs are limited, which can postpone and stop the development of medical investment. Second, this type of financing source puts the medical entrepreneurs under pressure and affects their strategic decisions since they are putting themselves and their family members at high financial risks.

Regarding the external financing sources, many opportunities and alternatives are available in the Middle East region for medical entrepreneurs. First, they can raise their funds from family, close social networks, and fools (Startup Explore, 2014). This financial source is often used by entrepreneurs in the Middle East region since it is well-known for solid family relationships. Through this type of financing source, medical entrepreneurs could have quick access to funds, and they are not under the pressure to pay back the borrowed money at a specific time with a high interest rate. In some cases, this type of fund could be given without interest and even as a gift. However, many problems could arise by using this source of financing, such as family conflicts and insufficient funds available by the family and close friends. Alternatively, to avoid conflicts with family members and close friends, the medical entrepreneur can raise its capital by getting funds from new partners (outside the family and close network of the entrepreneur). The disadvantage of this new funding type is that the new partner will be implied in the managerial process and will ask to obtain a quick return on investment.

Medical entrepreneurs can finance their investment through loans and further financial facilities from banks and other financial institutions. This traditional financial financing source is largely used in Middle Eastern countries by SMEs. Generally, banks prefer to finance existing SMEs with stable cash flows rather than new risky businesses. Offering collateral could help medical entrepreneurs obtain funds from banks. In return, the medical entrepreneur must prepare for the bank a solid business plan showing cash flow expectations and the financial feasibility of its investment (Deloof & Vanacker, 2018; Walz & Hirsch, 2019).

In the Middle East, business angels or smart investors help the entrepreneur finance their investment and offer them technical and managerial support. Business angels are wealthy investors who tend to support new start-ups by delivering from $25,000 to $100,000. In some specific cases, they could finance up to 1 million dollars. These investors are looking to support smart and innovative ideas (Bonini et al., 2019; Collewaert, 2012). Thus, to get the support of business angels, medical entrepreneurs must approach them with innovative investments. In return, business angels require a part of start-up equity, and they could be involved in conflict with entrepreneurs when they have different visions.

Venture capitalists could also help finance medical entrepreneurs in the Middle East. These investors are looking for new business ideas with high growth potential in specific sectors such as biotechnology, medical technology, communication,

and technology (Drover et al., 2017; Hellmann & Thiele, 2015). Financing through venture capital requires the medical entrepreneur to give up a specific percentage of its ownership for venture capitalists. Medical entrepreneurs could use this financing source if they passed the "seed phase".

Many medical and nonmedical investments are financed by governments in different Middle East countries, such as the United Arab Emirates, Egypt, and Qatar. They offer subsidies and grants such as R&D grants (Kanniainen & Keuschnigg, 2004). NGOs could also support new medical entrepreneurship projects in developing countries if they have either a social or environmental impact. In general, these financing sources do not require any ownership participation from the medical entrepreneur. In return, the grantors follow the development process of the investment. Additionally, medical entrepreneurs must offer a social contribution to receive this type of financing support.

Recently, crowd-sourced funding has been frequently used in the Middle East region to support new investments. It is a pool of funds (such as Indiegogo) based on small contributions collected from a large number of investors (Cai et al., 2021; Kietzmann, 2017; Lehner, 2013). There are three types of crowdfunding: donation, loans, and convertible loans to equity. The contributors expect quick and high returns. This type of flexible fund could be collected through an internet platform in exchange for high returns or a service/product provided by the entrepreneur. The funds collected through this source could not be sufficient for the medical entrepreneur.

The incubators are well developed in the Middle East region and could help any new medical entrepreneur to develop his/her investment. These accelerators offer a physical place in which medical entrepreneurs can receive all types of financial and technical support (Hallen et al., 2018). The support of incubators could be provided for up to two years, mainly in the technology and biotechnology sectors. If the medical entrepreneur receives any financial support, he/she must provide a percentage of business return or give up for a part of its equity for accelerators. In some cases, incubators could provide up to $25,000 for medical entrepreneurs without asking for any compensation.

In addition to the traditional financing sources, medical entrepreneurs in the Middle East region can finance their investment through the initial coin offering (ICO). The entrepreneur must explain his/her idea to the public through an internet platform, and he/she must ask them to finance the medical investment through cryptocurrencies such as bitcoin (Colombo et al., 2020). ICO is so close to initial public offerings (IPOs) and is employed frequently by medical entrepreneurs who execute their operational activities via blockchain technology.

3 Research Methodology

To explore the employed financial sources and reveal the impact of each funding source on the financial resistance of medical entrepreneurs during the last COVID-19 pandemic period, a structured questionnaire was emailed to medical entrepreneurs

Table 1 Sample distribution

Country	Number of medical entrepreneurs	%
United Arab Emirates	14	22.43
Qatar	11	10.28
Lebanon	8	11.21
Egypt	7	16.82
Bahrain	12	11.21
Jordan	7	7.48
Kuwait	6	8.41
Saudi Arabia	8	12.15
Total	107	100

in Middle Eastern countries during the last quarter of 2021. The data of medical entrepreneurs were collected via entrepreneurship platforms, incubator databases, and start-up reports in Middle Eastern countries. In total, 269 medical entrepreneurs were contacted, and only 107 of them agreed to participate in this research after sending two reminder emails. The sample distribution of this research is presented in Table 1.

The questionnaire was tested through 5 medical entrepreneurs before being distributed. Few modifications were considered after the recommendations of the participants in the pretest round. The questionnaire covers three types of information: demographic information of entrepreneurs, general activity description, and financial information of the new investment.

Three categories of financial variables are employed in this research. The first category includes financial profitability (return on equity and return on investment). The second category includes the liquidity indicators (current ratio and quick ratio). The third category includes the details of funding sources (percentage and nature). The first two categories of financial variables are measured based on a five-point Likert scale ranging from strongly agree to strongly disagree. This subjective method is used to decrease the risk of a low percentage of responses. The third category is measured through multiple-choice and open-ended questions.

Several statistical methods were employed in this chapter to achieve the different objectives. First, descriptive statistics were used to reveal the hierarchy of the financial structure of medical entrepreneurs in Middle Eastern countries. Second, Mann–Whitney tests were employed to compare the financial profitability and liquidity of two subsamples of medical entrepreneurs during the COVID-19 pandemic period. The first subsample includes medical entrepreneurs who are using internal funding sources. The second subsample includes medical entrepreneurs who are using external funding sources.

Furthermore, the sample of medical entrepreneurs using external funding sources was divided into two subsamples to compare the financial profitability and liquidity of those who used loans with those who employed other external funding sources.

4 Empirical Findings

The different characteristics of the medical entrepreneurs' sample are presented in Table 2. Medical entrepreneurship investments in the Middle East are led by a man. Out of 107 medical entrepreneurs, 83.13% are males, and only 16.82% are females. This result can reflect male domination in Middle Eastern countries. Most of the respondents were single (65.42%). This result indicates that being single increases the motivation to create a new medical investment since they do not have any family responsibility. The majority of the respondents (41.12%) were between the ages of 25 and 35. This result shows that in middle age, medical entrepreneurs are more willing to take risks and lead a new start-up. Finally, out of the 107 respondents, 48.60% had between 5 and 10 years of experience. Thus, after 5 years of experience in different fields, medical entrepreneurs are more motivated to create their start-ups.

The results in Table 3 and Fig. 4 show the main funding resource used by medical entrepreneurs in the Middle East. Despite the role of the family as support for youth and older people, the medical entrepreneurs count on bank loans as the main funding source for healthcare investments. Out of 107 medical entrepreneurs, 29.91% used loans from banks and other financial institutions, and only 16.82% of them used the support of family, friends, and fools as the main funding source. On the other hand, 19.63% of medical entrepreneurs used their personnel savings to lead new start-ups. The role of business angels and venture capitalists is limited in funding new medical start-ups since their contributions are 10.28 and 8.41%, respectively.

Table 2 Sample characteristics

Item	Item description	Frequency	Percentage (%)
Gender	Male	89	83.18
	Female	18	16.82
Marital status	Married	23	21.50
	Single	70	65.42
	Other	14	13.08
Age	Less than 25 years old	16	14.95
	Between 25 and 35 years old	44	41.12
	Between 35 and 45 years old	30	28.04
	More than 45 years old	17	15.89
Experience	Less than 5 years	26	24.30
	Between 5 and 10 years	52	48.60
	Above 10 years	29	27.10

Table 3 Main funding sources

Funding source	Frequency	Percentage (%)
Banks and other financial institutions	32	29.91
Personnel savings	21	19.63
Family, friends, and fools	18	16.82
Business angels	11	10.28
Venture capitalists	9	8.41
Incubators	8	7.48
Government	5	4.67
NGOs	3	2.80
Crowdfunding	0	0.00
Initial coin offering (ICO)	0	0.00
Total	107	100

Out of the respondents, 7.48% of medical entrepreneurs received their funding from incubators, and the rest of them (4.67 & 2.80%) created their start-ups based on the support of governments and NGOs. The crowdfunding and initial coin offering (ICO) are not used as funding sources by medical entrepreneurs in the Middle East.

During the COVID-19 pandemic period, medical entrepreneurship projects reached an acceptable level of financial profitability (Table 4). The levels of return on equity and return on investment were 3.3485 and 3.8471, respectively. These results could be explained by the development of medical services' demands by citizens in the Middle East region due to the enhancement of health awareness during the pandemic period. On the other hand, the liquidity ratios were not up to the level of financial profitability. The results in Table 4 show that the averages of the three liquidity ratios are less than 3. Thus, medical entrepreneurs suffered from liquidity problems during the epidemic period.

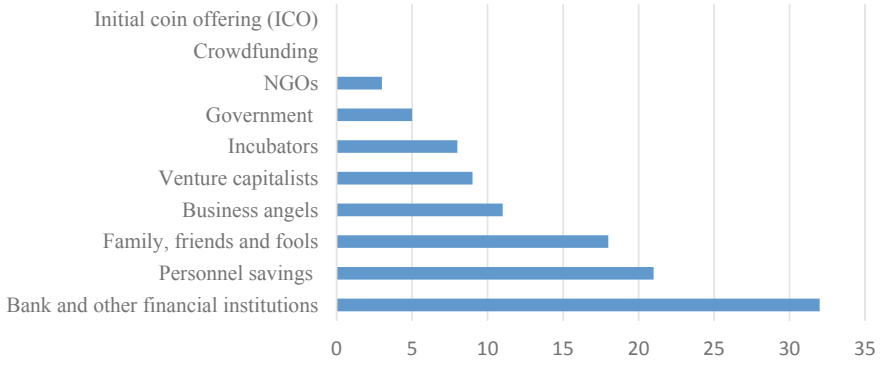

Fig. 4 Funding sources of medical entrepreneurs in the Middle East

Table 4 Financial indicators of medical entrepreneurship during the COVID-19 pandemic period

Financial indicator	Mean	SD
Return on Equity	3.3485	0.6355
Return on investment	3.8471	1.0394
Current ratio	2.8481	1.1351
Quick ratio	2.6948	0.9587
Cash ratio	2.3958	0.9011

Table 5 presents the financial performance (profitability and liquidity) of medical entrepreneurs in the Middle East by considering their funding source. The medical entrepreneurship projects funded by venture capitalists and business angels reached the highest levels of return (greater than 3.5) along with acceptable levels of liquidity (approximately 3). The level of returns realized by medical entrepreneurship investments funded by bank loans and other financial institutions was high (greater than 3), but their financial liquidity levels were low (less than 2.5). The levels of profitability achieved by medical entrepreneurs using their personnel savings and close networks were in fourth and fifth place, respectively, followed by other funding sources, namely, incubators, NGOs, and government. On the second hand, the levels of liquidity were acceptable when the medical entrepreneurs used their personnel savings and their close network to fund their investments, but the liquidity levels decreased when the medical start-ups were funded by incubators, NGOs, and the government.

Table 5 Financial indicators per funding source during the COVID-19 pandemic period

Funding source	Frequency	Return on Equity	Return on investment	Current ratio	Quick ratio	Cash ratio
Bank and other financial institutions	32	3.5921	3.5011	2.4512	2.3941	2.0117
Personnel savings	21	3.0381	3.0491	2.9991	2.9991	2.5752
Family, friends, and fools	18	2.9364	2.8501	2.9585	2.8595	2.7704
Business angels	11	3.5937	3.5241	3.1590	2.9491	3.0614
Venture capitalists	9	3.6575	3.5061	3.0033	2.9064	2.7471
Incubators	8	2.8565	2.7642	2.4954	2.4481	2.1453
Government	5	2.5382	2.6631	2.5010	2.5403	2.1187
NGOs	3	2.8504	2.7305	2.4837	2.5091	2.3494

The Mann–Whitney U test was employed in this chapter to compare the financial profitability and liquidity of medical entrepreneurship investments in the Middle East based on their funding sources. This statistical method can compare two different samples without having any constraint associated with the distribution of data. If the Z score is greater than the absolute value of 1.96 and p is less than 0.05, then the difference in the mean is significant.

4.1 Comparison of Financial Performance Between Medical Entrepreneurship Investments Based on Internal and External Funding Sources

First, the sample of medical entrepreneurs was divided into two subsamples. The first sample consists of 21 medical entrepreneurs, while the second subsample includes the remaining medical entrepreneurs (86).

The results presented in Table 6 show that both return on equity and return on investment were higher when medical entrepreneurs used external funding sources. The average values of return on equity and return on investment of medical entrepreneurship projects funded by external sources (3.2224 & 3.1462) are greater than those of medical entrepreneurship projects funded by internal sources (3.0381 & 3.0491). On the second hand, the level of liquidity in the case of employment of external funding sources is much lower than the level of liquidity in the case of using internal funding sources. The levels of current, quick, and cash ratios of medical entrepreneurship projects funded by external sources (3.0191 & 2.9991 & 2.5752) are less than those of medical entrepreneurship projects funded by internal sources (2.6874 & 2.5715 & 2.5001).

These results indicate that the presence of external parties in medical entrepreneurship projects had a positive impact on their financial performance; however, their contributions to start-up activities had a negative impact on financial liquidity during the COVID-19 pandemic period.

Table 6 Comparison between internal and external funding sources during the COVID-19 pandemic period

	Internal funding source		External funding source		Z value	AM
Name of the indicator	Mean	N	Mean	N		
Return on Equity	3.0381	21	3.2224	86	−4.3456	0.0000 (***)
Return on investment	3.0491	21	3.1462	86	−3.3246	0.0000 (***)
Current ratio	3.0191	21	2.6874	86	−4.3663	0.0000 (***)
Quick ratio	2.9991	21	2.5715	86	−3.5521	0.0001 (***)
Cash ratio	2.5752	21	2.5001	86	−3.5999	0.0003 (***)

4.2 Comparison of Financial Performance Between Medical Entrepreneurship Investments Based on External Funding Sources

In this section, the sample of 86 medical entrepreneurship projects funded by external sources is divided into three different subsamples. The first subsample includes 32 medical entrepreneurship projects funded by loans. The second subsample includes 46 medical entrepreneurship projects funded by new equity, namely, family, friends, business angels, venture capitalists, and incubators. The last subsample consists of 8 medical entrepreneurship projects funded by grants through governments and NGOs.

Table 7 shows that the entrepreneurship projects funded through banks and other financial institutions reached a higher level of performance than entrepreneurship projects funded through new shareholders. Both return on equity and return on investment of medical entrepreneurship projects funded by financial institutions (3.5921 & 3.5011) were higher than medical entrepreneurship projects funded by new equity (3.1594 & 3.0435). Second, the existence of bank loans exerted pressure on the liquidity of medical entrepreneurs during the COVID-19 pandemic period. All the liquidity ratios of medical entrepreneurship projects funded by equity (2.8669 & 2.7724 & 2.6125) showed higher means than those of medical entrepreneurship projects funded by loans (2.4512 & 2.3941 & 2.0117).

Table 8 shows the comparison between medical entrepreneurship projects funded by grants and the equity-based method. The results show that both profitability and liquidity ratios were higher in medical entrepreneurship projects funded by equity-based methods than in medical entrepreneurship projects funded by governments and NGOs. All profitability and liquidity ratios in Table 8 are higher in medical entrepreneurship projects funded by family, friends, business angels, venture capitalists, and incubators than in medical entrepreneurship projects funded by grants.

Finally, (Table 9) shows the comparison between medical entrepreneurship projects funded by grants and medical entrepreneurship projects funded by grant

Table 7 Comparison between loans and equity-based funding sources during the COVID-19 pandemic period

	Bank and other financial institutions		Equity funding sources		Z value	AM
Name of the indicator	Mean	N	Mean	N		
Return on Equity	3.5921	32	3.1594	46	−3.5482	0.0001 (***)
Return on investment	3.5011	32	3.0435	46	−3.4662	0.0000 (***)
Current ratio	2.4512	32	2.8669	46	−3.8762	0.0000 (***)
Quick ratio	2.3941	32	2.7724	46	−3.4234	0.0000 (***)
Cash ratio	2.0117	32	2.6125	46	−3.7271	0.0000 (***)

Table 8 Comparison between grants and equity-based funding sources during the COVID-19 pandemic period

	Government and NGOs		Equity funding sources		Z value	AM
Name of the indicator	Mean	N	Mean	N		
Return on Equity	2.6521	8	3.1594	46	−2.4328	0.0000 (***)
Return on investment	2.6842	8	3.0435	46	−4.2384	0.0000 (***)
Current ratio	2.4950	8	2.8669	46	−2.8762	0.0001 (***)
Quick ratio	2.5218	8	2.7724	46	−4.1618	0.0000 (***)
Cash ratio	2.2057	8	2.6125	46	−3.2726	0.0002 (***)

Table 9 Comparison between loan and grant funding sources during the COVID-19 pandemic period

	Bank and other financial institutions		Government and NGOs		Z value	AM
Name of the indicator	Mean	N	Mean	N		
Return on Equity	3.5921	32	2.6521	8	−2.8481	0.0001 (***)
Return on investment	3.5011	32	2.6842	8	−2.9669	0.0000 (***)
Current ratio	2.4512	32	2.4950	8	−3.0760	0.0001 (***)
Quick ratio	2.3941	32	2.5218	8	−2.9945	0.0000 (***)
Cash ratio	2.0117	32	2.2057	8	−3.5216	0.0001 (***)

loans. The results reveal that both return on equity and return on investment (3.5921 & 3.5011) were higher than those of medical entrepreneurship projects funded by grants (2.6521 & 2.6842). On the other hand, the current, quick, and cash ratios were lower in medical entrepreneurship projects funded by loans (2.4512 & 2.3941 & 2.0117) than in medical entrepreneurship projects funded by grants (2.4950 & 2.5218 & 2.2057).

5 Discussion and Conclusion

This research aims to explore the different funding sources used by medical entrepreneurs and their impact on financial performance in the Middle East during the last COVID-19 pandemic period. In addition, this research aims to offer a complete

guide for medical entrepreneurs showing the different available funding sources and their advantages and disadvantages.

The results of this research reveal that medical entrepreneurship projects funded by external sources showed higher profitability and lower liquidity than medical entrepreneurship projects funded by internal sources. For external funding sources, medical entrepreneurship funded by loans from financial institutions showed a higher level of profitability, followed by medical start-ups funded by equity-based methods and grant-based methods. In addition, the results reveal that the medical entrepreneurs suffered from liquidity pressures when they employed loans from financial institutions as a funding source. The start-ups funded by the equity-based method showed the lowest level of liquidity pressure on medical entrepreneurs.

Thus, the results of the research could be used by medical entrepreneurs in Middle Eastern countries as a guide to lead their new investment in the healthcare sector. First, they must know that there are several new funding methods, such as crowdfunding and bitcoin funding (ICO) that can be employed to create their new investments.

Second, medical entrepreneurs must be aware of the negative impact of loans on the liquidity of their investments during the crisis period. Thus, using the traditional loan method as a funding source to avoid capital dilution could lead to dramatic financial results.

Third, the level of projects funded by business angels and venture capitalists is relatively low compared with the other funding methods. Thus, medical entrepreneurs in the Middle East region have to develop their connections and propose their projects to the network of business angels and other investors.

Moreover, the results of this research make additional contributions by enriching the financial and capital structure theories. The results reveal that the capital structure of medical entrepreneurship investment has a direct impact on its financial profitability and liquidity.

Medical entrepreneurs in the Middle East region are more willing to select bank loans as a main source of funding despite their negative impacts on the liquidity of healthcare investments. Thus, these results do not confirm the pecking order theory, in which personnel saving and retained earnings appear as a first funding choice.

In the same line of several theories, such as agency theory and cash flow theory (Jensen, 1986; Jensen & Meckling, 1976; Stulz, 1990), medical entrepreneurship projects funded by loans have the highest positive impact on profitability.

Finally, this study has several limitations that must be pointed out. First, the sample size is limited and based on 8 countries from the Middle East. Second, the financial variables employed in this research are subjective and do not reflect an accurate presentation of the financial situation of medical entrepreneurship investments. Third, this study was limited to studying the relationship between capital structure and financial performance without considering other variables, such as entrepreneurs' characteristics.

All the above limits call for further research based on a larger sample size and objective measurement of financial performance. In addition, other variables could be employed in future research, such as that of medical entrepreneurs' age, risk behavior, lifestyle, and family status.

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Chapter 8
Funding Sources for Medical Entrepreneurship in the Digital Age (African Perspective)

Badaru Abiola Abdul-Basit

1 Introduction

In Nigeria, just an insufficient number of 40,000 doctors are left to attend to its larger population of 200 million citizens in 2020. The World Health Organization has revealed that the ratio between African patients and medical doctors is 1 doctor to 5,000 patients, which is nothing to write home about. It is noted that patients wait hours for services, which may not commensurate with their health needs. Medical apparatus needed to treat patients in dire need of attention are not available and where necessary to procure are found to be very expensive. Only government and highly grown entrepreneurs who have secured a large amount of money through various sources of funds are found acquiring medical equipment (Nigerian Medical Association, 2019). It is noted that there has been an increase in the rate of mortality in African countries (Nicolas et al., 2020). These and many other related reasons have made African entrepreneurs look into the direction of investing in Medical Entrepreneurship. In view of the imperative, it is wise for entrepreneurs to source funds in this digital age to creatively invest and explore investment opportunities in the medical area to amend the insufficiency in African medical ventures for the dual benefits of self and society. Entrepreneurs may invest in different areas of medical entrepreneurship, such as hospitals and clinics, pharmaceutical companies, pharmacy stores, diagnostic centers and laboratories, medical courier services, medical writing services, medical waste disposal services, medical tourism, medical consultancy, medical colleges, nursing colleges, paramedical or allied colleges, dental services, eye specialists, VIP weight loss clinics, etc. (Hewitt-Dundas, 2021).

At threshold, a medical entrepreneur is any healthcare professional or worker who is conscious of the challenges and tasks, wants and needs, tastes and preferences, changes and gaps in the health sector and is able to connect entrepreneurially

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with these market opportunities to offer pertinent advancement in health-oriented products, services, technologies, and other medical solutions for double bottom line (personal profit and social impact) (Steven, 2018). The concept of medical entrepreneurship (ME) is better explained by the Nigerian Medical Association (2019) as the ability of health professionals, specialists, or workers to create new business opportunities in the medical or health profession in response to the yawning needs tastes, demands, and changes in the areas of medicine, biotechnology, healthcare services, information and communication technology (ICT), medical inventions, and societal entrepreneurship across the globe. ME assists in sustaining, growing and developing the functionality, quality, and performance of the healthcare system of a country while making a double bottom line (Wellness for the patient and Profit for the ME). Medical entrepreneurship includes various professions, such as healthcare entrepreneurship, public health entrepreneurship, and digital health entrepreneurship. Modern technologies and innovations in ICT that ME uses as pillars enable fast and effective delivery of medical services to patients within the fastest hours and across countries (Eniola & Entebang, 2021).

It is, however, pertinent for African medical entrepreneurs to first and most importantly consider where their funds will be sourced and what type of fund will be needed for a particular business venture (Piesse & Thirtle, 2022). Funds are basically money set aside for a certain purpose. People use funds for many purposes: students use funds to procure writing materials amidst many other things; patients use funds to procure treatment for themselves; and entrepreneurs use funds to innovate and invent ideas and innovations. Therefore, many people need funds for various divergent reasons. Whatever the reasons, sources from which these funds are generated must be given due attention, as they remain a great factor upon which the survival and death of medical entrepreneurship stands.

The fund is to different people different things and serves different purposes to different people. Funds can be categorized into different types. Julia (2021) identified the following types of funds:

Emergency funds are money set aside for hardships, crisis, or major expenses; **college funds** are money set aside for children's school or institution expenses; r**etirement funds** are money set aside for retirement from active work; m**utual funds** are investment money allocated into stocks, bonds, and/or other assets; m**oney-market funds** are short-term interest funds from investors; h**edge funds** are investment designed to increase the return on investors' pooled funds; e**xchange-traded funds** (ETFs) are mutual funds traded on public exchanges; g**overnment bond funds** are for investors looking to put their money away in low-risk investments through Treasury securities; d**ebt-service funds** are allocated to repay the government's debt; c**apital projects fund** resources are used to finance the capital projects of a country; p**ermanent funds** are investments and other resources that the government is not allowed to cash out or spend.

1.1 Methodology/Approach

Ex-post facto research is adopted to gain an exploratory insight into the sources of funds for medical entrepreneurship. This paper also uses descriptive research to describe how funds are currently sourced in selected African countries. Based on a purposive research sampling technique, a selection of six richest African countries are studied, and inferences are thereafter drawn for the general study on African continents. The six African countries selected are Nigeria, South Africa, Egypt, Algeria, Morocco, and Kenya. In line with the extant literature between 2018 and 2022, the countries are selected and studied to reveal the latest findings on the various sources of medical entrepreneurship open to African countries. To forestall bias in the selection of articles, the author conducted a search on Google Scholar for academic publications on the sources of medical finance in each of the aforementioned countries. From over 100 publications generated by Google chrome, a sample of 12 relevant publications that focus on sources of medical financing was selected from the stated periods. Other publications with heterogeneous findings and that are not specifically on the selected six countries were also systematically reviewed and synthesized as integrated findings, which provide rich information on the trends in financing programs for MSMEs and associated challenges in Nigeria.

2 Conceptual and Theoretical Issues

2.1 Sources of Funds for Medical Entrepreneurship (ME) in the Digital Age

The overall amount of finance sourced for investments matters for an entrepreneurship's development, but which entrepreneurs have access to funds and which ones do not is just as important as which countries in Africa do or do not have access to funds in the growing digital economy (Chen & Chen, 2021). Most resource exchanges in ME are by nature exclusive to some entrepreneurs and not open to all. From an entrepreneur's viewpoint, his or her linkages are significant for acquiring financing, contracts, and information, leading to an enhancement in the performance of businesses (Jane, et al., 2019).

It is unsurprising, then, that entrepreneurs in our review who were independently wealthy or who had relationships able to support their entrepreneurial efforts had better chances and think less of external sources of funding their businesses. However, it is a well-known fact that the distribution of resources in any country in Africa is necessarily uneven. However, what determines ME's sustainability to productive entrepreneurship is the degree to which funds are made available for new and creative businesses rather than existing and nonproductive businesses that are only in business for personal gains or exploitation (Ben & Harrison, 2018; Stam & Spigel, 2018).

Raising funds is a very important aspect of any entrepreneurial adventure. While many entrepreneurs rely on the traditional styles of sourcing for funds, many others adopt the new methods of innovation competition. Innovation competitions broadly include any initiative where in-kind support or prize money is delivered to ventures or teams as part of a competitive and relatively short-lived process (one night to a few months), such as, business plan competitions, pitching and demo nights, hackathons, bootcamps, and the like (Wout, 2020; Chen & Chen, 2021). Both methods are applicable to early stage start-ups, and most importantly fast-growth mature companies, in African Medical Entrepreneurship. The summary of the different sources of finance opened to medical entrepreneurs in Africa are as follows:

1. **Grant funding:** Grant means to give or award money. Grant funding is a type of money given by a government, an organization, or an individual for a specific purpose. The granting organization or individual could be an international, national, or even domestic entity (Ross et al., 2019). Naturally, organizations or individuals awarding grants will put out a call for applications, inviting interested entrepreneurs to pitch their ideas. A judging board narrows down the field to finalists, and the winners are chosen from there and subsequently given the grant (Eisenhardt & Martin, 2020).

2. **Personal savings, family, and friends:** It might be valuable to try raising funds within oneself, networks of family, friends, and fools before approaching certified investors. These cliques of people are closer to you and mainly invest because they have confidence in your idea. As they are not expert investors, you should not expect an expert assessment of your business strategy with them (Owusu, 2019). This source of financing is often followed to cover the costs of setting up a start-up or bridging some identified gaps in the business. Mostly, the amounts concerned with this source of funds are not exorbitant and are typically repaid as a loan (with or without interest) or are invested in interchange for a quota of the business equity share (Keasey & Watson, 2019).

3. **Debt financing (the bank):** In simple terms, debt financing is described as a collection of loans from commercial banks with the assurance to refund the actual money with accrued interest during an agreed period of time. It is best suited for mature start-ups that maintain stability in their cash flows. Debt financing comes from commercial banks, online and mobile lenders, peer-to-peer crowdfunding, investors, financial institutions, microfinance institutions, and many other entities (Chandler, 2020). The two types of debt financing are secured loans, which are financing mechanisms in which the entrepreneur bargains some asset as collateral to reduce the risks involved in payback. The collateral bargained could be a car, landed property's document (Certificate of Occupancy), or debenture over assets, etc., and unsecured loans that do not have any protection for the investor and therefore have higher interest rates.

4. **Equity investments:** Equity financing occurs when an investor places money into a start-up in exchange for a quota of the company's shares, which invariably turns him or her an owner of the business. Equity investment differs in amount, depending on the entrepreneur's wants. It comprises everything from little injections of money from self, family, and friends to big companies that run into billions of Naira. Business plans that have strong financial models for growth projections, competitor analysis,

marketing, etc., are prerequisites necessary for receiving equity investment (Nason & Wiklund, 2018).

5. **Mezzanine financing:** Mezzanine is a mixture of equity and debt financing because it protects investors from certain dangers connected with pure equity investment and debt financing while still providing benefits if a business becomes extremely successful. It includes subordinated debt, convertible notes, and equity kickers. These are regularly united into a single financing facility for investors to negotiate between equity and debt finance (Chen & Chen, 2021). Convertible notes or debts are fairly popular in Kenya's early stage start-ups. Aside from the fact that both the investors and entrepreneurs will benefit when an institutional investor comes in, there are several reasons investors and entrepreneurs issue convertible notes instead of debt or equity. For investors, convertible notes empower investors to protect issued debt in case the money is used in a fraudulent way. This is typically referred to by entrepreneurs in Kenya as the "*Compreneur*" (where early stage start-ups enter business in searches for available funders just to fraud them) (Chandler, 2020).

6. **Angels/Informal investors:** Angel or informal investors are described as qualified entrepreneurs who have some funds from previously exited businesses and equally want the business of entrepreneurs to succeed and invest those funds into others' businesses (Eniola & Entebang, 2021). Mostly, funds collected from angel investors are used as seed capital for start-ups. Angels give not only money but also a network of opportunities, mentorship, professional expertise, etc., just so that the entrepreneurial businesses succeed (Ross et al., 2019). Angels are found almost everywhere, especially on platforms such as Crunch base and f6s Angel List. Entrepreneurs therefore needs to search for angel investors that best suit his/her business in terms of field of expertise and experience, amount of money needed, etc. (Filbeck & Krueger, 2020).

7. Crowdfunding: In crowdfunding, the mass or crowd funds the entrepreneur. Crowdfunding is done via the digital space where entrepreneurs pitch his/her business ideas and interested mass or crowd of people in the cyber space who are convinced about the idea subscribe to dolling out money for the business (Owusu, 2019). Crowdfunding is performed on digital platforms such as Dutch crowdfunding and one-planet crowd platforms. Generally, there are three types of crowdfunding: Loans crowdfunding, which is meant for those whose risk profile is too high and who also have trouble securing loans from commercial banks; Preorders/Donations crowdfunding, which is meant for those who cannot finance their good business idea but who want to test the product or market suitability of the idea with the larger populace; and Convertible loans, which do not issue shares and whose valuation discussion is withheld until the value of the business is known.

8. **Venture capital/Private equity:** Expert investors that only invest in businesses that are privately listed are known as private equity. Venture capital, on the other hand, is an aspect of private equity that deals with investing in early stage start-ups with high risk (Nason & Wiklund, 2018). The term private equity comes to being when investing in matured businesses that have longer years of existence. This source of finance is meant for giant businesses that are already internationalized, with the highest expectation of funds ranging from billions of naira to trillions. On the other

hand, venture capital comes to being when investing in early stage start-ups for the growth of the business. Businesses under this category are mostly locals (Keasey & Watson, 2019). They usually receive start-up funds between the ranges of thousands of naira to millions, which are spread across different risk profile portfolios with the aim of selling the shares after some years for profit.

9. **Revenue-based financing:** This source of funds is better explained as a funding system where investors provide funds for the entrepreneur and subsequently collect some agreed percentage of the entrepreneur's income from the business. The agreed percentage to be received from the entrepreneur's income is usually coated at two to three times the amount of the initial funding (Ross et al., 2019). This type of funding is naturally obtainable at the early stage of the business with the benefit of the founder retaining its ownership. This source of funds gives the entrepreneur the rest of mind, as he knows that there is no personal guarantee involved in the case of the high-risk nature of start-ups. This source of financing is the traditional style of sourcing for funds, as it gives entrepreneurs the opportunity to grow, develop, and become well-known. It is flexible in the sense that the reduction in the income of the business automatically leads to a reduction in the percentage to be collected by the investor and vice versa (Eisenhardt & Martin, 2020).

2.2 Theory of Resource-Based View

The resource-based view (RBV) theory proposes that there are unlimited sources of opportunity for medical entrepreneurs. It reveals that entrepreneur creativity is limited as a result of the lack of financing, human, firm resources and capability (Eniola & Entebang, 2020; Hewitt-Dundas, 2021). Using resource-based theory, Eisenhardt and Martin (2020) demonstrate the importance of entrepreneurs' decisions on financial capital. Similarly, Cortina and Didier (2019) use resource-based theory to show that an organization with a high degree of long-term finance is more effective than those with a low degree of long-term financing. The source of financial capital to purchase fixed and current assets is important in keeping up and maintaining the competitive advantage of a company. Williamson (2019) suggests that both dimensions of an organization should be closely connected to each other. Nason and Wiklund (2018) apply the resource-based approach for results on the growth of the business complemented theorem. Their research is largely fixated on universal initiatives; they develop new organizational agendas to control development and how tactical change finishes with institutional progress. The decision to finance was considered a significant component in small and medium-sized enterprises' (SMEs) success and development. Decisions on availability of funding are strongly and completely related to dynamism and creativity in entrepreneurship (Sharon & Arlen, 2020). Moreover, the existing firms to leverage the opportunities for growth and innovation and to achieve greater stability are motivated by financing. Companies can also firmly attain a progressively proficient, productive asset portfolio with

Table 1 Medical entrepreneurship sources of funds in Africa

S/N	Author and Date	Country	Findings on Sources of financing
1	Hachimi et al. (2018)	Morocco	Bank loans, capital and debt market, participatory banking, Islamic finance
2	Fasseeh et al. (2021)	Egypt	Regional health financing, government spending, private agent
3	Dutta et al. (2018)	Kenya	Donor government, multilateral organizations, development partners' funding
4	Sakhri, S. (2018)	Algeria	Venture capital, subsidies, grants, donations, and legacies
5	Beck, T. & Cull, R. (2019)	South Africa	Crowdfunding, mezzanine financing, equity
6	Nigeria Medical Association (2019)	Nigeria	Personal savings, relatives and friends, angels investors, partners, investment clubs, banks, venture capitalists

financing infrastructure and are also able to select increasingly productive organizational systems such as incorporation (Beck & Cull, 2019). The remoteness of financial means is a significant hindrance to SMEs' advancement, not least as it hinders them from purchasing new technologies, which would make them more competitive and increasingly industrious. Moreover, Wiklund and Shepherd (2020) claimed that financial decision-making is a significant asset for corporate success, and quantitative research has shown that small businesses have better performance as they are externally affected by financial facilities that are open to enterprises. In growing and financing new entrepreneurial activities, a company utilizes both debt and equity financial resources to produce income and furthermore give preprints insurance. Hence, new innovation often requires workers' technical expertise, whereas the expected cash flow (source of financing) is a part of the small and medium-sized companies, where owners, managers, and employees could and should use this to create the company and grow it (Table 1).

3 Key Entrepreneurial Challenges

A major criticism across all MEs was that the traditional styles of sourcing for funds, such as bank loans and government grants, are unobtainable or exclusively insufficient to be accessed by digital businesses and involve a series of unproductive bureaucracies Julia (2021). The huge populace of MEs whose businesses had reached the zenith of financial stability had wholly and unilaterally realized this by reinvesting most of their funds while trusting on no or very minor quantities of outside funds to

sustain their businesses. Series of ancient support programs by the government agencies for medium, small, and micro business enterprises (MSMEs) have often required one physical asset as collateral or the other and at least must fulfill a condition for eligibility of four to six years of existence or experience, as the case may be with two to three guarantors who must maintain current accounts with approved financial institutions (Eniola & Entebang, 2021). Many entrepreneurs from Africa (e.g., Nigeria, Algeria, Morocco, and Kenya) perceived their governments as deliberately attempting to cuckold them of basic supporting systems. These entrepreneurs pointed to proof such as inadequate business grants, exorbitant taxes, unobtainable licenses, or government shenanigan styles that privilege international ventures at the detriment of local businesses called competition entrepreneurs or *compreneurs*. Participants in Kenya used this term to refer to mostly young and inexperienced entrepreneurs with a technological background who participate in innovation competitions to win prize money and recognition but without showing any commitment to developing a digital venture (Eniola & Entebang, 2021). In 2015, in Morocco, more than 7,700 businesses went bankrupt (Wout, 2020). This figure keeps on growing every year by 15%. This is due not only to the coolness of orthodox banks to finance medical entrepreneurship because of information irregularity but also to economic reasons and the delays in payment deadlines chosen for by the ME.

4 Findings/Result/Insights

From the exploratory and descriptive research conducted, this study found that the sources of medical entrepreneurship in Africa revolve around traditional and innovation competition financing such as loans from commercial and microfinance banks, development financial institutions intervention grants from government agencies, pension fund assets, sovereign wealth funds, venture capitalists, and business plan/innovation competitions, which include personal savings, cooperatives, funds from friends, families, and fools, business angel financing, crowdfunding or crowd equity, Islamic finance, etc. The sources of medical entrepreneurship in Africa are depicted in Fig. 1.

5 Summary, Conclusion, and Recommendations

Sourcing for funds is inevitable, as there are many sources of funds available for medical entrepreneurship in this digital age depending on the situation and venture stage. Despite the sources of funds mentioned, it is still noted that there are still several sources of funds available for medical entrepreneurship, which could not be totally captured in this paper. Further research on the subject will reveal many other sources of funds. However, one or two of these sources of funds mentioned will definitely be suitable for any entrepreneurial business in African countries.

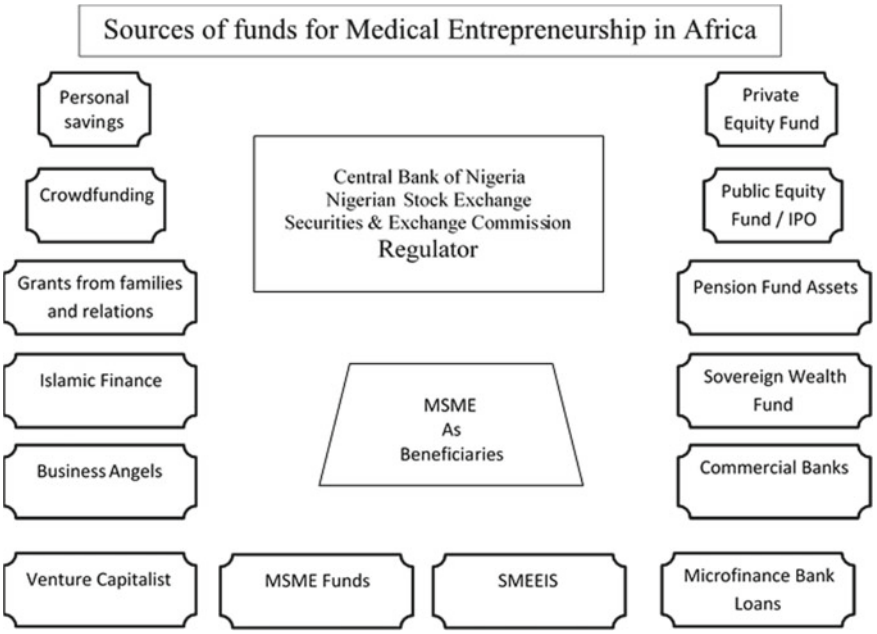

Fig. 1 Sources of funds for medical entrepreneurship in Africa 2019 (*Source* Adapted from Raimi & Uzodinma [2019])

In view of the imperatives, it is wise for entrepreneurs to fill the gap in government recognition to support entrepreneurs, as support varies strongly across African countries. Entrepreneurs in African countries such as South Africa and Kenya receive better supporting resources such as reduction of taxes, benefits of targeted funding, simplicity in registration, and licensing without much bottleneck, etc., from their governments compared to other African countries.

This paper has advanced knowledge in presenting sources of funds available for African medical entrepreneurship in the digital age, taking into consideration traditional styles of sourcing for funds and innovation competitions.

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Chapter 9
Future Health Care and Medical Entrepreneurship in the Age of Pandemic

Muhammad Usman Tariq

1 Introduction

Artificial intelligence is playing a significant role in the creation of these mRNA vaccines. Humans are now at the edge of the great understanding of genetic code as well as artificial intelligence. Other developed solutions involved the at-home COVID-19 test for the initial detection of fever or other symptoms. These technologies will escort in a new age of innovation in biology, both resolving current medical issues and preparing completely new organisms. The entrepreneurial business that offers business intelligence and information to patients using mobile applications has been at the front of the long-term shift in health care. Another change that will most likely be sustained postpandemic is the shift to preventive care instead of reactive care. It is predicted that there will be more general solutions at scale, including curated content, artificial intelligence triage, telehealth, remote point-of-care diagnostic solutions, and telemedicine. There is little uncertainty that 2020 marked the start of a permanent and massive shift in how people experience and interact during health care. Future health care will be more personalized, take advantage of Artificial Intelligence, and emphasize preventive care with the help of providers and consumers (Davulis et al., 2021) (Fig. 1).

The impacts of the COVID-19 pandemic globally are striking, as it significantly affects many countries' economic, political, social, and healthcare elements. The number of this pandemic measured with human suffering and life, the psychological impact, and the economic strike involve strong reasons to explain experiences into actionable lessons to mitigate future crises and enhance the whole field of population health and medical care delivery. It is the third coronavirus occurrence of global concern twenty years after severe acute respiratory syndrome (SARS-CoV) and Middle East respiratory syndrome (MERS-CoV), in addition to other viral epidemics,

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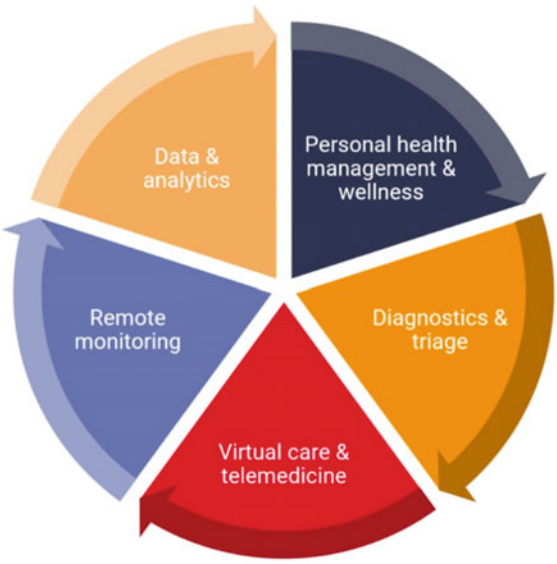

Fig. 1 Healthcare Management

for example, Ebola and Zika virus, in the last decade. It becomes evident that contagious disease should be considered among the most significant health risks that we will require to continue dealing with in the near future. Therefore, the conversion of several aspects at the governmental, individual, and societal levels seems unavoidable. The COVID-19 pandemic has become a reality check for many domains of medical care systems, particularly regarding their entire preparedness. Public health observation programs and accessible infrastructures were shown to be not persistently optimal (Duplaga & Grysztar, 2021).

Furthermore, healthcare systems seemed incapable of absorbing and managing persistent and sudden pressures on their workload, particularly in the settings of extreme care. Although exigency plans were mainly in place, medical care systems appeared incapable of handling an intense and sudden surge in demand. From a policy vision, possible delays in pledging to significant decisions, such as lockdown measures, may suggestively affect downstream healthcare results in a timely epidemiologic fashion. The latter is essential, as healthcare issues in one country should be considered an internal and possibly global challenge for contagious diseases. Eventually, the speed at which a global public health problem converted into an economic downturn impacting various industrial sectors was underrated. The COVID-19 pandemic functions as a transformation catalyst, amplifying the application and adoption of changes in public health involvements. Therefore, the latest medical care delivery model focuses more on preventive measures, substantial technological dependency, and remote care. These are contrasted against continuing technical issues to meet the surge capacity in lab testing, the accelerated implementation of latest technologies, the psychological health concerns, the ethical concerns on the possible rationing of inadequate resources, and the protection of personal data

and privacy in the crisis times. Considering the former, the following features seem likely to arise as most affected post-COVID-19 times (Friebe, 2020).

1.1 Deviating Number of Patients to Remote Care

Telehealth and remote care services were previously utilized in crises, routine care, and emergencies. In the COVID-19 pandemic, their more extensive usage has increased. Telehealth services have now been used in significant patient screening before their visit and triage examination, in the routine check-up of patients at home, for remote clinical meetings, or for administering patient care by off-site experts. A substantial portion of some services may remain telehealth-based postpandemic, for example, the remote management and monitoring of vast numbers of patients, as it offers higher convenience and enhances patient-centered care, partially addressing the medical care system capacity and flow rate challenges. COVID-19 became a stimulant for implementing online e-health and therapy tools in regular practice in psychological health care, following more than twenty years of many excellent and mostly failed attempts. Essentials dominate the field; for example, the patient/clinician therapeutic alliance can only be established in person, despite research depicting the opposite being fixed. It is possible that once psychological healthcare institutes have based the abilities post-COVID-19 of serving their patients using various digital technologies, they have little reason to give all these up, in perspective of the benefits they have experienced in the extended time of crisis response. A future "blended approach" may arise, where e-mental health solutions employ a more significant part of regular services (Albrychiewicz-Słocińska, 2021).

Furthermore, the presently developed knowledge can expand the broader public e-mental health approach, using directed and entirely self-directed involvements, such as self-help applications or online therapeutic modules. The latter could also be verified and ultimately implemented in countries and settings with threatened mental health resources, where such requirements have been identified previously as a positive postpandemic long-term outcome. System development can support the gradual adoption of other latest technologies, such as drones as delivery vehicles for crucial supplies, the extensive 3D printing of healthcare relevant items, robotics, and smartphone-enabled monitoring of patient observance (Zainal et al., 2021).

1.2 Enhanced Focus on Data Analysis and Surveillance Systems

The speed by which SARS-CoV-2 spreads globally calls attention to once more that the requirement for dependable and representative surveillance systems for contagious diseases remains as critical as ever. Public health surveillance of infectious

illnesses uses testified positive outcomes from laboratory networks or sentinel clinical labs to survey the existence of particular microbial agents that involve a risk to public health in a given population. The ongoing rationalization of public health expenses has led to the alliance of various clinical microbiology labs, including a switch to laboratory consolidation. By this amalgamation activity, an operational framework appeared with large centralized clinical labs dealing locally only with crucial assessments. It would be enlightening to observe whether this reduction in the number of small clinical labs and the collection of the remaining ones constrained or were unable to spot epidemiologic changes regarding COVID-19. Therefore, the routine of artificial intelligence and big data approaches to model crises and recognize and comprehend the weaknesses of previous systems would be essential to support previous frameworks. Smartphone-enabled technologies can now be deployed simultaneously to monitor quarantined patients and accurately track exposed people within countries or regions. These are new tools to move further into the public health domain and back recognition in a unified and hypercomplex environment. The requirement of global collaboration and information sharing between experienced healthcare authorities during the crisis has been emphasized previously. The quick deployment of expert teams on the ground can be further strengthened postpandemic (Aashima et al., 2021).

Any such deviations would require a greater public awareness of the health systems, new and better tools, and their possible execution to fight contagious pandemic outbreaks. As a result, behavioral science and social media collaboration can be utilized broadly for health education, promotion, and mass communications. The pandemic has also emphasized that poor health knowledge among the general population is an underrated public health issue globally. Enhancing public health knowledge is now necessary, as it might support people in understanding the reasons behind the recommendations and reflect on the results of their several possible actions, particularly in the context of resource-restricted environments (He et al., 2021).

1.3 Progress of Political, Legislative, and Healthcare Management Systems

Although the COVID-19 pandemic augmented many of the above procedures, there remain issues, for example, licensing, credentialing, reimbursement, technology, litigation, privacy, and safety. More particularly, in the ethical domain and from an individual outlook, the assortment and accessibility of extensive amounts of information related to people using geo-tagged social networks make complete data anonymization inefficient in safeguarding the identity of the data source, making it more challenging, still feasible using advanced systems and triangulation, to reclassify individuals. Consequently, the ethical directions of transparency concerning the hazards of downstream data linkage and unintentional individual identification

should be defended. For example, the ethical transparency imperative regarding the threats of downstream data linkage and unintended personal identification should be supported. Considering the population-level viewpoint, if systems are developed to be ultimately dependent on anonymous data to safeguard contributors, they might not work correctly, either, as the fact of information reliability and, hence, it might affect transparency. Anonymous information is the current best practice in humanitarian emergencies and contagious disease outbreaks but cannot be measured as an ethical solution. It should be distinguished that public health ethics vary from clinical ethics in that it needs to prioritize promoting the common good over safeguarding individual autonomy. The ethical contrast becomes even more significant in resource-restricted settings during public health emergencies, where dazed healthcare systems may initiate the regulation of staff and medical supplies, with stressful decision-making, for example, who gets life support. One of the essential features of the current global pandemic was the exceptional information levels, intrigue theories, and rumors reproduced by social media and relevant to COVID-19; these can only be counterproductive in the fight against the current global pandemic, both in the long and short run. This may be the result of the worldwide pandemic during the age of social media (Braune et al., 2021).

The World Health Organization responded to the infodemic making a statement and overturning various such measures promoted online and in social media, which are not efficient in treating COVID-19 and have done so consistently. Social media platforms have responded to most social media posts rated falsely by analysers by eliminating them or attaching different warnings. Although the number of English-language analysers rose more than 900% from January to March, outperforming the accessible fact-checking resources, misrepresentation has almost undoubtedly grown even faster. Constancy in public health messaging and increased funding dedicated to fast checking seems to be required as the immediate first step. It appears to be foreseeable that post-COVID-19, there will be an assessment of policies, regulations, and guidelines relevant to individuals' rights and the execution of severe health measures, for example, continued quarantine measures and the power of new ones technologically driven solutions within health care. Required public health-triggered powers are presently justified under a mutual legal and ethical standard, taking into account the hazard of the contagious disease to the individual and the general population, the occurrence rate and transmission medium of the infectious disease, the efficiency of accessible public health interventions, and the accessibility and kind of clinical treatments. Notably, in an evolving crisis, for example, in the case of COVID-19, when science is indeterminate, the employment of the precautionary principle is rational to ensure public safety. It is anticipated that post-COVID-19, some of these measures will be assessed on their effectiveness and timing, whether the steps' nature and execution are comparable to the hazard, and whether the legal evaluations of the partial scientific indication are successful (Thompson & Anderson, 2021).

1.4 Progress of Communication Technology-Based Methods

The revolution in health care would not be possible if it is not linked with technological inventions in communication, transportation, and machine learning. The growth of Medicare Telehealth coverage among the pandemic is a significant step in the precise direction and increased healthcare delivery closer to home for chronic neurological patients. However, security concerns remain, as not all freely accessible tools for videoconferencing conform with globally accepted confidentiality standards. For instance, the security concern is zoom bombing, which is implemented as much to patients as to medical specialists delivering new remote services. Consequently, technology-empowered methods must take all required steps to protect the participants' privacy. The bright side for the post-COVID-19 age is the awareness that technologically empowered strategies can enhance a substantial portion of healthcare activities in the broader sense, and some can also be cone remotely equally as efficiently. For instance, for some postsurgical follow-ups, phone visits are not inevitably inferior to personal visits in terms of patient satisfaction, adverse events, and complications. Their requirement to be an enhanced prominence is the assessment of how technologies can be used earlier or better to offer added suppleness to the receptiveness of the healthcare system in times of crisis. Current strategies have braced part of this perspective. However, there has been a perceptible struggle to switch the focus of healthcare systems to manage the current emergency, resulting in possible response time lags (Stephan et al., 2021).

1.5 Evolution of Financial Models to Support Scientific Research, Crisis Awareness, and Cooperation

COVID-19 directed concurrently to two opposite outcomes on laboratory medicine activities. In contrast, microbiology departments confronted a significant increase in their diagnostic activities relevant to the accession of COVID-19-suspected individuals. In contrast, clinical laboratory activities not directly appropriate for COVID-19 dropped enormously, involving, for example, cancer services, which had to familiarize themselves with a different, remote-based service model. A similar picture was also witnessed at the hospital or institutional level, with the drop in routine activity and the stringent requirement to reallocate services and staff. Given these factors, COVID-19 has evolved the healthcare business models of standard academic health sciences, industry, and public health surveillance. Effective collaboration within informal networks consisting of clinical labs servicing associations of test manufacturers, hospitals, and educational groups forged through recent pandemic and operation consolidations signified a prime element in the European response against COVID-19 and in assisting acute global and clinical requirements. Therefore, it is possible that because of their prompt response and mobilization times to

clinical needs, further international activities, for example, those within the Innovative Medicines Initiative (IMI) framework, will be reinforced, hopefully sustaining the extensiveness of creative methods. The insistence of the COVID-19 case forced significant healthcare providers to respond primarily without an all-inclusive discussion of the financial costs included in those emergency responses. However, the investment scale required for fighting COVID-19 is determined and a prime consideration for the near future. For example, new public–private associations are essential, including vaccines, drug tests, and development. Discovering additional financial sources, recognizing the necessity to associate financial returns with capital providers, and developing profitable, sustainable financing frameworks will be essential in creating new economic models to assist scientific research, crisis preparedness, and cooperation (Cobelli et al., 2021).

1.6 Disaster Awareness vs. Applied Improvisation

The healthcare sector is dependent on the in-person interaction model. Most healthcare work procedures and financial incentives have been developed principally to support this healthcare model. This ended in the inescapable gatherings of patients in emergency departments risking the efficiency of social distancing and other safety protocols. Vulnerable people suffering from chronic conditions are also obliged to opt between risking exposure to the virus during visits and delaying required care. However, unprepared for the global pandemic COVID-19, the healthcare industry has instantly switched to action to fight the crisis. Pharmacy benefits managers (PBMs) and medical systems have improved various procedures to respond to emergencies at once. By abandoning member-cost sharing, involving copays, renouncing home delivery charges for prescriptions, and coinsurance in diagnostic testing, they have lessened the financial burden for healthcare providers and patients (Bhattacharyya & Chandwani, 2021).

By reassuring virtual visits, developing new reimbursement for teleappointments, and launching telemedicine, PBMs have boosted the switch to a digital-first scalable framework. Before the global pandemic, healthcare providers anticipated investing 15% more in digital information technology services by 2025. However, currently, increased investments are predicted along a lesser timeline, as providers feel the need to proof check their information technology infrastructure. In the pre-COVID age, a fragmented legacy information technology system merged with stringent regulations, and the pressure of maintaining the status quo delayed digital migration. However, as the global pandemic has overtaken the healthcare industry's capabilities to prevent, contain, and track the virus, the requirement for a quick digital revolution is sturdily felt across the industry (Viswanathan et al., 2021).

2 The Requirement for a New Status Quo

All the factors mentioned above are forcing the healthcare industry to level up the system and become more robust by releasing the power of digital solutions—several digital solutions and technologies, for example, telehealth. EHRs and digital therapeutics have been there for more than ten years but cannot reach the anticipated market penetration because of heavy regulations and a deficiency of supporting payment structure. The healthcare industry also has artificial intelligence, blockchain, and wearable technology. Simultaneously, this can lead to the digital evolution of the providers, influencing them to break the previous status quo and develop a new one. Healthcare industry experts are forecasting a unique spike in elective surgeries, cancer medicaments, and other unfulfilled health requirements later in the year. As patients will return seeking treatments that have been postponed, hospitals must be well equipped to achieve the requirements. Governments are reassuring the implementation of telemedicine and telehealth services to enable care prioritization. Remote care facilities and telehealth facilities have been proven efficient in relieving hospitals struggling with space crunches and acute resources. Telehealth services also confirm the delivery of both asynchronous and synchronous care (Hackl & Hoerbst, 2021).

The following are six ways to make a strong and resilient healthcare system:

1. Balance speedy innovation with an exceedingly regulated framework

   At the start of the global pandemic, exploring the cure for COVID-19 was crucial. A closer partnership among academia, hospitals, technology companies, life science firms, regulatory bodies, and payers resulted in a more efficient innovation procedure. The lessons learned now must be implemented for the delivery of efficient treatments in future. For instance, the design of clinical trials could be improved by utilizing digital technology, for example, artificial intelligence, to assess patterns across previous trials with real-world data (Hoo et al., 2021).
2. Develop mediums supporting healthcare partner ecosystems

   The once-in-a-lifetime opportunity would have been missed if the previous procedures had been digitalized only due to the global pandemic. Future delivery and design need to reimagine health care, making it more integrated, personal, and collaborative and enabled by digital capabilities, for example, artificial intelligence and clouds with other emerging technologies. The world needs design-driven technology instead of technology-driven design (Maharana et al., 2020).
3. Put the customer at the heart of the healthcare system

   Safeguarding individuals, especially vulnerable and elderly individuals, from spreading and catching the virus has been a prime goal for governments and health care. The industry quickly assembled applications to carry out contact tracing and keep people safe by allowing a level of freedom while opening up society. For post-COVID life, these speech and chat interfaces can be reprocessed to triage people' health concerns and lead them to the most appropriate healthcare

specialists, with potential cost, efficiency, and time savings (Sobowale et al., 2020).

4. Reconsider future healthcare delivery

   Virtual healthcare services have been accessible for many years, but it took a global pandemic for healthcare specialists and patients to recognize the value of telemedicine. As we shift to a new normal, healthcare provider must support ensuring that their virtual infrastructure is secure, robust, and completely integrated with other delivery mediums. These services and platforms must be delivered for all stages of digital literacy (Purnomo et al., 2021).

5. Scrutinize wider societal problems in future

   The global pandemic led to the unanticipated consequences of mental health issues and isolation epidemics amidst multiple lockdown-societal problems that had a lower priority than COVID treatments. Technology and data can be utilized to normalize accessibility to virtual services, assisting in decreasing stigma, enhancing continuity and engagement with treatments, and enhancing long-term results (Hoo et al., 2021).

6. Security is the top priority

   Devices connected to cloud applications run the danger of exposing health networks to threats and malware. With the progress of virtual consultations during the global pandemic, keeping private and sensitive patient records protected has become more vital. Borderless and robust healthcare cybersecurity can both protect and prevent privacy, safety, and operational disruption. Just as the objective of health care is prevention and wellness, the objective of cybersecurity is avoidance and resilience (Hackl & Hoerbst, 2021).

Last, the following four prime actions can support the development of the future healthcare ecosystem:

- Forecast results by enhancing data understanding. Researchers working on COVID-19 mined data and utilized simulation and modeling techniques to forecast the impact of variants on vaccine programs and disease progression.
- Automatic procedures utilizing artificial intelligence technology. With long waiting times for physical triage of COVID-19 symptoms, the help of a virtual agent supported bolster the resilience and reliability of health services.
- Secure and safeguard operational data, protect patients from physical and cyber threats, and keep life science and healthcare organizations running steadily.
- Modernize healthcare operations and supply chains by actual-time, flexible accessibility, assisting future-proof businesses.

The road to recovery for hospitals, healthcare staff, and health systems is likely to belong, making it crucial to explore methods that can decrease pressure in future. Artificial intelligence technology such as machine learning and natural language processing (NLP) depicts excellent promise to allow better integration and experiences for healthcare firms, patients, and clinicians. With more shareable health information, incredible results can be unlocked and procedure improvements can be made for patients and providers (Bamufleh et al., 2021).

Automating procedures, enhancing efficiencies, and allowing alternative care service models:

One of the most stimulating domains driven by artificial intelligence is remote patient monitoring (RPM), which leads to more efficiencies and decreases costs for healthcare providers and is depicted to enhance clinical results for patients. According to the literature, RPM supports the following:

- Decrease transmissions by thirty-eight percent and emergency room visits by twenty-five percent
- Enhance patient satisfaction by twenty-five percent
- Diminish care costs by seventeen percent

Artificial intelligence-powered RPM supports keeping people healthy in an automated manner. Clinicians can stay closer to their patients remotely and monitor various conditions without the requirement for physical visits. Accumulated data provide vital clinical insights in real-time, relevant alerts, notifications are automatically triggered, and continuous contact between patients and clinicians under their care. The technology proved particularly beneficial during the global pandemic when person-level care was restricted. However, patients still required support from their healthcare providers, premier members who had set the base for population health abilities. For example, before the global pandemic, a hospital at home reported caring for numerous patients on virtual platforms monitoring thirty-five thousand COVID-19 patients with more minor symptoms, thus providing a safe and effective method to provide care for COVID-19 patients in their comfort zones, freeing up hospital space and decreasing avoidable emergency ward visits. RPM is also beneficial to patients in rural or remote communities or lacks transportation options, permitting them access to care they may miss otherwise. Patients should have a reliable remote or rural broadband connection to realize this advantage ultimately. By expanding healthcare service beyond clinicians' offices, RPM effectively offers care directly to patients, nonetheless of where they are located, shifts away from scheduling repetitive visits and being responsive to acute ailment to providing proactive care that improves patients' overall health and wellbeing, and clears the road to better disease prevention and management (Khan & Qureshi, 2020).

2.1 Allowing Patients to Manage Their Health Proactively

The development of wearable healthcare technology has allowed people to take more ownership and control their health and lives. Digital devices, fitness trackers, and smartwatches accumulate real-time personal health data involving blood pressure, glucose, and electrocardiograms, keeping people well aware of the knowledge on the data points that matter most to their well-being. Artificial intelligence can switch these personal health data into medically beneficial information, allowing patients to be more involved with and proactive about their health conditions. The data can be transferred back to clinicians' offices or hospitals through a monitoring hub, assisting

providers in recognizing their patients' daily habits and offering more personalized and tailored care. Artificial intelligence also sums personal health data with other data sources, medical records, DNA tests, and medical histories to develop a more efficient data set that provides keys to more efficient illness prevention and enhanced treatment of individuals and populations (Yao et al., 2021).

2.2 Revealing Artificial Intelligence Potential: The Road to Future

All healthcare technology developments are promising, but the challenge faced presently in artificial intelligence success is redemptive the amount of information stuck in disparate EHRs and avoiding interoperability in health systems. Health data sharing and use among researchers and providers is a significant issue for the healthcare system. Artificial intelligence has significant potential to enhance healthcare delivery, and its full potential can best be recognized when we have allowed access to data that have been maintained in data silos. With appropriate protections for consent and privacy, artificial intelligence will allow a new age of health care where information is primal to enhance efficiency, patient responsiveness, and quality, catalyzing clinical upgrading (Kalabikhina, 2020).

2.3 Disclosing Patterns in Disease, Reaching a Diagnosis Swiftly, and Advancing Therapies Promptly

Another kind of artificial intelligence that is composed to transform the healthcare sector is NLP technology. Natural language processing (NLP) allows computers to recognize, interpret, and manipulate human language. When utilized in health care, natural language processing (NLP) algorithms can search eighty percent of valuable HER content that is not structured, involving physicians' free-flowing notes, documents, and pathology reports. Natural language processing (NLP) technology reads and interprets millions of pieces of data in record time, classifies the data, and provides insights to physicians to support in diagnosing complex conditions and better recognize treatment procedures more swiftly, leading to brief therapy and enhanced patient satisfaction. The technology is also beneficial in the life sciences domain, where it accelerates the data extraction procedure linked with scientific research and clinical trials. It is useful when researchers seek patient studies in complicated therapeutic areas, such as oncology, that need detailed phenotypic data, which cannot be extracted in structured data. However, they can explore unstructured narrative data with Natural Processing Language (NLP) (Puaschunder, 2020).

3 Prime Considerations for a Resilient, Technology-Driven, Sustainable Future

3.1 Next-generation technologies

As scientists, governments, and healthcare providers are attempting to take advantage of every bit of data available to forecast the transmission of COVID-19, the requirement for real-time data transfer has become imperious. The hike in health care has also amplified bandwidth even in remote locations. There is also the revolutionized market of wearable technology added to the above. Healthcare providers must transfer significant data amounts, medical imagery, large data files, and high-quality videos that are capable of responding effectively and in a timely manner. All this is possible only when the healthcare industry has near-instant data transfer speeds. 5G technology is a disintegrator that can actively transform the industry and its functions. In the next few years, extensive data-enabled artificial intelligence will also attain the next level, allowing faster and easier real-time patient data assessment. These advancements will enhance patient care value and support pharmaceutical companies in recognizing promising drug targets, boosting drug development, and ultimately decreasing the medications' costs. Virtual reality (VR), augmented reality (AR), and robotics will also be significantly affected by 5G. In the fight against a highly infectious virus, these technological advancements enabled by 5G can prove to become definitive weapons for the healthcare industry, safeguarding frontline workers' lives (Bamufleh et al., 2021) (Fig. 2).

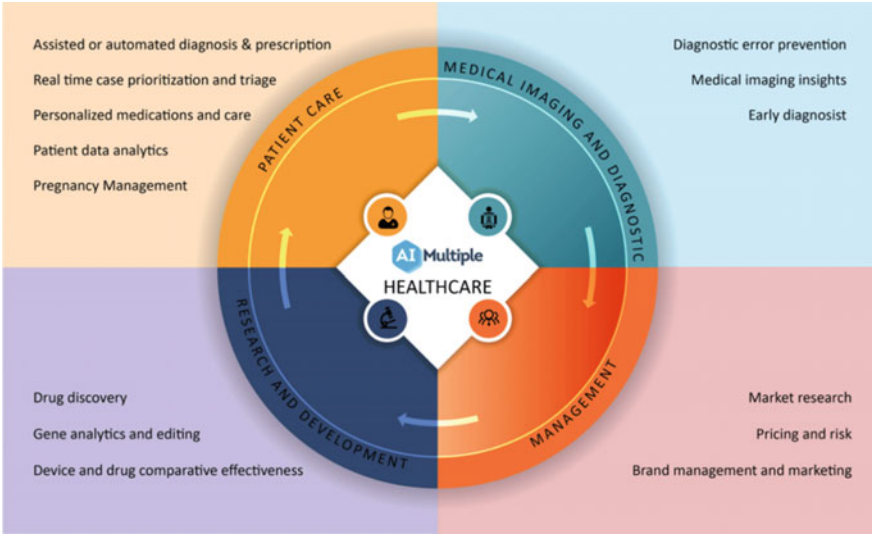

Fig. 2 AI-Based Health care

4 Future Leaders of Evolution

COVID-19 has forced healthcare providers, pharmaceutical companies, and payers to work remotely. In March 2020, Microsoft Teams witnessed a surge in users, from twelve to forty-four million within seven days, procreating nine hundred million calling minutes and meetings. Telehealth services have also seen a fast adoption rate. This makes chief information officers (CIOs) the basis of a strong technology backbone needed to assist and ensure transformation business continuity. Although every industrial sector requires CIOs more than ever, health care requires them the most presently. As CIOs will commence obtaining significant strategic responsibilities even in the post-COVID age, developing a flexible model that permits healthcare stakeholders to work efficiently will become a prime concern for them. As new leaders for evolution, they would need to break the silos to bring dexterity and better responsiveness to handle similar unpredicted threats in future. The changing situation focuses on the requirement for digitalization and integration but, even more, focuses on privacy and security (Sobowale et al., 2020).

4.1 Interoperable System

The digital revolution of the healthcare industry will rely heavily on healthcare business and clinical systems working collaboratively to share data, connect, collaborate, and communicate more than ever now, as the healthcare industry is swiftly shifting to value-based care that calls for enhanced accountability, the requirement for interoperability hikes to a strategic imperative. The current regulations by the Department of Health and Human Services (HHS) are anticipated to further improve data exchange and enhance the COVID-19 response. Data are crucial to fight diseases and viruses. However, new regulation enforcement was postponed until July 2022, and payers must comply with the unique needs (Thompson & Anderson, 2021).

4.2 New Paradigms of Chronic Care

Retail hospitals have been there since 2013, but only the global pandemic COVID-19 has brought this care delivery paradigm into the limelight. Some hyperstores, grocery stores, and supermarkets have opened their doors for drive-through testing. Retail clinics can be efficacious in providing care services for minor illnesses, symptom checks, and vaccinations. Association with these retailers can allow healthcare providers to enhance access to primary care, expand their patient base, lessen costs, and attend to patients' chronic health conditions. When the world is struggling with insufficient physicians, retail clinics can act as extra care access points. These

care points are likely to explore their niche and evolve as the go-to option for low acuity care and flu shots (Venkatesh, 2021).

4.3 Sustainable Supply Chain

The global pandemic COVID-19 has also interrupted the conventional supply chain. As the need for essential medical equipment and medicine increases, firms scramble to meet the abrupt requirements. A social supply chain can efficiently resolve the challenge by integrating social data, demand charts, and social networks. Firms will recognize areas with growing demand for particular products and modify their distribution plan to meet the requirements by monitoring social data. A social supply chain also allows firms to recognize risks and mitigate time losses and delays. As the world combats COVID-19 and its extensive impact, the requirement to build flexibility has become the prime focus for the global public healthcare system. Presently, the industry is struggling to fight linking its past knowledge and expertise with the technological advancements of the present time. The world requires a future-ready system that will have the capability to withstand an insurmountable global healthcare crisis. With that, a new age of health care is upon us, a future in which technology will make medical care available to everyone, irrespective of age, geographical location, and socioeconomic background (Bae et al., 2021).

5 Conclusion

The COVID-19 pandemic has brought unprecedented challenges to the healthcare sector. Some of these challenges are complicated and need immediate attention. Others are pushing the industry to a future that will be dependent on enhanced resilience and faster adoption. Presently, healthcare providers are assessing the financial impact of COVID-19 on their revenue cycle. They must recognize ways to reinstate financial stability and avoid financial losses caused by primary prohibitions on routine visits and elective treatments. Healthcare professionals and hospitals also seek ways to triage and recognize suspected patients while staying alert and equipped to confront any sudden rise in confirmed cases, even with limited resources (Venkatesh, 2021).

In contrast, insurers attempt to ensure sufficient coverage, no delay in payments and quick processing of outstanding claims. The key factor in handling these trying circumstances is to expand the technological capabilities of providers by shifting to cloud infrastructure, supporting remote work, efficient analytics, and a push for more digital and contactless mediums, among others. While the healthcare industry is already witnessing an acceleration on these technologies, that acceleration may not be sufficient to counter the pandemic. The COVID-19 pandemic indicates that proactive strategies for healthcare emergencies and increased commitment to international

public health alertness remain essential. The lessons learned on the restrictions of existing healthcare systems and their capability to respond to contagious disease pandemics in the twenty-first century should be considered, allowing the revolution of future health care (Thompson & Anderson, 2021).

Furthermore, the comprehension that technologically empowered solutions can be applied and work well. It should involve the standard for the greater integration of such technologies as part of regular healthcare provision and design. Positive results can be achieved where both healthcare providers and patients become active participants in this procedure. However, regulatory, legal, and ethical concerns that arose during this pandemic must be addressed for that to be attained. The present international experiences set the base for a substantial post-COVID-19 healthcare revolution so that systems can better prepare to address the subsequent global hazards of the twenty-first century (Puaschunder, 2020).

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Chapter 10
Medical Schools and Curriculum Enrichment in Entrepreneurship

Ibrahim Kolawole Mogaji

1 Introduction: Medical Curriculum in Context

The term curriculum in academic or professional education represents the expression of educational ideas in practice. The curriculum should be easily communicated and be readily transformed into practice. It should, however, be open to criticism and flexible enough for change. The medical curriculum is more importantly a social contract and exists in the context of two domains: what the competencies of the medical student should be and what competencies the social environment expect the trained medical doctor should have. The two are not synonymous (Cantillon et al., 2017; Prideaux, 2003). Furthermore, the curriculum is a function of the human effort that represents the beliefs and philosophy of its proponents on what is expected to be learnt and how it will be learnt. There have been repeated calls for the medical curriculum to be more forward looking, evolving, and responsive to the changing values and demands of the fast-changing world**.** It is argued that the medical curriculum should not be the so-called sabretoothed curriculum, which is based on the fable of the cave dwellers who continued to teach about hunting the sabretoothed tiger long after it became extinct. In contemporary medical education, it is expected that the curriculum should achieve a 'symbiosis' with the health services and communities in which the students will serve. (Cantillon et al., 2017; Prideaux, 2003).

The medical school curriculum encompasses premedical preparation in basic sciences and medical school training in clinical sciences encompassing the pathologic basis of diseases, medicine, and surgery with clinical postings in hospitals. At the postgraduate level, there is a residency program involving medical specialty training and fellowship programs. This foundational and advanced education provides the needed requirement for a professional career enhanced by continuing medical education and life-long practice (Ludmerer, 1999).

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The principles of medical education propounded by Abraham Flexner and William Osler early in the twentieth century guided the curriculum development of most medical schools for decades. Fox in 1999 opined that there is a need to enrich the medical school curriculum because of serious social, economic, organizational, and value-oriented problems facing medical education in different contexts, which, if not addressed, could threaten excellence and the sense of purpose of medical programmes.

Flexner (1910), a leading scholar, recommended that medical schools should be university based, have minimum admission requirements, implement a rigorous curriculum with applied laboratory and clinical science content, and have faculty actively engaged in research today (Norman, 2012). Osler recommended direct clinical bedside teaching, which brings medical students into direct contact with patients, and an apprenticeship-mentorship process where medical students learn medicine from experienced clinicians (Buja. 2019). The result was the creation of the dual approach to learning medicine as seen today—the basic sciences and the clinical sciences. (Samarasekera et al., 2018). From the foregoing, it is obvious that the curriculum of medical schools requires urgent review and enrichment with the entrepreneurship curriculum to produce medical graduates with the mindset of becoming medipreneurs, wealth creators and game changers in medical ecosystems.

2 Curriculum Reforms: Minor or Major Reforms—Making a Case for Entrepreneurship Education

Undoubtedly, medical schools across the globe have achieved far-reaching milestones over the years using traditional curricula that have produced scientifically sound physicians with core competencies in clinical practice, academic research, and life-long learning (Brancati et al., 1992). However, several stakeholders have called for major reforms in the traditional curricula, citing concerns about the lack of key abilities among newly graduated doctors to work in the emerging complex healthcare environments in the twenty-first century. Both the teaching methodology and the content of the established curriculum have come under severe criticism (Roberts, 2004). Some other stakeholders call for minor reform through capacity building and serialized training programs of different types of physicians to fill observed deficiencies and equip doctors with new practices in the current healthcare scene (Buja, 2019).

There has been little change to the Osler and the Flexner approach to medical education since the early 1900s. This has led to a stable expectation from the doctor and seems to serve the training institution, the public and the product, the doctor, well until the early twentieth century. However, concerns have been raised as social and technological developments spring up in the 1960s, resulting in new expectations of the doctor–patient relationship. Medical education bodies in both the US and the

UK (AAMC, 1984; Standing Committee on Medical Education [SCOPME], 1992; GMC, 1993) have recommended changes in the medical curriculum. New doctors have also voiced their unpreparedness to meet expectations upon graduation (Evans et al., 2004). A growing gap between these expectations and service delivery has led to increasing dissatisfaction within the public sector for medical services and has resulted in complaints both to the National Health Service and General Medical Council both in the United Kingdom. It is, however, interesting to note that most of these complaints are related to issues of a generic kind rather than specific medical competencies.

Furthermore, Roberts (2016) discussed some critical areas in medical schools that require urgent reforms. First, medical school students in their first years should not be forced into specialty in contemporary times. In the US and other places, the medical profession heavily incentivizes specialist physicians—they make more money and tend to have more prestige. Consequently, medical schools are doing the same by encouraging their students to choose a specialty early. There is a need for reform of this practice because all medical specialties are goldmines when students are trained to be medipreneurs—they can carve out business models and successful careers in all specialties. Second, medical schools need to be inclusive in the recruitment of resource persons and trainers for medical students.

Particularly, there is a need for a balance of medical physicians and nonmedical professionals in the medical field while ensuring compliance with medical training regulations and reality in society. Medical schools should accommodate the thoughts, knowledge, skills and experiences of physician assistants, nurse practitioners, and entrepreneurs to have a broader perspective of opportunities and challenges in the health system. Third, medical schools, as a matter of urgency, should incorporate technology, biotechnology and business as complements and value additions. This third reform calls for curriculum enrichment because the curricula (curricula) of several schools have not changed in decades. At present, medical students have deficiencies; hence, the future curriculum should embed business skills, entrepreneurship, innovation, and technological education to bridge the notable gap in training of physicians. Curriculum enrichment with business and creative thinking skills in the medical curriculum would help medical student entrepreneurs, technology-savvy medical doctors, and medipreneurs. More importantly, two different reports in the US and the UK have recommended a more generic medical education in the undergraduate program, and the following should be incorporated into the curriculum:

- Provision of specific skills and knowledge needed to be a doctor;
- Build medical students capacities and abilities to understand research;
- Cognitive skills and opportunity identification capacity to respond to the needs of society;
- Design thinking skills to develop competency in critical thinking and problem solving;
- Business model development, costing and pricing knowledge for developing cost-effective care;

- Mastering of information communication technology (ICT) skills to be able to assess and use technology;
- Cloud computing and data processing to manage patients' information;
- Emotional intelligence, coaching, and mentoring skills to aid counseling on ethical issues; and
- Financial literacy and basic fund management skills to strengthen transparency and accountability (Towle, 1991; Jayakumar et al., 2017).

Entrepreneurship finds relevance in medical education because a twenty-first-century doctor is expected to be a problem solver and a professional who can adapt to new challenges, as well as having the ability to apply innovation in medical care aside the basic competencies in diagnosis and patients' treatment. Contemporary doctors are specifically required to add to their traditional clinical skills competencies in management and leadership, communications and information technology, including financial literacy and business acumen. In the modern era, physicians operate in the complex milieu of IT advances, disruptive technologies, changing payment models, and rising cost of treatment. Dynamic changes have also come with more professionals outside the well-known medical team joining the ever-expanding and increasingly complex healthcare system. For doctors to continue to lead effectively in this environment, they need to improve their skills in team management, communication, decision making skills, knowledge in business management with relevant skills in the use of emerging technologies, and disruptive innovations, all of which are characteristics of the entrepreneur or better described as the medical entrepreneur.

There is a well-known age-long gap in medical training that has prevented medical practitioners from integrating into the world of entrepreneurship. A study from 1993 demonstrated that only 3% of physicians younger than 45 years felt that they were well prepared to manage the business aspects of medical practice (Cantor et al., 1993). The need to add entrepreneurship and innovation proficiencies to the undergraduate curriculum was expounded upon by Rubino and Freshman. They argued that students need to learn and implement such skills to enhance service delivery in the expanding twenty-first century healthcare system (Rubino & Freshman, 2005). Eyre et al. (2015) explained that doctors in training (DITs) already have well-developed skills that are empirically associated with entrepreneurial success, such as teamwork, communication, responsibility, data analysis, and problem-solving skills. He therefore propounded that incorporating these into the curriculum and training of DITs via courses, lectures, internships, exchange programs via mentorship, and coaching integrated pathways for clinical academic careers that incorporate research, education, and leadership studies into clinical duties.

3 Literature Review

3.1 Concept of Entrepreneurship

The need for entrepreneurship in the medical curriculum could be questioned by antagonists; hence, there is a need for conceptualization. The field of medicine uses diagnostic science in treating a patient and seems far-fetched from the business mindset of innovators and entrepreneurs. However, understanding the ideals of entrepreneurship will bring forth the relationship between the two concepts. The concept of entrepreneurship has not had a consistent definition, although it has been used for ages. It was defined as "an act of innovation that involves endowing existing resources with new wealth-producing capacity" (Drucker, 1985). One of the most popular definitions for entrepreneurship was given by Joseph Schumpeter, an economist, who argued that for the entrepreneurship process to validly occur, there must be (1) the introduction of a new good or of a new quality of good, (2) the introduction of a new method of production, (3) the opening of a new market, (4) the conquest of a new source of supply of raw materials, and (5) the carrying about of new organization in any industry (Schumpeter, 1942).

Moreover, entrepreneurship is linked directly to productivity, where it is seen as the process of making decisions on optimal production, investment, and financing (Williams & Thompson, 1998). Therefore, an entrepreneur is seen as an individual who conceives and undertakes risk to establish a business venture while harnessing the factors of production (land, labor and capital) to fill a gap in demand with the aim of generating profit. Therefore, the process of integrating factors of production to create new markets and fresh opportunities for higher yield and profit is termed entrepreneurship. The entrepreneur is a person, while entrepreneurship is a process. Entrepreneurship is a process undertaken by entrepreneurs where investment opportunities are utilized to create a value chain that leads to incremental wealth and profit while undertaking risk and economic uncertainties. Some of the key elements associated with entrepreneurs include the following:

- Vision: This is the process of identifying the market gap in demand and supply (an indication of investment opportunity). This underscores that medical entrepreneurs must have a vision in pursuit of medical business models.
- Innovation: This is the ability to create the pathway to meet this demand different from what has been existing. The dynamic capability to innovate new medical solutions is central to medical entrepreneurship.
- Risk bearing: This is the ability to analyze and take on economic uncertainties. Medical entrepreneurs must have tolerance for risk-taking.
- Organization: This is the coordination of the factors of production (land, labor, capital and entrepreneurship). The hallmark of medical entrepreneurship is the ability to organize, coordinate and manage businesses, clinics, and other medical-oriented ventures.

– Result oriented: This is the determination to achieve the set objective be it profit or service. Successful entrepreneurs are goal-setters, goal-getters, and result-oriented people.

Medical graduates are clearly proficient as both educators and scholars. They are trained in critical thinking, risk-taking, problem solving, and life-long learning. Despite these being core entrepreneurship elements, the lack of direct entrepreneurship training in medical school cannot be overlooked. The incorporation of business into medicine is both controversial and topical. Many junior doctors are taking time out to directly learn entrepreneurship skills (Ahmad & Akram, 2018), and the number of organizations supporting ventures, such as medical entrepreneurship and outside medicine, has increased astronomically (Limb, 2017). This is not surprising.

The global health industry was worth $8.45 trillion in 2018 and projected to reach $10 trillion in 2022. The US spends up to $10,224 per capita the highest in the world. Many European countries also have heavy investment in health, with Switzerland spending approximately $8000 per capita. In the same vein, India's health sector was worth 160 billion dollars in 2017, and it is estimated to reach up to 372 billion dollars by 2022. The healthcare sector has become the largest sector in terms of revenue generation and employment, and medical tourism to India has become a huge source of revenue for the country (Statista Research Department, 2021).

Furthermore, the Nigerian Sovereign Investment Authority (NSIA) reports that Nigerians spend an average of $1 billion dollars annually on medical tourism, with 60% spending across four key specialties: oncology, orthopedics, nephrology, and cardiology (Oyeranmi, 2021). This shows the healthcare gap and the room for investments. Entrepreneurship ventures in the health sectors globally are a goldmine. For instance, Nigeria needs an extra 386,000 hospital beds at an estimated investment cost of $82 billion to bring the country up to a global average of 2.7 beds per 1,000 people. This is a country of 200 million people, and at least half of that number can viably pay for health care (Proshare (2020) (Fig. 1).

Health care is a big business that is still growing with opportunities for deploying innovative business models and disruptive medical technologies. Deloitte Touche Tohmatsu Limited (2022) reported that health care spending in the US in 2019 increased to US$3.8 trillion dollars, which is approximately 18% of the gross domestic product (GDP) based on the estimate of the Centers for Medicare & Medicaid Services (CMS) Office of the Actuary. Deloitte's report also noted that before the COVID-19 pandemic, the projected health spending in the US was growing at a rate of 5.3% a year, which is projected to reach US$6.2 trillion by 2028. With the current trend, health spending in the US in the next 20 years could escalate to US$11.8 trillion by 2040.

New medical models are required in the face of a worldwide increase in the cost of health services, hyperinflation, and dwindling economic resources. Hopefully, entrepreneurship and innovative healthcare business solutions can offer reliable, affordable, and accessible healthcare products and services for a growing number of people despite scarce resources. Healthcare recipients are also likely to be willing to receive health-related innovation if offered by medical doctors (Smith & Sfekas,

Fig. 1 Nigerians expenses on foreign Healthcare vs Health care budget (*Source* CBN, Budget office, NM Research [2021])

2013). In the same vein, a study investigating patent application patterns for medical devices found that medical device firms were more likely to incorporate information from physician-founded start-ups than non-physician-founded start-ups, as physicians tend to provide important information that is more applicable to the challenges of end users (Smith & Sfekas, 2013). Therefore, there is a verifiable need for medical entrepreneurship to solve the obvious business-academia gap observed in the medical curriculum (Miron-Shatz et al., 2014).

3.2 Defining Medical Entrepreneurship

Medical entrepreneurship is still in its infancy; hence, there is no standard definition. Lukman Raimi (2019) defined medical entrepreneurship as "the ability of health professionals to create new business opportunities in the medical profession in response to the needs, tastes, demands and changes in the fields of medicine, biotechnology, health care services, ICT, medical innovations and social entrepreneurship across the globe". Perhaps a popular definition is that given by the dermatologist entrepreneur, Hacker (2012), who states that a medipreneur or medical entrepreneur is any healthcare professional who is fully aware of the challenges, needs, tastes, preferences, changes, and gaps in the health sector and has the capability and ability to connect entrepreneurially with the observed market opportunities by providing relevant health-oriented products, services, technologies, and other medical solutions

for double bottom-line (personal profit and social impact). In summary, medical entrepreneurship is the process of using entrepreneurial principles via disruptive technologies to engage in innovation and ventures in the field of health care. The scope is enormous and keeps expanding. It encompasses fields such as healthcare service, biotechnology, digital healthcare technology, and data analytics.

4 Medical Curriculum Enrichment and Methods of Teaching Entrepreneurship Education

While there is a growing consensus that medical schools should supplement traditional medical training with entrepreneurship education, there is diverse opinion on the manner of implementation of curriculum enrichment. The initial step will involve two processes. The University Commissions in charge of undergraduate medical training and the Postgraduate Colleges of medicine in developed and developing countries should emphasize entrepreneurship and innovation as competency domains for medical students and residents. To give the necessary 'legal' backing to the process of curriculum enrichment across boards, necessary accreditations must be made with international accreditation bodies for medical education, such as the Royal College of Physicians and Surgeons of Canada and the Australian Medical Council. The Australian Medical Council (2020) has a rich document on Accreditation Standards and Procedures for medical practice. The Royal College of Physicians and Surgeons of Canada (2022) has developed the CanMEDS Framework for physicians that has been integrated into the Royal College's accreditation standards and specialty training documents.

Second, it is necessary for medical schools willing to train medical students on entrepreneurship to develop a curriculum map that has details of the scope, objectives, and expected outcome of the course. The maps may differ based on the intended focus. A map aimed at the students will place them at the center and will have a different focus from a map prepared for teachers, administrators, or accrediting authorities. They will all, however, have a common purpose in showing the scope, complexity, and cohesion of the curriculum (Fig. 2).

4.1 Curriculum Design

The following approaches are recommended for medical schools willing to enhance entrepreneurship training for medical students and residents:

The common educational themes include the following:

1. Entrepreneurship: Program is designed for students to be able to identify a definite need and turn it to a viable business venture.

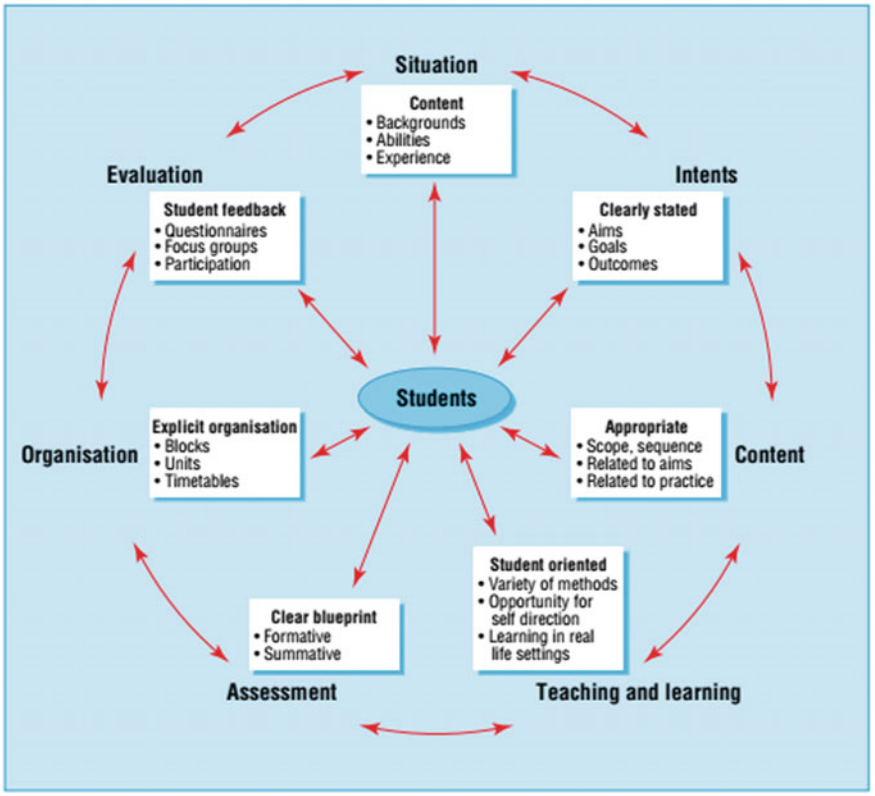

Fig. 2 Example of a curriculum map from the student's perspective. Each of the boxes representing the elements of design can be broken down into further units and each new unit can be related to the others to illustrate the interlinking of all the components of the curriculum (*Source* ABC of learning and teaching in medicine curriculum design by David Prideaux)

2. Innovation: Emphasis on the creation of ideas and translating them into products and devices. The course is focused on the use of data analysis, biotechnology, commercialization of technology, and medical device design to solve problems in healthcare delivery.
3. Healthcare management and Leadership: Understanding the central role of physicians in developing new ideas and the multidisciplinary approach among several stakeholders in achieving this.
4. Business of Medicine: This focus is on healthcare financing, education on financial principles, and profit making from healthcare management.

4.2 *Teaching Methods for Cascading Medical Entrepreneurship*

1. **Seminar series:** These are done in sessions and spread around the academic session. Topics around the themes are discussed to acquaint students with entrepreneurship principles.
2. **Medical-oriented Entrepreneurship Mentoring:** Periodically, in medical schools, successful medical doctors and experienced entrepreneurs in different segments of the healthcare industry should be invited to mentor and support prospecting or novice medical students in acquiring the necessary business competencies and skills for developing business models, establishing their business ventures, and managing the business venture after successful launch.
3. **Conferences and Workshops:** Entrepreneurship-themed conferences and workshops organized by medical schools or medical entrepreneurship companies or corporate organizations are made to be attended by students.
4. **Electives:** Entrepreneurship courses can be made as electives for medical students. A validated approach to teaching entrepreneurship, such as the MaRS Entrepreneurship 101 Framework, can be adapted for medical students and used to design course outlines and learning objectives ***(Entrepreneurship 101. MaRS Discovery District.***https://www.marsdd.com/wpcontent/uploads/2014/03/Entrepreneurship-101-Course-Syllabus_Final1.pdf**.)**.
5. **Project:** Medical students are to identify a healthcare challenge in their communities and proffer viable business solutions that can subsequently be produced for end user use. The project can be divided into two parts: thesis writing and production (for end user use).
6. **Clinical 'postings' in entrepreneurship wards:** This is achieved with the creation of special wards with the entrepreneurship mindset by universities with state-of-the-art facilities and offering premium services. These are better achieved with collaboration with medical entrepreneurship companies or a public–private partnership. Medical students are posted there as part of the normal clinical rotations during the course of the training. Students learn practically about issues related to medical entrepreneurship.
7. **Expanded medical entrepreneurship outside training:** These are achieved by posting medical students with core interest in entrepreneurship into an apprenticeship program in accredited entrepreneurship companies. Students have mentors who take them through skills and knowledge in product development and commercialization. The US-based Society of Physician Entrepreneurs (SoPE) recently launched their Innovation Scholar Program, where students are assigned mentors in bioentrepreneurship companies for a 1-year apprenticeship program. Society for Physician Entrepreneurs ***(The SoPE Innovation Scholar Program 2013.*** http://sopenet.org/scholar-program/program-overview***).***
8. **Intercalated degrees:** Medical students who have a strong interest in entrepreneurship can intercalate and apply for entry into either BSc or MSc in

entrepreneurship courses in universities that offer such. These are usually done after students have completed some years of study in medical schools.

9. **Dual degrees:** Dual degrees for medical students are becoming increasingly common. Some institutions in the US offer the MD/MBA (Medicine degree and Masters in Business administration), and some also offer the MD/MPH program (Medicine and Masters in Public Health) and MD/MS (Medicine and Biomedical Engineering). These degrees can enhance the entrepreneurship abilities of medical doctors. However, intercalated and dual degree programs for medical students are limited and competitive (Ahrari et al., 2021).

Other pathways could be collaboration between medical schools and relevant faculties in universities to create certificates or diploma courses in entrepreneurship that are flexible enough to accommodate the tight schedule of medical students. Certificate awards will help to increase students' interest and give a sense of recognition for the effort. One such program is Healthcare Delivery Science, Management and Policy Distinction by Carver College of Medicine at the University of Iowa, US, and another is McMaster University delivering a Healthcare Innovation, Commercialization, and Entrepreneurship program for select MD and Ph.D. graduates (McMaster University, 2022).

5 Possible Pitfalls in Medical Entrepreneurship

There is no doubt increasing interest in healthcare entrepreneurship, and there are obvious pitfalls that are worthy of note. Medical students taking time out to study entrepreneurship either concurrently with medicine or after a break from medical school means longer training and increased volume on the already tedious and voluminous medical curriculum. This can translate to an increased cost of training and may exacerbate burnout syndrome, which is unfortunately high among medical students today (Rodrigues et al., 2018)**.** Entrepreneurship may be a distraction from the core medical training. Taking time out to study entrepreneurship, which is different from the core medical discipline, will mean greater nonclinical activities during the training. While this can be a distraction, the effect will need to be empirically determined. Entrepreneurship training for medical students has a tendency to create doctors with a 'dual psyche'—seeing the patients on the one hand as a human being that he is duty bound to help and on the other hand, as a commodity for business. While there is a need for increased research on the effects of these methods on medical training, some authors have claimed that evidence for compromised clinical learning is minimal (Neuhaus et al., 2012). Perhaps one of the major pitfalls is the possible compromise on the ethical standard of the medical profession. Entrepreneurship brings about commercialization and profit making within the space of healthcare delivery. Greed from profit-minded individuals can severely compromise patient care and ethical decision-making (Rubino & Freshman 2005).

6 Conclusion

This chapter set out to discuss how to enrich the medical school curriculum through entrepreneurship education. For ages, the focus of the medical curriculum is to produce competent doctors. Medical schools adopting the traditional medical education system have produced generations of scientifically grounded and clinically skilled physicians. The turn of the century has seen many stakeholders from within and without arguing that the curriculum of yesterday cannot adequately address the needs of the doctors of today. The future of health care has been argued to involve leveraging entrepreneurship and innovation. Unfortunately, health care has traditionally proven resistant to change (Safi et al., 2018). There is therefore an urgent need for all stakeholders to reform and enrich the curriculum for medical graduates trained as physicians to meet the needs of the rapidly changing healthcare ecosystem.

Irrespective of the times and generation, the medical curriculum must always produce doctors who are competent in the diagnosis and treatment of disease based on a sound understanding of the pathological basis of disease and the clinical sciences. However, we must also accept that the curriculum should be a dynamic concept, flexible enough to accept the changing role society expects from the doctors from generation to generation. The twenty-first century demands a doctor who is not only competent in managing the patient but also able to use innovation to solve the numerous challenges of the healthcare industry. The question to ask is not the necessity for these changes but how best to add it to the curriculum without compromising the traditional competencies of doctors.

Entrepreneurship can be implemented by introducing relevant modules on business ideation and enterprise development to the undergraduate medical curriculum. This systematically would ensure widespread delivery and the nurturing of a new set of healthcare professionals from the onset (Kassirer, 2007). Another possible approach is to delay until the penultimate or final year in medical school, where entrepreneurship and innovation courses will be taken as electives. This will allow medical students to be grounded in clinical skills before taking such courses. Those with deep interest can now apply for advanced programs in postgraduate studies. There will be a need for research to be carried out, where these methods are trialed in medical schools and the real impact on medical education is assessed. It will answer the question of how best to position entrepreneurship and innovation within the context of a medical school curriculum, whether as an elective, a core curricular requirement, or a more advanced and rigorous learning program of intercalated or dual degrees.

Moreover, there is a need to answer the question of a suitable teaching style for infusing entrepreneurship into the medical curriculum. The suggestion of ‘entrepreneurship wards’ or apprenticeship programs in biomedical companies or certified private clinics is instructive and seems to be consistent with the age-long clinical apprenticeship teaching approach that has been used successfully by medical schools for decades. Didactic lecture styles followed by robust discussion

among students and experts were used successfully by researchers at the University of Toronto's distributed medical education campus in Mississauga to teach entrepreneurship modules to early-stage medical learners (Ahrari et al., 2021).

Although contemporary medical students may benefit from a structured teaching approach, they would appreciate more interactive learning experience and instruction that is delivered in shorter segments, including flipped lectures that incorporate media resources such as videos, audios, and other interactive resources that support paced-learning (Buja, 2019). Perhaps an amalgamation of the two teaching styles will give better results. Clinical medicine is evidence-based; therefore, the curriculum for teaching medical students should be designed with this important standard in mind. Further research is required to unveil the best teaching style for the enrichment of medical school curricula with insights from entrepreneurship education.

From the foregoing, it is right to affirm that no single approach has been proven to be the best in embedding entrepreneurship into the medical curriculum. However, the marriage of medicine and entrepreneurship curricula to create medical entrepreneurship is plausible and feasible by reviewing and enriching the undergraduate medical curriculum. To realize the novel goal of medical entrepreneurship, policymakers in medical schools should understand that curriculum design is dynamic and progressive, not static. At the same time, all stakeholders in medical education should be wary of the risk of distraction from the core focus of medical education by giving preference to commercialization over the known ethical principles in patients' care, which is the hallmark of the medical profession.

In conclusion, flexibility in the curriculum between medical schools and postgraduate medical colleges would obviously help in providing different choices and pathways for willing medical students to focus on medipreneurship, thereby becoming medical entrepreneurs. This presents two advantages: (a) the medipreneurs would be acceptable in the medical profession and (b) the medipreneurs, as trained medical doctors, would better respond to the healthcare needs and problems of twenty-first-century communities.

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Chapter 11
Social Entrepreneurship and Medical Entrepreneurship: Lessons from Nigeria

Ik Muo

1 Introduction

Entrepreneurship involves creating innovative values while absorbing the attendant risks in anticipation of some economic returns. It is all about the ability to identify and evaluate opportunities, acquire necessary resources and take adequate steps to successfully exploit these opportunities (Muo, 2020; Oladimeji & Ezeh, 2021; Muo, 2021a, 2021b). An entrepreneur is one engaged in entrepreneurship. The requisite skills for successful entrepreneurship are diverse and vary with the time, industry and environment. For instance, ICT skill was not central to entrepreneurship in the 1950s, but it is now a sine qua non, but the weight of its importance differs between somebody in software development and another in events management. However, the entrepreneur must possess the entrepreneurial spirit, that inner force that continues to propel and energize the person (Julien, 2007). Entrepreneurial alertness, the ability to sniff out opportunities long before others do so and before they become commonplace, is also critical in this furiously changing world. The key elements of this alertness are scanning and searching, association and connection, evaluation and judgement (Tang et al., 2012). It is vital to identify the opportunity that impacts one's mindset for exploiting these opportunities and has a positive and significant effect on attitude, subjective norms, perceived behavioural control and entrepreneurial intentions (Hussien et al., 2016). The environment is also an important factor since it determines the boundaries of entrepreneurial activities, influences entrepreneurial goals and objectives and creates change because of its restlessness. There are many genres of entrepreneurship, including corporate, green, medical and international entrepreneurship; *techno-preneurship*, *agri-preneurship*, and *edu-preneurship*. Indeed, it is now normal to add '*preneurship*' to any profession or

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business to create a new brand of entrepreneurship. However, our focus here is on social and medical entrepreneurship.

Social entrepreneurship (SE) is the science and art of designing and implementing sustainable solutions to communal challenges with a business and entrepreneurial mindset. These challenges may be environmental (desertification, climate change or refuse management), social (out-of-school children, *almajiri* phenomenon or the challenge of illiterate traders) or cultural (attitude towards female education or holding the first son responsible for the father's funeral, irrespective of his material circumstances). In doing so, the entrepreneur adopts practical business models to provide innovative solutions with significant social impact while maintaining the business traits of discipline, determination, perseverance and strategic flexibility (Net Impact, 2022). SE has no generally accepted definition, as the meaning varies with the users and the environment. That is why Cargman et al. (2020) examine it from a 'German lens' and identify five dimensions that extend the core term: societal-visionary, ecological, societal entrepreneur, innovative entrepreneurial and economic. These five dimensions collectively possess 50 attributes (Fig. 1).

Medical entrepreneurship (ME), on the other hand, is the process of identifying and filling gaps in the healthcare sector by providing the appropriate products that satisfy the needs and preferences of the customers (Raimi, 2019). A medical entrepreneur is a person engaged in medical entrepreneurship. ME has many branches, including public health and healthcare entrepreneurship, digital health entrepreneurship and even trado-medical health entrepreneurship. ME has been described as a gold mine in Nigeria (Damagun, 2021; Edom, 2020; Idowu,

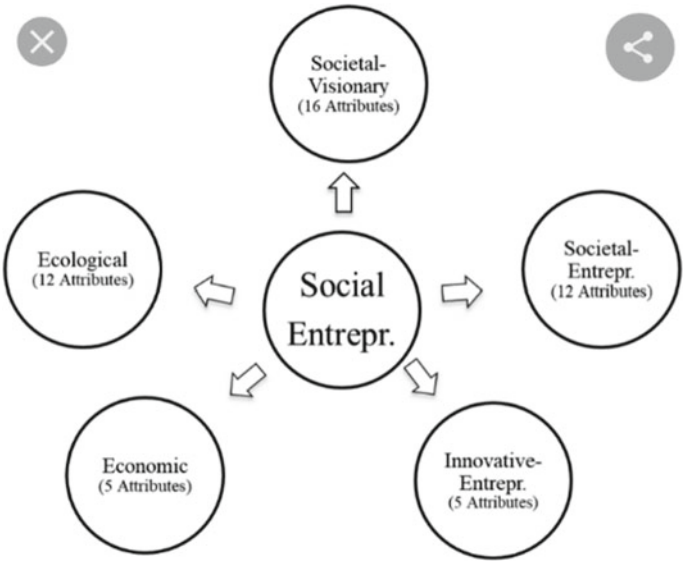


Fig. 1 Five dimensions and attributes of SE (*Source* Cargman et al., [2020] https://doi.org/10.3390/su12187764)

2015) with opportunities in areas of VIP/exclusive treatment, nonemergency medical transportation, smoking cessation services, medical waste disposal, remote site emergency support, medical financial and billing solutions, weight management clinics, egg and sperm banks and mobile medical screening services. The prospects for ME are also high in Nigeria due to a poor doctor-patient ratio precipitated by a worrisome medical brain drain, poor budgetary allocation to health, poor service quality and alarming rate of medical tourism, mostly in India (Raimi, 2019).

ME is common, while SE abounds to a lesser extent, but a combination of social and medical entrepreneurship is not common. This chapter is a study of one of the cases of social and medical entrepreneurship in Nigeria, Apex Specialists Nigeria Ltd., founded by Professor Uchenna Nwosu and located initially in the rural community of Igbo-Ukwu, Anambra State. It is expected that lessons will be mined from this study for entrepreneurial and policy purposes.

2 Literature Review

Social entrepreneurship (SE) as a concept has been defined by various scholars and researchers across different disciplines. It is a variant of conventional entrepreneurship, which focuses more on general societal benefits, without losing sight of the natural entrepreneurial profit orientation. SE in effect involves undertaking an enterprise with the major objective of proffering solutions to some socioenvironmental challenges. ME, on the other hand, focuses on making socioeconomic impacts in the healthcare sector. The medical entrepreneur, for instance, notices the lack of quality health and health care and takes steps to fill the gap. From this perspective, social and medical entrepreneurship are intertwined, as they are both aimed at innovatively mitigating health challenges among citizens. However, medical entrepreneurship is not limited to rural communities.

In their evaluation of SE as a veritable tool of sustainable development and rural transformation in Nigeria, Madu and Yusof (2015) argue that the government's ability to create an enabling environment for successful engagement and collaboration is key to achieving results. Surely, an inconducive environment remains one of the major factors militating against social entrepreneurship vibrancy and sustainable rural transformation. Looking at this issue from the health sector, Arowolo (2021) notes that the disparity between urban and rural areas in terms of healthcare accessibility is one of the reasons why the health status of urban dwellers is better than that of their rural counterparts.

Furthermore, Arowolo (2021) proposed transformation and improvement approaches backed by adequate funding to record success in the SME of a nation. Adeniyi, Ighalo and Adeyanju (2020) note that poor harnessing of natural and human resources is the major bane of sustainable development in Nigeria. This is the underlying problem of transforming socioeconomic infrastructure in Nigeria, which is why it is connected to SMEs. In their own wisdom, Ada et al. (2021) identify knowledge transferability between hospitals and other healthcare units within

the community as a prerequisite for building a strong healthcare system. From the viewpoint of sustainable entrepreneurship and innovation, Jackson, Maleganos and Kleopatra (2016) argue that the effectiveness of businesses is highly connected to the vibrancy of the healthcare system in the community within which it operates. This suggests that SMEs are critical to the transformation of any economy. Thus, the government should strengthen healthcare infrastructure and support related institutions and professionals to transform the health system so that social and medical entrepreneurship will contribute meaningfully towards the attainment of sustainable goals.

Dacin, Dacin, Tina and Matear (2017) examine the state of social entrepreneurship vis-à-vis other types of entrepreneurships and conclude that there is no clear distinction between social entrepreneurship and conventional entrepreneurial frameworks. However, they identify five features, three of which are similar to the traditional entrepreneurship models: challenging the traditional mindset, seeking complementary supporters and engaging in continuous experimentation, while two are peculiar to social entrepreneurship: recruiting social-profit-oriented investors and signifying social-profit objectives clearly and at the initial stage. Battaglia, Paolucci and Ughetto (2021) submit that the advent of the COVID-19 pandemic has further created socioeconomic crises but also highlighted the inevitability of doing things differently and thus culminated in many innovative spinoff opportunities. This includes the pervasive application of social media and other internet platforms for healthcare delivery (Hawn, 2009), which significantly revolutionized healthcare services, improved cost effectiveness and created opportunities for social and medical entrepreneurs. The issue of racism and biases are part of the challenges militating against the sustainability of SMEs, and health practitioners are advised to eschew stigmatization (Sun et al., 2022).

There should also be greater coordination and collaboration among the institutions involved in SMEs because interorganizational collaboration is the panacea to solving organizational and intersectoral problems (Adeneye et al., 2021; Dacin et al., 2017; Yunus et al., 2010). In view of the foregoing, a paradigm shift is required from the shareholder mindset to the stakeholder mindset so that typical entrepreneurs will be encouraged to focus on social entrepreneurship: solving humongous problems affecting our communities. Similarly, Partington, Wynn, Suriadi, Ouyang and Karnon (2015) note that strengthening the processes within the sector will be a push-factor for social entrepreneurship, just as Hardy and Philips (1998) suggest strategies to help the business community include effective collaboration, uncompromised compliance, contention and contestation.

Medical entrepreneurship (ME) is a rapidly expanding field of research and practice due mostly to the increasing opportunities in the field, especially in this digital age. It is rapidly growing in terms of practitioners, resources committed, and revenue being generated; it has become a cross-border phenomenon due to medical tourism. Badulescu and Badulescu (2014) argue that a wide range of medical-tourism services are being entrepreneurially undertaken by the private sector, especially in markets distorted by regulations. Similarly, Njuguna et al. (2021) contend that enterprises within the ME ecosystem are facing many supply chain challenges, such

as late deliveries. ME is thus currently inefficient and ineffective, and as such, more players are needed, including supply management institutions, procurement experts, tourists, insurance, warehousing and information integration professionals. Of course, its scope is ordinarily broad and, as highlighted by Raimi (2019), includes general healthcare services, medicine, biotechnology/information communication technology (ICT) and medical innovations. It is thus obvious that disruptive innovation is taking place within the healthcare sector at large, which confers benefits for stakeholders in the form of improved accessibility to health care. The increasing incorporation of ICT will also enhance the efficiency of medical entrepreneurs with enviable micro- and macroeconomic impacts.

According to Fichman, Kohli and Krishnan (2011), the essence of ICT in ME is to enhance healthcare effectiveness and efficiency. Similarly, Igor, Inna, Svetlana and Anna (2019) posit that investing in digital, cybersecurity, open data and e-payment infrastructure will all assist in digital economic transformation, which will positively affect ME. These developments will also provide opportunities for new product architecture and general innovativeness for all businesses, including ME (Yoo et al., 2010).

From the performance management perspective, Buttigieg et al. (2016) opine that health care is migrating from output-based to a system-based approach, which, together with other improved management processes, are now making positive differences in terms of performance and competitiveness across the health industry at large. On the other hand, Gudkov and Dedkova (2020) focused on tourism and argued that digitalization can help medical entrepreneurs optimize medical tourism, but the collaboration of all stakeholders, including researchers, is essential in this regard (Walker & Ko, 2016).

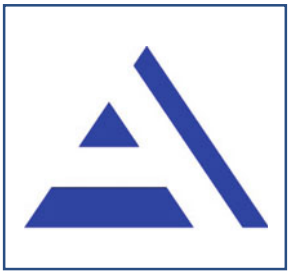
3 Methodology

This was a descriptive qualitative study that adopted open-ended extensive interviews as the method of data collection. It is a case study of Professor Uchenna Nwosu and the Apex Specialist Hospital, which he founded at Igbo-Ukwu, a rural community in Anambra State, in 1981. This hospital is apt for the study because the founder through it provided innovative solutions to social problems, and initially, the profit motive was not prominent. He is also engaged in ME because he identified and continues to identify and fill gaps in the healthcare industry with appropriate products in line with customers' preferences. The founder also exhibited entrepreneurial tendencies and has expanded and modernized its operations and relocated to Awka, the capital of Anambra state. The interview, conducted solely by the author, revolved around biography, motivating factors, business and general values, business challenges and experiences, the impact of government policies, succession plans and the practice of apprenticeship. The interview was done verbally and recorded. These were then transcribed and further reviewed with the interviewee for quality control purposes.

4 Insights

This section presents the highlights of an extensive interview with Professor Uchenna Nwosu, Medical of Apex Specialists Ltd., a hospital engaged in social and medical entrepreneurship, which started in Igbo-Ukwu, 2001, with some branches in other parts of Anambra State before berthing at Awka, the State Capital. Some parts of this interview have been published before (Muo, 2018a; Muo, 2018b; Muo, 2021a).

Professor Uchenna Nwosu was born in 1938 in Igbo-Ukwu in the present day Anambra State. His father was a retired policeman, deeply religious, a disciplinarian and a hard-working man, while the mother was a successful entrepreneur. From both parents, he learned the values and virtues of hard work, entrepreneurship, honesty and love for community. He attended Government Secondary School, Afikpo for his secondary education and Kings College Lagos for his Higher School Certificate, Harvard College for his undergraduate degree in biochemistry and Boston University, where he qualified as a Medical Doctor in 1968. He became involved in the Biafran win-the-war efforts and then went into research/residency. He became a Senior Lecturer at the University of Ife in 1977 and a professor of Obstetrics and Gynaecology in 1980.



Prof. Uchenna Nwosu…. Apex Logo

The establishment of Apex Specialist Hospital, Igbo-Ukwu, was borne more out of commitment to community development rather than money-making motives. The vision for the hospital was conceived on 30 August 1954, when his father died due to the absence of medical facilities. His sick father was treated with holy water and coconut oil as prescribed by his church, a denomination that forbade any form of medication. By the time, the church authorized the family seek medical attention for their patriarch, it was too late; he had become very weak, and there was no means of going to the hospital at Adazi-Nnukwu, approximately 6 miles away. Therefore, ***the man died***. There and then Uchenna resolved that he would not only read medicine but would establish a hospital at Igbo-Ukwu so that nobody would die for lack of medical attention, like his father. That was the mental foundation of his social and medical

entrepreneurship. As a US-trained and research-oriented gynaecologist, Prof Nwosu did not find Nigerian University life very exciting and believed that he was wasting his time at Ife. That was when he remembered his 1954 resolution and decided to move from dream to reality by establishing a hospital at Igbo-Ukwu and giving back to the community after his sojourn in the US and then Ife.

Friends, relatives and colleagues thought that the Prof was crazy, especially on account of the Igbo-Ukwu aspect of the agenda. They wondered how a US-trained Professor could relocate with his family, including a foreign wife, practice medicine and survive in the rural area, where there was neither water nor electricity. They did everything to dissuade him, advising him rather to consider Lagos, Enugu and Onitsha. In fact, Eric Nwobi, his friend, always showed him all the landmark buildings owned by medical doctors in Lagos. However, each time he visited the village, people troped to his house for medical attention, which reinforced his earlier conviction. There was also the usual initial challenge of finance. Then, his friend, Eric Nwobi, loaned him approximately 66% of the projected project cost, without any formalities, witness or documentation, and that was when he had not formally asked for the loan. He also met the late Chief Ezeadilieje Okoye, appreciated the import of what he was planning and gave him the building that housed the hospital after a discussion that did not last up to 10 min and at a nominal rent.

Getting professionals to key into the hospital dream was difficult. All Igbo-Ukwu nurses he approached flatly turned down the offer. Everybody thought it was a huge joke; there were no private hospitals then, and the idea was strange. He therefore decided to create the staff, remembering the words of our elders that *ihe amahu ka esi eme, etu esine mee ya, o bulu ka esi eme ya* (whatever you don't know how to do, however you do it becomes how it is done). He must also have been encouraged by the doctrine of *kwakam puta, kwakam esobe ya* (an unusual situation demands an unusual response). Therefore, he decided to build up his staff from scratch. He placed announcements in the churches, and from approximately 100 that replied, he employed 30. He prepared a curriculum and taught them the basics of biology, physics and the science of heat, light and electricity, mostly through visual aids and prolific analogies. He also discussed properties of living organisms, relating each to human anatomy and organs and the usual medical practices and processes. Those who scaled through the first stage went on to the clinical training stage: vital signs, use of hospital equipment, drug and drip administration, patient communication and the essence of confidentiality in medical practice.

Moreover, recruiting doctors was also impossible for the same reasons: the perceived impracticability of his dream and the location of the hospital. However, he eventually obtained an expatriate quota from the government and employed two doctors from Ghana. In addition, that was how Apex Hospital took off on 1 August, 1981. It became the first private hospital to be approved for Part 2 Residency in the whole of Eastern Nigeria, if not in the entire country. He had along the line, got other people interested in the project and today Apex has a credible, functional board of 10 with 45 shareholders. The major challenges Prof Nwosu encountered as a first time and trail-brazing social and medical entrepreneur (first private hospital, established by a US-trained Professor in the environ) were the reluctance of people to buy into

his dream, lack of staff, paucity of capital and poor returns (in a village economy), worsened by the fact that it was far more difficult to medically educate a patient in Nigeria than the US where he acquired his experience.

Beyond Apex, his flagship venture, Prof Nwosu eventually diversified into other related and unrelated businesses. The hospital literarily gave rise to the mortuary business. The mortuary business, like the hospital, is a practical response to a personal experience. His mother had died while he was at Ife, and due to his status and social expectations, the mother could not be buried quietly and immediately. He requested Professor Ige Grillo of Obafemi Awolowo University (OAU) Anatomy Department to embalm the corpse, while he watched. When the corpse arrived at Igbo-Ukwu two weeks later, people were wondering openly how it was still *fresh. A*t that time, nobody had seen an embalmed corpse at Igbo-Ukwu, a community that was used to the refrigeration mode of corpse preservation. When he started Apex, it was obvious that some patients would die, that delayed removal and deterioration of corpses would be the norm and that he remembered his experience with his mother's corpse. Therefore, he engaged technicians from the Anatomy Department of University of Ife who introduced and taught his staff, the art and science of embalmment. The first person who died at the hospital was embalmed, which brought attention to the practice of embalmment. The demand for embalmment grew in geometrical proportions, and before long, Apex became synonymous with embalmment in the whole country, since people brought their dead relatives from across the country and the obituary announcements in the mass media usually read: "… body leaves Apex Medical Center Igbo-Ukwu…" To restore the Apex brand to its original purpose and institutionalize the embalmment business, he established the Allied Medical Services, with the first branch established in faraway Aba, Abia state while another branch was later established at Nkwele-Ezunaka, in Anambra State. *Today, Apex Specialists operates in its permanent site (commissioned 2002) using an outsourced management model, with a ten-member board, 45 shareholders and Prof Nwosu as the Medical Director. Allied Medical Services also has its own board and shareholders.*

Apex has now grown beyond the Igbo-Ukwu vision because he believed that there was a limit to how far the catchment-area mindset would go. People also eventually started believing in him by investing in the hospital, and that was how Apex moved to Awka, the capital of Anambra state. He has thus attained his entrepreneurial aspirations by depending on OPM (other peoples' money). The initial plan for Awka was to establish a funeral home as is practiced in the US. So he went to the US, understudied the business and came back to implement the idea, but it did not work. In addition, so, it started as a normal embalmment centre, which he was already used to. He mentioned the Awka idea to his in-law, whose mother had died for lack of blood, and he pledged to donate a blood bank if he was going to Awka. So the idea mutated to establishing a blood bank that would cost about $100,000 then. He then added a diagnostic centre to integrate it with the blood bank. In addition, this took off in 2012. He then felt that people who visited the lab might need to consult a doctor, and thus, an outpatient doctor's office was added. It also became obvious that some of those who saw the doctor may end up on admission and put on an inpatient

building. They have just started the Apex School of Nursing, which is based at the Apex Permanent Site, Igbo-Ukwu.

The integrated complex is modern, with excellent aesthetics and modern equipment, and thus attracted the attention of specialists who wanted to key into the Apex success story. That was how the Orthopaedic Department was established and this attracted a physiotherapist. A neurosurgeon came on board, and then an intensive care unit was established. The hospital is now planning to engage an interventional cardiologist. Apex at Awka has adopted the American model where doctors do not own hospitals. It is thus an Apex model wherein Apex provides the coordinating management and shared services while the specialists dictate the tune in their own specialities, with responsibilities for their own staff (hiring, compensation and firing), treatment, charges and expenses.

Apex turned 30 in 2021. Professor Nwosu believes that the future is bright. The specialists came on board because even though they have expertise, they may not be able to build and equip modern hospitals. Most wealthy Nigerians prefer to indulge in medical tourism; however, most of the doctors who attend to them overseas are also Nigerian doctors. Therefore, as Apex has a well-equipped hospital and has the services of the specialists who trained some of the doctors whom Nigerians consult overseas, patronage will ultimately rise. Another entrepreneur has started CT-Scan (Computed Tomography Scan) and MRI (Magnetic Resonance Imaging) services in the neighbourhood (perhaps encouraged by Apex), so Apex and its patients have access to those services. Of course, Awka is an urban centre, far larger than Igbo-Ukwu, with better facilities and enlightened clientele. He is happy with the way things are turning out. The specialist hospital he wanted to establish in 1981 is now a reality. He now sleeps better and at 80 + , which is a welcome development. He is no longer totally in charge since each specialist heads his own unit as a Deputy Medical Director. His dream is to create a global medical institution. The consultants are taking over the dream, and they are the ones now urging and nudging him on. The ultimate is to have a medical school because he believes that they have what it takes. They have already acquired a large expanse of land at Umuleri, adjacent to the new Anambra Airport, for that purpose.

Prof Uchenna Nwosu is a perennial entrepreneur who ventures whenever and wherever he identifies opportunities. He established Novotech at Amaokpala in Aguata LGA of Anambra State (agriculture and manufacturing) and Tropicana Guest House behind his country home at Igbo-Ukwu. He is an ozo-titled man and Chief in Igbo-Ukwu.

It is obvious that Prof Nwosu always has his eyes and ears wide open in search of opportunities, a trait that enhanced his entrepreneurial adventures. He was a merchant as a small boy, selling matches in sticks, packets and boxes. At Harvard, he managed the Harvard Birthday Cake Agency, which involved soliciting for surprise birthday cakes from parents, for their children at the university. Therefore, his is a case of born-entrepreneur. He saw the abundance of unemployed women at Igbo-Ukwu as sources of nurses for his hospital; he realized that patients must die in his hospital and that removal of corpses would always be delayed and hence the need for a mortuary,

and when he noticed that there was an abundance of water at Amaokpala, he went into the water business.

The philosophies that guide his professional, business and general life were developed from his family background, personal experiences and general world view. His guiding philosophy is to act in such a way that what he does becomes the universal principle and that is why he believes in the golden rule (do unto others as you would have them do unto you: Luke,6:31). He is certain that when one adopts the golden rule, the person has internal peace, and even if one is not materially wealthy, he should at least sleep well at night. On the subject of integrity and business, he states unequivocally, "*a*ny business without integrity and character will collapse, at some point; if not now, then later*"*.

He also believes that entrepreneurs should be trustworthy and make deliberate efforts to build trust in their businesses. On his experience with the issue of trust, he remarks with regret that business is not always smooth. He recalls that Apex is not what he had wanted it to be. He had planned it to be a specialist hospital, at the core of which would be his relations. He brought three of them into the US: Okenwa-Surgery; Sunday-Internal Medicine and one of his nephews, Obstetrics and Gynaecology. Even though Okenwa returned to Nigeria, he had a different idea of what the hospital would be, and eventually, he beat a different path. Sunday did not return at all, although he later became an investor. The third one rejected the Nigerian citizenship outright, which was a major disappointment.

On the issue of succession, he does not believe in one-man businesses, as he always co-opts other people; compatible business associates, people who are successful in their own businesses and thus can infuse their ideas into his own for optimal outcomes. He operates with capable boards, which can make strategic decisions and oversee the management as the need arises. Now, he adopts the outsourcing model, in which his businesses are handed over to management 'contractors' who run the business on agreed terms.

On the impact of government on entrepreneurship as it affected him, Prof Uchenna Nwosu regrets that the government did not take any steps to positively influence his professional and entrepreneurial aspirations. He further observes that the infrastructural decay had an overwhelmingly negative impact on his undertakings and that the sociological environment was another problem. He is not happy that people did not understand health issues, and the government did not know how to make it understandable to the public. Prof Nwosu adds that there is also poor control of drugs that are publicly hawked like pure water along the streets. He reveals that he is allergic to borrowing due to his sad experience with Novotech. He had borrowed to build the factory, but the projections did not work out, and the loan eventually became due. After surviving that trauma, he had sworn never to take bank loans and rather opted to invite investors into his businesses rather than outright borrowing.

One practice for which Igbos in business are known is the apprenticeship system, and even though Prof Nwosu did not and does not have apprentices as such, he has an interesting perspective on apprenticeship and puts it thus:

> Apprenticeship means on-the-job training. It was the only alternative to rustic farming before the arrival of opportunities for mass higher education and oil money in the 1970s. The easy oil money short-circuited apprenticeship by creating instant "businessmen" in hot pursuit. Currently, apprenticeship is disappearing in favour of higher education and is being replaced instead by internships. Since the majority of school leavers are unable to achieve higher education for one reason or another apprenticeship should be encouraged

Based on his entrepreneurial odyssey, he advises impending entrepreneurs to discover unfulfilled niches, have a mental picture of how to occupy that niche (vision), stoop to conquer, persevere and be patient, embrace honesty, involve others with written and signed documents and plan how the business would be run after one's demise.

5 Discussion and Conclusion

Prof Nwosu is surely engaged in social entrepreneurship because he adopted practical business models to provide innovative solutions with significant social impact while maintaining the entrepreneurial traits of discipline, determination, perseverance and strategic flexibility (*Net* Impact, 2022*)*. In line with the views of Dacin, Dacin, Tina and Matear (2017), he signified social-profit objectives early enough and eventually recruited social-profit-oriented individuals into the board. He is engaged in medical entrepreneurship as he identified and continues to identify and fill gaps with appropriate products that satisfy the needs and preferences of the customers (Raimi, 2019). The prospects of medical entrepreneurship in Nigeria continue to be bright given the paucity of investment in health, increasing medical tourism by Nigerians and the worsening medical brain drain. One hundred medical consultants left 17 Nigerian institutions in 2020 and 2021; 3725 Nigerian nurses left for the UK in 2021, making it a total of 15,019 since 2017, while 805 doctors were licenced in the UK in the second half of 2021 (Tolu-Kolawale, 2021; Tolu-Kolawale, 2022; Globalupfront.com). The Nigerian budget for medical care in 2022 is 4.3% of the total and N3453 (approximately $6) per capita. While 4.3% is higher than that of 2021 (2.75%), it is still lower than the 20-year average of 4.7% and the highest of 6.08% in 2012. However, it is a far cry from the AU benchmark of 15%, which Rwanda has met consistently since 2001. The figures become worrisome when the impact of inflation is factored in (www//: devex.com) (Fig. 2).

Medical tourism is high and continues to rise. An analysis of Balance of Payment Data from CBN shows that Nigerians spent $11 bn on medical tourism between 2011 and the first quarter of 2021, 60% of which went to oncology, orthopaedics, nephrology and cardiology. The highest annual bill was 2019, when $2.5 bn was expended on it. (Oyeniran, 2021). I assume that this humongous figure excludes the overall cost of Buhari's medical tourism, including the 100 days he spent in the UK at a sitting in. Therefore, medical entrepreneurship continues to be an untapped goldmine, as opined by Idowu (2015, August 15). Global medical tourism is also on the rise, growing by 358% between 2000 and 2017 (FDI Intelligence).

Fig. 2 Budgetary allocation to the federal ministry of Health (N'Bn) (*Source* Devex Partnerships; https://www.devex.com)

The entrepreneurial odyssey of Prof Nwosu also shows that just as Julien (2007) argued, he possessed the entrepreneurial spirit, without which he would not have gone far. His degree of ALERT, which is vital for identifying opportunities, creates a mindset for exploiting these opportunities and significantly influences entrepreneurial attitudes and norms, is also enviable. This is in line with the arguments of Tang et al. (2012) and Hussien, Hashim and Iba (2016). He also

exhibited the entrepreneurial imperative of creativity and innovation whenever and wherever necessary. This is evidenced by the training of nurses, foray into embalmment, moving to Awka and establishing a school of nursing. It is also obvious that the government has not created an enabling environment for social and medical entrepreneurship, as advised by Madu and Yusof (2015). His story has also stressed the fact that the entrepreneur will not always receive a general acclaim for his ideas and may have to go it also, at least, initially. People thought that he was 'mad' to embark on a rural hospital project, but he did not allow that to derail his dream. Family support is also essential, as he was and is still supported by his wife and children.

6 Implications of Findings and Policy Prescription

The implications of the findings are as follows:

i) Social and medical entrepreneurship is inevitable in an environment such as ours where healthcare infrastructure and public healthcare services are poor and underfunded.
ii) Social and medical entrepreneurs should possess the general traits of entrepreneurship, such as innovativeness and creativity, entrepreneurial alertness, perseverance and having a knack for identifying opportunities.
iii) The government has not created an enabling environment and has not provided support for social and medical entrepreneurship, even when this is obviously in the public interest.
iv) The entrepreneur should not expect to receive general acclaim for his ideas and may have to go it alone initially.
v) Family support is essential. The wife supported him wholly and still supports him to the present day. The story might have been different if she had joined other nay-sayers
vi) As time goes on, even those who were sceptical about social and medical entrepreneurship will have a change of mind and support the venture. He eventually had shareholders and was/was able to raise funds for the expansion and modernization of the enterprise.
vii) Social entrepreneurship does not mean a charitable or loss-making venture. Apex moved from a rented apartment to an expansive permanent site to a modern medical complex at Awka. This evidence indicates good financial performance.
viii) There are born entrepreneurs, and Professor Nwosu appears to be among this breed. He studied biochemistry and medicine, but his passion to produce medicare to his people turned him into a social and medical entrepreneur.

Based on the foregoing, the following recommendations are made:

- The government should create an enabling policy and physical environment for social and medical entrepreneurship.
- There is a need to subsidise entrepreneurs engaged in social and medical entrepreneurships. Special grants, tax waivers and provision of land may be considered.
- Entrepreneurs should dig in; exercise patience during the teething period support comes in the form of investors.
- Social and medical entrepreneurs should avoid the temptation of going it alone because it limits their ability to expand and optimize economies of scale.
- Social and medical entrepreneurships are not much different from conventional entrepreneurship. Those engaging in this genre of entrepreneurship should thus receive appropriate training on entrepreneurship practice and skills.

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Chapter 12
Case Studies of Medical Entrepreneurship

Fardeen Dodo, Muhammad Rabiu Balarabe, and Maryam Abdulkadir

1 Introduction

Healthcare is perhaps one of the most fundamental areas of livelihoods among people. Since the industrial revolution, the quality of healthcare has improved worldwide through correct diagnoses, effective treatments and potent medications. However, the distribution of accessibility to healthcare, particularly in developing countries, remains highly uneven (Peters et al., 2008). While governments and nonprofit organizations are striving hard to reduce healthcare access disparities worldwide, a clear stream of industry activity helping to fill the pocket of inefficiencies is the private sector. According to the World Bank, the share of total health expenditure among people is inversely related to the wealth of the country (Peters et al., 2008). Not only has this initiated several public reforms worldwide, but the presence of vibrant private sector participation in various areas of the healthcare industry has also slowly emerged to various extents, from complementing to replacing public interventions in some contexts (Fig. 1).

The importance of the private sector in delivering healthcare is so important that some countries have emerged several laws and administrative structures to guide and regulate how private firms operate independently and on behalf of the government. These include but are not limited to administrative departments and institutes, laws and acts, penalties for violation of laws, statutes and general ethical guidelines to eliminate fraud and unethical behaviour (Iyer & Solomon, 2020). In developing countries, however, the rising participation of private actors is an increasing reality,

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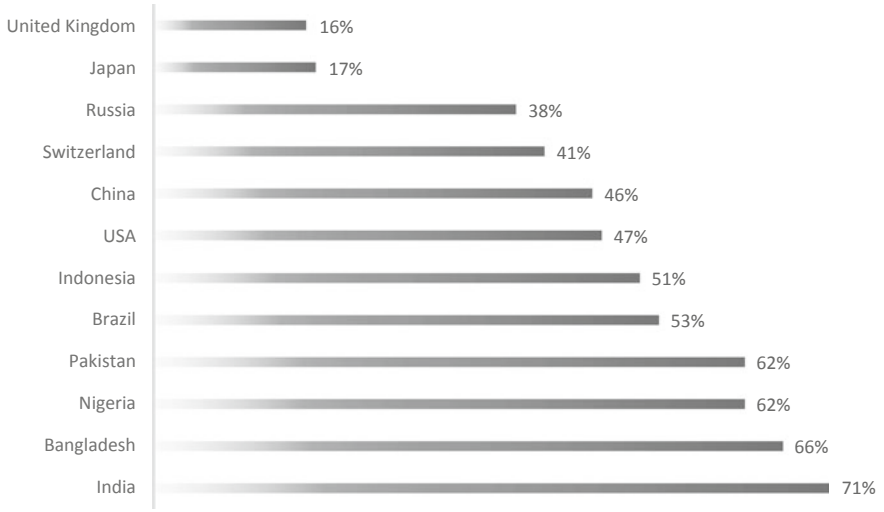

Fig. 1 Healthcare (part of total) expenditure

however, amidst weaker regulations, making for a context that could rationalize both transformative entrepreneurship as well as rent-seeking and fraud (Atogenzoya, 2020). Given the relevance of entrepreneurship in the work of enhancing healthcare access among people, this book chapter presents the results of an exploratory study of examples of medical entrepreneurial organizations and initiatives, and how they are using entrepreneurial approaches to improve access to medical products and services in the various subsectors of the healthcare industry.

2 Literature Review

2.1 Medical Entrepreneurship: Commercial Vehicles

In seeking to explain how entrepreneurs operate in the medical industry, several vehicular models have been attributed to entrepreneurship in the medical industry, focusing primarily on how entrepreneurs appropriate access gaps in the healthcare industry based on exploratory case analyses. According to O'Donnell (2007), the fundamental dimensions to the healthcare access dilemma have been, on the one hand, around the fact that quality healthcare may not be available, and on the other hand, the issue that people may be unable to access it, even if it is there. Therefore, this not only rationalizes entrepreneurial action, which has sought to innovate new effective offerings and systems (Schumpeter, 1934) but also simply bridges what is required versus available through knowledge of market imperfections (Stevenson & Jarillo, 1990).

Studies have, therefore, sought to illustrate exactly how entrepreneurs go about ameliorating these market imperfections. Bloom and Chu (2012), for example, identified four features of commercial models that have been evidenced in the private sector's attempt to bridge the access gap, particularly in developing countries. From the perspective of how firms bridge the geographical access gap for clients, South African BroadReach, for example, leverages a network of primary healthcare service providers to offer advanced care to patients with no hitherto access. From the perspective of developing cheap and effective products and services, Indian Sulabh International's cheap and sustainable toilet system provided a rapid and healthy alternative to the commonly practised open defecation to address its many health and well-being effects. From the perspective of building a new frontier of price versus performance, others have organized more efficient and effective systems that are helping to ameliorate systemic dysfunction in healthcare systems. Farmacias Similares in Mexico, for example, uses a chain of pharmacies that provide cheaper medicines than traditional drugstores. In addition, the likes of Aravind and Narayana leveraged process innovations and pricing mechanisms to drive down the cost of healthcare and reach millions without prior access.

3 Theoretical Development

3.1 Entrepreneurship

Entrepreneurship is generally regarded as the overall journey of identifying opportunities and organizing businesses to appropriate them and deliver any combination of economic, social, cultural or environmental value. First recognized by economists in a bid to explain how an emerging genre of economic activities is transforming economies and creating wealth (Schumpeter, 1934), after which subsequent dimensions of entrepreneurship continued to emerge from the management literature. These, according to Stevenson and Jarillo (1990), can be divided into 'what happens when entrepreneurs act', 'why entrepreneurs act the way they do', and 'the hows of doing entrepreneurship'. However, in conceptualizing studies (in medical or other sectors), proxies of the entrepreneurship term have ranged from the 'actor' in the process—the entrepreneur (Mueller, 2011), the 'act' of doing entrepreneurship (Sauka & Welter, 2007), to the 'product' of the act, which is the enterprise itself (Acs et al., 2008).

However, despite initial attempts to explain entrepreneurship in the medical industry, there remains a considerable need to build a more elaborate lens to understand the overall commercial pipelines through which medical entrepreneurship is pursued. For this work, the business model canvas will be used, given its universality for developing, iterating and documenting the strategic infrastructure used to build businesses. Founded in Normann's (1971) original positions on business idea,

which represent the coordinated set of activities that firms use to gain a competitive advantage. The business model provides a common approach to envisioning, iterating, building and implementing new business ideas (Stenn, 2016). Additionally, as pointed out by Osterwalder and Pigneur (2010), the business model canvas is designed not only for-profit-oriented firms but also for organizations that have strong nonfinancial missions, such as those oriented towards social, environmental, or public services causes and mandates.

3.2 Medical Practice

The healthcare industry (also called the medical industry or health economy) is an aggregation and integration of sectors within the economic system that provides goods and services to support or treat patients before, during or after the manifestation of illnesses. There are hence two dimensions for seeking to understand the healthcare industry relative to its subsector and the stage of the value chain. Therefore, from the point of view of the industry subsector, the primary care sectors in the healthcare industry are: preventive (focused on avoiding the occurrence of health problems), curative (focused on treating already occurring illnesses), rehabilitative (focused on restoring the functional abilities of persons with physical impairments and disabilities) and palliative (concerns about optimizing the quality of life among people with serious, complex issues). From the perspective of the stage of the value chain in which entrepreneurs operate, medical ventures can be either give supply providers [such as technology providers, labs, pharmaceutical companies], primary care providers [primary care facilities, hospitals], secondary care providers [specialized hospitals, advanced medical service providers] and auxiliary services [such as pharmacies, laboratories, physiotherapy, researchers—epidemiology, public health and consultancy firms].

3.3 Entrepreneurship in Healthcare

From an understanding of the healthcare industry and entrepreneurship, this chapter seeks to examine how entrepreneurial actors are identifying and appropriating opportunities in the various sectors and lifecycle stages of the healthcare industry. This means that we examine how entrepreneurial actors in the healthcare industry are helping to bridge access gaps to medical services and products through particular aspects of the business strategy as encapsulated in the business model canvas.

4 Design/Methodology/Approach

The overall approach to this study is a qualitative exploratory design that is best for relatively understudied phenomena (Cresswell, 1994). Even then, the paper sought to leverage the strategies of case-based research by using a theory-informed sampling design to ensure as opposed to statistical sampling (Eisenhardt & Graebner, 2007). This was implemented by including cases of medical entrepreneurship based on how they use particular and combinations of the 9 elements of the business model canvas to address the healthcare access gap across the healthcare value chain and in various industry clusters. In total, 50 cases were sufficient to achieve theoretical saturation, which is typically implemented when limited additionality is achieved regarding the insights being generated (Strauss & Corbin, 1997). Cases were identified using a simple internet search that was targeted towards communities of medical entrepreneurship, including: professional associations, industry magazines and newspapers, practitioner conference publications, trade expos, literature, business listings, trade unions, technology platforms, online shops and social media posts. Additionally, the organizational entities included: small businesses, private businesses, social enterprises and nonpublic-funded initiatives (such as self-help and nonprofit organizations) and cooperatives and initiatives that operate in curative, preventive, rehabilitative and palliative care sectors.

5 Findings

5.1 Category 1: Platforms

Platforms mainly offer new and more effective channels for delivering healthcare services to customer segments. They constitute forms of businesses or organizations that either connect individuals with healthcare services or provide remote healthcare advisory or technical services to individuals and/or healthcare providers. This is typically achieved either through digital/technology vehicles such as mobile applications and software or physical establishments that facilitate healthcare services and product delivery and exchanges between healthcare providers (Business to Business, B2B) or between healthcare providers and patients/individuals (Business to Customer, B2C). Further analyses allowed categorization of these platforms into four, including patient-only platforms, provider-only platforms, patient-and-providers platforms and platform facilitators. This subcategorization allows for deeper scrutiny of the similarities and nuances that exist in the cases within and between categories.

Subcategory 1: Patients' Only Platforms

One dimension of platforms is those that only focus on patients, typically using autonomous digital technology solutions and advisory services to address existing or manage long-term healthcare issues mainly through software applications (apps) or mobile telecom infrastructure. Examples of mobile apps include *HealthlifeMe*, which provides weight loss tips and lifestyle advisory services based on users' medical conditions and habits using a software application. *Wysa* promotes mental health through app-based chatbots to enforce cognitive behavioural therapy for people with mental health challenges, providing clock support. *MyPaddi* also uses a software app that advises about youth-friendly sexual and reproductive health while allowing the participants to remain anonymous.

Examples of those using telecom infrastructure are *Safermom*, which makes use of voice notes and SMS messages to remind nursing mothers of any check-ups or vaccinations for their newborns using mobile telephone infrastructure, and *SEHAT*, which is a telemedicine platform where people living in rural communities can buy generic medication more easily. In essence, all cases in this subcategory provide digital services and solutions that help patients and individuals become managers of their health. The last business in this group is the *PRC Recovery Centre*. As the name implies, the *PRC Recovery Center* provides psychological therapy to recovering drug addicts.

Subcategory 2: Healthcare Providers Only Platforms

This subcategory comprises businesses whose platforms assist healthcare providers in administering their services more easily and effectively by offering infrastructural resources to make better decisions for helping patients. Similar to the patients-only platform, the businesses in this category typically provide digital technology solutions to healthcare providers. Examples of businesses in this subcategory include *Medlinker, Global Healthcare System, Baobab Health Trust, Promedeo* and *Kitcheck*. While *Medlinker* serves as a platform for experienced medical doctors to share their medical expertise with their junior colleagues and increase collaboration between their doctors without the need for a physical meeting, *Global Healthcare System* and *Baobab Health Trust* provide platforms that allow for precision diagnostics and digital healthcare record-keeping systems, respectively, for practitioners. However, *Promedeo* and *Kitcheck* help to digitalize the inventory and stocktaking processes of hospitals, thereby enhancing their performance.

Subcategory 3: Patients and Providers

This class of medical enterprises typically connects establishments such as hospitals with patients. By replacing the traditional marketing channels of in-person visits to the hospital, these businesses are illustrating an electronic way of providing

healthcare. For example, *Maya* approaches this by helping patients to perform self-diagnosis and reducing congestions in health centres using an app accessible on mobile phones and for flat monthly subscription. Likewise, *SeamlessMD* also uses an app to allow patients to become managers of their health after seeing the doctor, thereby relieving doctors of the workload of having to follow up with patients after clinic visits, leveraging both channels and relationships. *Dawa Health* similarly leverages an app vehicle, but particularly for providing services targeted towards assisting pregnant women and infant healthcare. Additionally, *Safermom's* approach follows suit targets women but enriches additional access options. They allow patients (especially pregnant women) to follow up on their health during pregnancy and beyond using voice notes and SMS messages to remind patients in their preferred language about any health check-ups or vaccinations. *Babymigo* provides very similar services as well but enriches the platform by allowing pregnant women to connect with and seek healthcare advice not only from doctors but also from other health experts in the platform community.

Another group of platforms encompasses businesses that further enrich the scope of services accessible to patients and healthcare providers. One such example is *WASPITO*. This business helps individuals find nearby doctors and health centres, discuss their health in forums coordinated by healthcare professionals and have virtual consultations; they also provide pharmacy and diagnostic services. *Xelpha Health,* on the other hand, provides solutions similar to those of *WASPITO*; only that it also hosts services for healthcare providers as well as patients with additional services for their needs, including artificial intelligence-aided decision support systems. Taking it a step further is *DawaSwift*. In addition to connecting patients and healthcare providers, it also directs patients to nearby pharmacies and efficient health insurance providers.

Another group focuses on specific healthcare needs and technologies. Given the importance of CT and MRI in healthcare delivery, *Rology,* for example, ameliorates the void access to quality radiologists in hospitals and health centres globally by providing a platform that remotely and instantly matches radiologists with cases from hospitals based on their availability and subspeciality. Similarly, *Helium Health* provides electronic medical records collection and storage systems and telemedicine services. Patients can use the *Helium Health* mobile app to access their medical records and make request loans for medical treatment.

5.2 Category 2: New Innovations

Another distinct category of medical entrepreneurial activities is those that develop or assist the development of innovations that bring new value in the industry and for a particular group of customers. Among them, some develop and commercialize innovations meant for specific groups of customers (patients and providers), while others facilitate innovation among others, altogether enabling the deployment of technologies and solutions that facilitate healthcare access.

Subcategory 1: Ecosystem Facilitators

Businesses in this group have designed technical support tools and assistance that have eased the activities of other businesses and startups providing medical services, especially digital health service providers. Examples are *Villgrow, Redbank* and *54Gene. Villgrow*'s approach to improving healthcare delivery is through the provision of technical assistance for social entrepreneurs looking to advance healthcare systems at grassroots levels, thus aiding the growth of for-profit companies and job creation. It has been able to do this by forming key partnerships with healthcare startups, universities and colleges. Similarly, *Redbank* helps hospitals and patients find safe blood for transfusion. This is done with the use of mobile services such as SMS and voice calls in real time, making the tedious process of obtaining blood, especially the rare blood types, quicker and easier. Another business in this group is *54Gene.* This business aims to expand the global genomic data used for development research in the medical field. By creating a database of African genomic data, *54Gene* hopes to democratize the process of drug discovery, molecular diagnostics and clinical programmes.

Subcategory 2: New Product and Service Developers

This group contains businesses that target specific customer segments with innovative products or services that address particular needs. Examples of such ventures are Wazi Vision, Crib-Aglow, *Ubenwa, Medfix, DREET, Faso Soap* and *OncoTherapy*. Some of these ventures in particular emphasize low costs. *Wazi Vision* provides low-cost diagnostic services and medical glasses for the visually impaired, using recycled materials to achieve lower costs than traditional products. Similarly, *Crib-Aglow* developed solar-powered foldable phototherapy cribs that used LED lights to help cure neonatal jaundice at hospitals in areas where there is no constant electricity. Likewise, *Faso Soap* aims to reduce Malaria prevalence in Sub-Saharan Africa with bathing soap. The product *Faso Soap*, a bathing soap, deters mosquitoes for up to 6 h after being applied through the disposal of soapy water in the sewage system, thereby preventing malaria through a minor shift in lifestyle.

Others emphasize problem solving typically through advanced technology. *Ubenwa*, for example, develops AI-powered software for the early identification of neurological and respiratory conditions in infants using their cry sounds. The technology captures a baby's cry, translates it and makes a prognosis. Similarly, *Medfix* promotes access to quality advanced healthcare technology solutions tailored to the particular needs of individuals, hospitals, laboratories and other healthcare service providers. Additionally, *DREET* (an acronym for detection, research, education, equipment and training) uses solar power to provide a hearing diagnosis with a mobile app using noise-cancelling headphones connected to a phone and produces a solar-powered hearing aid in an effective yet cost-effective way. Finally, *OncoTherapy* provides anticancer therapy and medication with minimal adverse effects. This

is a very important innovation given the problems and suffering associated with chemotherapy among cancer patients.

5.3 Category 3: At-Home Services

Businesses in this category, such as *Greymate Care*, *PhysioHome*, *GeroCare* and *Nguvu,* provide specialized in-home care services such as physiotherapy and at-home medical consultations and fundamentally leverage innovate both through business model elements of channels and relationships. Some of these offer services to a more generic audience. For example, *GeroCare* is a subscription-based service that gives access to regular doctor home visits for medical consultations and routine check-ups. *Nguvu* also provides digital services by providing access to trained and certified clinical therapists that provide at-home services.

Conversely, some others are more targeted in who they seek to serve or in what way. For example, *Greymate Care's* approach focuses on targeting elderly persons and providing companionship as well as specialized in-home care services. Thus, while the business focuses on providing at-home services, as in the case of all businesses in this category, it also targets a unique customer segment. Others such as *PhysioHome* are not very particular about the customer segment; instead, they provide value, particularly in the area of pain management and general physiotherapy services delivered in customers' homes.

5.4 Category 4: Technology Developers and Suppliers

This section hosts businesses very similar to the innovation developers, albeit focusing more on manufacturing (typically in mass) and supplying technologies to points of need. One clear lens to use in understanding ventures in this category is the breadth of their customer segments. For example, while *Sinapi Biomedical* and *Pharmed Vietnam* build and sell more generic products, *Ti-Tamed, Cape Ray* and *DiSA Vascular* are more focused on a particular group of products.

Regarding medical enterprises offering generic products and services, *Sinapi Biomedical* ensures that their products are general enough to be used for different illnesses and user-friendly enough not to require expertise when used, such as a specimen collection cup that can be used to collect any patient fluid or sample in ways that seek to archive collections that are as accurate and hygienic as possible. *Pharmed Group*, on the other hand, provides an array of healthcare product supply services, including distribution, warehousing, sales, marketing, e-commerce and contract services, typically for other businesses. Likewise, *Pharmed Vietnam* offers a platform for medical equipment exhibitions, hosting some of Asia's most popular medical events with 400 businesses from around the globe and 15,000 visitors coming to see them and exchanging ideas on how to improve existing medical technology.

Regarding enterprises providing more particular manufacturing and/or supply services of products, *Ti-TaMed* specializes in precision engineering using exotic constituents such as titanium, stainless steel, nitronic, aluminium and polymers and building products such as uniaxial screws that can be used to correct spinal curvature. Similarly, *CapeRay* develops a faster system for breast cancer detection, which combines two prior technologies with mammography, thereby assisting with better cancer prevention. *DISA Vascular* develops vascular technology for the treatment of coronary artery disease and targets the whole of the African continent as manufacturers of cardiology-related surgical devices.

5.5 Category 5: Healthcare Logistic Services

The companies in this section focus on facilitating logistical and inventory management need peculiar to the healthcare industry benefitting hospitals by reducing delays and improving patient care. Examples include *ConnectSx*, *FullSight Health Analytics, LifeBank* and *Flying Doctors Nigeria*.

ConnectSx helps hospitals track the broader array of available resources, such as beds, rooms and respirators, thereby better managing existing patients and making informed decisions on which patients to admit and when. *FullSight Health Analytics*, on the other hand, focuses on taking inventory for medication. A hospital reducing their money wasted on unneeded medication means that they can use the extra money to reinvest in other departments that may need updating or expanding. Both companies play a critical role in ensuring care quality. If a hospital knows how many free beds they have, they can quickly assure that their patients are assigned to the nearest hospital bed or refer them to the closest hospital that can provide what they need.

Regarding healthcare ventures offering emergency logistical services, *LifeBank* is a facilitator for emergency access to supplies for hospitals by supplying them with blood and oxygen supplies in less than an hour of order. They complete the chain of distribution for medicine by providing 24-h support to facilitate hospitals that are looking for urgent supplies and patients who want to have access to hospitals with the appropriate equipment using SMS messages and enable customers to check the safety of the blood and other supplies in a context where HIV/AIDS is prevalent. *Flying Doctors Nigeria* provides localized emergency care by air ambulance and transport casualties to the nearest hospital. In addition to functioning as an air ambulance, rural medical infrastructure should be developed, such as by establishing small clinics to improve access to care among populations out of reach of its pricing schemes.

5.6 Category 6: Additional Services

This section includes services that typically offer rehabilitative and follow-on support for patients who are outside traditional hospital care as well as other services to

facilitate and enrich the healthcare entrepreneurship industry. Examples include *Villa Paradiso*, *Chekkitt* and Synapse Services. *Villa Paradiso* is a luxury rehabilitation centre for men and women to stay and cure their drug and alcohol addictions. Services address the particular additional-related illnesses as well as others, such as botox and face revitalization treatments to reverse the physical effects of addiction. In comparison, *Synapse Services* is a charity that has built small mental health homes across the major cities for patients suffering mental health illnesses from psychosis to drug addiction. In places where mental health is considered a cultural taboo, such an approach is helping to provide awareness and support for mental health. In addition, *Chekkit* confronts a negative trend that is facing medical industries in many developing countries of high circulation of counterfeit medicines. The company verifies pharmaceutical goods to eliminate counterfeit products in the market. This way, both individual customers and healthcare providers, can ensure having access to high-quality supplies with genuine ingredients.

6 Summary

In summary, the foregoing analysis offers a preliminary mapping of the business model vehicles that businesses utilize to address the healthcare access gap across 52 cases of medical entrepreneurship from around the world. As seen in the table below, healthcare technology-aided platforms appear to be central among the activities of entrepreneurs at facilitating healthcare access, which typically eliminates or reduces the traditional barriers that stifle access to healthcare. In addition, innovation companies and ecosystem and technology developers ensure the continuous development, manufacturing and commercialization of solutions in the healthcare system. Other actors, such as at-home, logistics and additional service providers, help to complement the particular needs of customers and customer groups that enrich and enhance the healthcare service industry in many ways (Fig. 2).

7 Conclusions and Recommendations

This study aimed to conduct an exploratory examination of approaches to medical entrepreneurship among a sample of 50 businesses that generally seek to leverage elements of their business models to address healthcare access gaps across contexts. Using thematic analyses, six main categories and 12 subcategories were defined to summarize the business vehicles that they use. In general, the use of technologies appears to be central across the cases, particularly in ways that connect actors that hitherto found it difficult to interact and effect particular forms of healthcare service provision. This generally rhymes with the literature on social entrepreneurship, which explains how businesses can identify gaps in public services and build

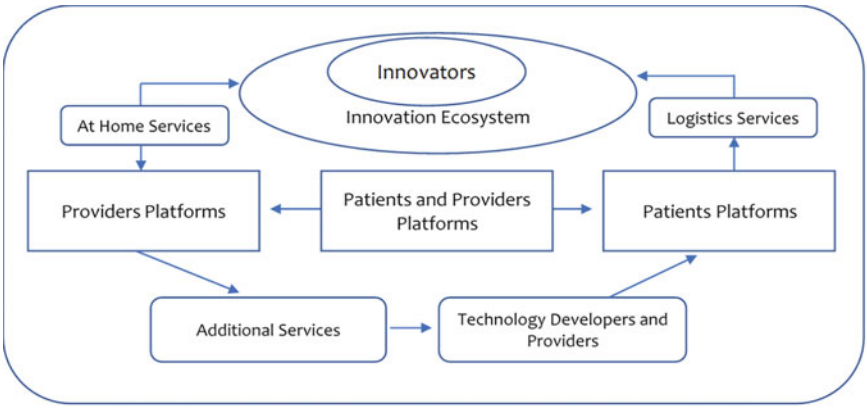

Fig. 2 Business model vehicles in medical entrepreneurship

business models to ameliorate them while making a profit (Prahalad, 2005). Additionally, along with other supplementary services addressing the particular needs of specific clients, medical entrepreneurs inadvertently build an ecosystem that strengthens and empowers private sector participation and continues to open niches of opportunity both for customers and service providers alike. As pointed out by Bloom and Chu (2012), governments are also heavily leaning in and providing standards and regulations for participation in the industry in ways that protect and build confidence. An important line of inquiry for further studies will hence be to examine how entrepreneurship in the area is being institutionalized vis a vis prevailing structural and regulatory arrangements and informal institutions. In this way, medical entrepreneurship can be better understood relative to the context in which it occurs, as has been achieved elsewhere (Bruton et al., 2010). This effort should in particular segregate these insights between developing and developed economies as well as between social and mainstream entrepreneurial forms. For educators, it is essential not simply to teach in the healthcare industry and business schools; it is essential to understand to employ technology and innovations in ensuring that businesses can serve a wide customer base in ways that address the last-mile problems preventing customers from accessing.

8 Appendix: List of Cases

S/N	Name of business	Reference link
1	SeamlessMD	https://seamless.md/
2	Villgrow Africa	https://villgroafrica.org/
3	Helium Health	https://www.heliumhealth.com/payers.html

(continued)

(continued)

S/N	Name of business	Reference link
4	Wazi Vision	https://wazivision.com/
5	LifeBank	http://www.lifebank.ng/#/vision
6	Greymate Care	http://greymatecare.com/services/
7	Crib A'glow	https://thespindle.org/project/crib-aglow-units/
8	DREET—detection, research, education, equipment and training	https://face2faceafrica.com/article/meet-tendekayi-katsiga-creator-of-worlds-first-solar-powered-hearing-aid
9	Medlinker	https://www.top10asia.org/rankings/top-10-asian-healthtech-startups/
10	HealthilfyMe	https://thehealthcaretechnologyreport.com/the-top-25-healthcare-technology-ceos-of-asia-for-2020/
11	Glocal Healthcare Systems	https://www.youtube.com/watch?v=0_GxWVZB5HU
12	Flying Doctors Nigeria	https://www.flyingdoctorsnigeria.com/corporate-organisations/
13	MyPaddi	https://venturesafrica.com/10-healthcare-companies-and-startups-saving-lives-with-technology-in-nigeria/
14	Safermom	https://www.changemakers.com/discussions/entries/safermom
15	Wysa	https://www.wysa.io/for-individuals
16	Maya	https://m.mayaiswithyou.com/
17	Faso Soap/Maia	https://www.maia-africa.com/en/home/#team
18	OncoTherapy Science Inc	https://www.oncotherapy.co.jp/en/research-development/clinical-development-pipelines/
19	Dawa Health	https://dawa-health.com/
20	Baobab Health Trust	https://healthmarketinnovations.org/program/baobab-health-trust
21	SEHAT	https://sehat.com.pk/
22	PhysioHome	https://www.f6s.com/physiohome
23	Waspito	https://www.waspito.com/
24	Ti Tamed	www.titamed.co.za
25	Synapse Services centre for psychological Medicine	www.synapseservices.org
26	PRC RECOVERY CENTRE	www.prcrecovery.co.za
27	Villa Paradiso	https://luxuryrehabs.com/villa-paradiso-tunisia/
28	DISA Vascular	www.nsmedicaldevices.com

(continued)

(continued)

S/N	Name of business	Reference link
29	Dawaswift	https://www.linkedin.com/company/dawaswift/about/
30	Helium Health	https://heliumhealth.com/
31	LifeBank	https://startup.google.com/stories/lifebank/
32	Babymigo	https://babymigo.com/
33	Ubenwa	https://www.ubenwa.ai/
34	RedBank	https://redbank.com.ng/
35	Medfix	https://medifix.ng/
36	54gene	https://54gene.com/
37	Chekkit	https://chekkitapp.com/
38	Nguvu	https://www.nguvuhealth.com/
39	Baobabcircle	https://www.baobabcircle.com/
40	GeroCare	https://gerocare.org/
41	Xelpha Health	https://xelphahealth.com
42	Rology	https://rology.health/products-and-services/
43	Pharmed Limited	www.imperiallogistics.com
44	PHARMEDIVIETNAM	https://www.pharmed.vn/
45	Pharmed Group	pharmed-group.com
46	Sinapi Biomedical	sinapibiomedical.com
47	PHARMED	www.pharmedlimited.com
48	CapeRay	www.caperay.com
49	ConnectSx	https://connectsx.com/solutions/
50	FullSight Health	https://www.fullsighthealth.com/solutions/
51	Promedeo	https://www.promedeo.com/smart-cabinet
52	Kitcheck	https://kitcheck.com/solutions/inventory-management/crash-carts/

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Maryam Abdulkadir is a dryland reforester. After witnessing the rapid desertification of Yola whilst studying at the American University of Nigeria, she decided to create a forest garden

replanting endangered medicinal trees on a hectare of land as a collaboration with Modibbo Adama University. She is dedicated to hiring local permaculturalists to educate their community on how they can grow their own crops and fruit trees efficiently; providing a consistent generational source of food and medicine. She is currently completing an MSc in Global Health Policy at the London School of Hygiene and Tropical Medicine to enhance her understanding of how traditional medications can integrate into a global culture that prioritizes and normalizes the use of pharmaceuticals.

Chapter 13
Healthcare Consumerism and Implications for Care Delivery

Rajasekhara Mouly Potluri and Sophia Johnson

1 Introduction

Consumerism leads to economic growth. The most vulnerable community consumers spend more on goods and services introduced by the business community in an everlasting process, which leads to economic growth. Consumerism is a social moment that fosters consumption or purchasing all the required above an individual's basic needs and increases pursuit for the "good life." Due to industrialization and mass consumption, there is increased production and employment in diverse parts of the world, which leads to more consumption. Therefore, the escalating trend of living standards is destined to progress because of consumerism. Healthcare consumerism is a movement to make healthcare services more efficient and cost-effective. It changes an employer's health benefit plan, setting the economic acquiring power and decision-making in the hands of plan applicants. The current pandemic has forced the world healthcare sector toward consumerism driven by a heavy flow of patients turning into consumers. The world healthcare sector is rapidly becoming consumerized due to the increasing trend of casualties, in which the pandemic is fueling the fire with losing money and people in every part of the globe. The ongoing COVID-19 crisis has thrown the entire healthcare sector, mainly in the developing and underdeveloped world, under severe pressure to think of consumerism. Through healthcare consumerism in these drastic situations, hospitals, insurance companies, and other businesses not only obtain all kinds of assistance, but even the patients are also driven for efficient and cost-effective service.

Moreover, due to the fear of spreading the virus from all front-line COVID-19 warriors, most consumers are not interested in physically taking the service and showing interest in taking the service with digital technology since the outbreak of the virus in the first quarter of 2020. The rise of empowered consumers feels that

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obtaining quality healthcare service is their right and believes that the delivery of quality service is also the responsibility of service providers. The attitudinal change in the market also stressed that healthcare service providers should concentrate on designing, developing, and delivering the most effective and economical healthcare service. Currently, patients are increasingly becoming consumers, trying to know the rights, duties, and responsibilities to obtain quality healthcare services, particularly in developing countries such as India. The concept of healthcare consumerism introduced the comprehensive transformation service delivery process from the traditional "doctor says/patient does" to a "working partnership model" just as in the developed world. To this point, healthcare consumerism's primary goal is to enable patients or consumers to become wholly involved in their healthcare decisions. In developing and underdeveloped countries, the general practice is that most healthcare service providers never consider patients' opinions in terms of how they consume healthcare services. These price-sensitive markets, as a result, tend to pay serious attention to the price or cost involved in getting the service instead of knowing the quality parameters of the healthcare service.

In addition, patients primarily do not like shopping for healthcare or managing their health information. As an alternative, patients always consider the same care and service they have nurtured in other sectors. In summary, healthcare consumerism is the swiftly expanding tendency that poses patients as basic decision-makers when selecting care providers and treatment alternatives. The kind of reimagining of the healthcare sector system trusts upon understanding patients as buyers, informedly spending for treatment as they would for any product or service purchase. During the current pandemic, the conscious and hybrid mode of the approach of both healthcare service providers and receivers toward service delivery leads to the awareness of consumerism and healthcare consumerism. As the movement increases impetus, service providers must distinguish their value proposition in healthcare and adjust their methodology to care, delivering value over volume to patients (LaPointe, 2017). Considering the above, to acquire more diligent healthcare customers, plans and healthcare professionals need to provide info, financial incentives, and decision-making tools to consumers to allow them to make educated healthcare purchasing decisions. In brief, healthcare consumerism aims to empower patients to become wholly involved in their healthcare decisions (Data Path, 2022).

2 Literature Review

Consumerism traditional from its inception was defined as both positive and negative, and its origins, at least in the USA, trace back nearly a century. However, the concept of consumerism in healthcare is more recent, with references to patients as "consumers" dating to the 1930s. Today, the picture is commonly assumed to represent people proactively utilizing reliable, pertinent information and applicable technology to get into well-advised assessments about their healthcare options in the broadest sense, both within and outside the clinical setting (Carman et al., 2019).

Healthcare consumerism is a drive that makes healthcare services more efficient and cost-effective. Patients seek care and assistance from other sectors and become more involved in healthcare decisions. Healthcare consumers expect better information and more transparency from healthcare providers. Rather than a healthcare provider-to-patient relationship, consumers ask for more partner relationships and decision-making powers, playing the role of purchasers and managers of their health and wellness. Patient-centered care delivery emphasizes honoring patients' values and preferences. To improve more conscientious healthcare users, plans and healthcare professionals need to provide information, financial incentives, and decision-making tools to consumers to make educated healthcare purchasing decisions. Patient satisfaction is predicted by factors relating to caring, empathy, reliability, and responsiveness (Tucker & Adams, 2001). Ware et al. (1980) identified dimensions affecting patient evaluations, including physician conduct, service availability, continuity, confidence, efficiency, and outcomes. Other components have been introduced to capture patients' healthcare evaluations (Ramsaran-Fowdar, 2005), including core services, customization, professional credibility, competence, and communications. Patient satisfaction is based on cost, quality of service, facility appearance, staff expertise, and interpersonal interactions with staff. The importance of measuring patient satisfaction is of great value to healthcare providers. It cannot be ignored (Ware et al., 1980) to assert that healthcare providers must be interested in measuring patient satisfaction because they can gain valuable insight into healthcare delivery structure, processes, and outcomes. Healthcare quality is positively affected by courteous staff with excellent communication skills and a neat and clean service environment (Marley et al., 2004).

2.1 Consumerism and Healthcare Consumerism

The problem of "consumerism" has thus become high on the healthcare industry agenda (Devaraj et al., 2013). In addition, healthcare is dynamic, and considerable customer changes have taken place with increasing competition (Gilbert et al., 1992). Subsequently, healthcare quality evaluations raise problems owing to service size, complexity, specialization, and expertise within healthcare organizations (Eiriz & Figueiredo, 2005). The notion of consumerism in healthcare is more contemporary, with allusions to patients as "consumers" dating to the 1930s, which means that people proactively (Devaraj et al., 2013) use trustworthy, relevant information and proper expertise to make better-informed judgments about their healthcare choices (Carman et al., 2019). Healthcare consumerism is a movement to make healthcare services more efficient and cost-effective**.** Growing healthcare consumerism is transforming the conventional physician–patient relationship into a provider–consumer relationship. By considering a consumerist stance, patients are now more prone to ask issues, impact decision-making, "shop" for doctors' checkout healthcare givers, and switch services if they experience dissatisfaction. Healthcare consumerism assumes

that healthcare is a market where high healthcare costs are a function of excessive consumer demand. Therefore, price transparency and competition can deliver on the promise of reducing costs or ensuring quality. In other words, it transforms an employer's healthcare decisions and health benefit plan, putting the financial acquiring capacity and decision-making in the hands of plan participants. As per the 1974 report titled *Advancing the Quality of Health Care*, the IOM called for "shifting control over decisions from physicians to patients" (Institute of Medicine, 1974). In short, consumerism is now associated with market-driven health reforms that burden patients to solve cost and quality problems, while healthcare consumerism's goal is to enable patients to become wholly involved in their healthcare decisions. Unlike other industries, the healthcare industry introduces a considerable assortment of bewildering options, communication points, and service flows without any direct pricing information. Most healthcare consumers expect to make better decisions and demand more authentic information with greater transparency from a service provider and a confident partner relationship rather than a one-way dialogue from a medical provider to a patient. Simultaneously, as healthcare costs continue to rise, consumers are being forced to accept accountability for a more significant share of the costs of health plan premiums, copays, and out-of-pocket expenses. Even though genuine healthcare consumerism is still growing slowly, many limitations or hurdles are identified, which holds the tendency for growth. Consumers are commencing to actively make decisions about their health and healthcare with clear preferences. Because of the introduction and marketing of health insurance policies to meet the needs of every class of consumers, a growing number of people have been selecting or purchasing health insurance plans for reasons other than price alone (Anand et al., 2016).

2.2 Healthcare Consumerism and Patient Care

A consumerist attitude to care needs a patient approach to individual and didactic information, price openness, healthcare choices, and care alternatives from which to select. With the upswing of healthcare consumerism, the healthcare sector is experiencing a remarkable makeover. Moreover, the existing COVID-19 pandemic has dramatically distorted consumerism's trajectory in healthcare. Therefore, healthcare service providers must gain a competent and clear picture of healthcare consumerism, which means that patients are becoming more implicated in their own healthcare decisions and well-being. Similar to previous years, economic purchasing power and decision-making shift into the hands of the consumer only because of healthcare consumerism. The affordable care actions have accelerated this trend, leaving many consumers significant reductions.

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2.3 Healthcare Industry and Consumerism: Current Status in India

The healthcare sector is one of India's most prominent and fast-growing sectors in revenue and employment. The most promising unproductive industry consists of hospitals, medical devices, clinical trials, outsourcing, telemedicine, medical tourism, health insurance, and medical equipment. The Indian healthcare sector has both public and private participants in all areas. Nevertheless, the private sector offers many secondary, tertiary, and quaternary care institutions with a significant concentration in metros and tier I and tier II cities. The country's healthcare sector's competitive advantage lies in its large pool of well-trained medical professionals. India is also cost-competitive compared to its peers in Asia and Western countries. For example, the cost of surgical procedures in India is approximately one-tenth of that in the USA and other Western European countries. The Indian healthcare market in India is predicted to reach USD 372 billion by this year ending, driven by rising income, better health awareness, lifestyle diseases, and increasing access to insurance, along with generating over 0.5 million new jobs per year. India is a nation full of prospects for participants in medical gadgets manufacturing. The government has also developed one of the primary destinations for high-end diagnostic services with immense capital investment for sophisticated diagnostic facilities, therefore providing a particular population. Moreover, Indian medical service consumers have become more conscious of their healthcare sustenance. The Indian healthcare sector is much differentiated and is full of openings in every division, which comprises providers, payers, and medical technology. With the expansion in competition, businesses are looking to explore the most modern dynamics and developments that will have a positive impression on their business. The hospital industry in India is predicted to grow to US$ 132.84 billion by FY22 from US$ 61.79 billion in FY17 at a CAGR of 16–17%. The Government of India is preparing to expand public health expenditures to 2.5% of the country's GDP by 2025. India's competitive advantage also lies in the increased success rate of Indian companies in obtaining Abbreviated New Drug Application (ANDA) approvals. India also offers vast opportunities in R&D as well as medical tourism. In summary, there are vast opportunities for investment in healthcare infrastructure in both urban and rural India (Indian Brand Equity Foundation, 2021).

2.4 State of Healthcare Consumerism During COVID-19

Frequently, patients do not have well-formed inclinations, and they seek care under considerations in which they do not have the time or emotional stamina to shop around based on quality and price. COVID-19 has enhanced the path of consumerism in healthcare. Healthcare leaders are obliged to move the industry forward by ensuring patient safety, building consumer trust, and bringing more human understanding into

every care experience. According to NRC Health (2021), healthcare consumerism has accelerated and evolved by looking at providers' perspectives during the pandemic. Some note trends include those patients looking for convenience and a relationship with the healthcare providers more than before and who have been using the telehealth mode rather than on-site visits. In addition, the pandemic accelerated the experience of digital tools and social media to a certain extent. Most healthcare sector stakeholders, including hospitals of all magnitudes, governments, control mechanisms, and hurled or fast-tracked digital health capabilities during the outset of the COVID-19 pandemic, are worsening to obligate copious to the digital and consumer-centered alteration required to bring care when, where and how consumers want to obtain it, according to Kaufman Hall's 2021 Healthcare Consumerism Survey (Pennic, 2021). India has the vast potential to emerge as a knowledge process outsourcing center by offering digital health services beyond telemedicine, such as teleradiology, telepathology, and remote ICU monitoring (EH News Bureau, 2022). As India is growing as a potential destination for both illness and wellness care of global patients along with the domestic, it is an imperative situation to design and introduce quality control mechanisms to closely monitor the service delivery process by both central and state governments and make its quality control mandatory in the entire healthcare sector. This confident introduction of the quality control mechanism and frequent monitoring of the service delivery process enhance the inflow of international patients with confidence. Today, medical tourism in the country is greatly supported by the fact that people are coming to India to satisfy their medical needs based on the massive confidence in the expertise of doctors and the most cost-effective manner. However, the government of India, both state and central, should set up a committee to only permit overseas patients to hospitals with approvals such as the National Accreditation Board for Hospitals & Healthcare Providers (NABH) and Joint Commission International (JCI). This will help enhance the level of care, and we can steer clear of any critique. Another notable change the government should introduce to bring patients to India is to develop partnerships and collaborations with international governments and insurance bodies to get patients to India. As discussed above, the availability of expertise and cost benefits and the comprehensive care that the Indian healthcare system provides, these global partnerships and collaborations confidently enhance medical tourism in the country. At the same time, India has the unique advantage of emerging as a health hub through traditional Ayurveda combined with top-grade medical and clinical capability at desirable prices. India has the vast potential to provide healthcare services and even to serve remote patients through the efficient use of digital health technology.

Along with the above, the government of India should introduce healthcare consumerism with a swift judiciary mechanism to safeguard the interests of both domestic and international patients and save these from the exploitation of both public and most private healthcare service providers. The contagious nature of the different versions of the coronavirus and its harmful ramifications have forced a significant revolution across the global healthcare system. Similar to the Kaufman Hall Healthcare Consumerism Survey, the authors conducted an informal collection of data from different healthcare industry stakeholders related to consumerism. Even

though most of the selected respondents were reluctant to respond to the questions, the authors collected these respondents' opinions based on the personal request for the quickest possible time with just three or four questions. The authors identified some key findings based on survey responses garnered from doctors, paramedical staff, clinical centers staff, health insurance staff, security staff, and, most importantly, patients of different classes from the south-eastern state of Andhra Pradesh in India shocking responses on the awareness of healthcare consumerism. The survey's key findings are that 94% of doctors and 52% of paramedical staff only have some idea about healthcare consumerism. Concerning the remaining clinical centers' staff, security and even patients will not have accurate information about the concept of healthcare consumerism. More than 90% of patients think about consumer protection, and consumer protection is widely popular in the country. Nevertheless, the majority of them never listen to the word healthcare consumerism. Surprisingly, 63% of medical staff guided their patients during the pandemic related to telehealth services. The authors raised the final question on the quality of the healthcare service delivered to providers and service receivers. Astonishingly, neither of these parties was satisfied with the healthcare service delivery process. More than 98% of patients and 76% of medical staff expressed their discontentment over the service delivery because of the heavy flow of COVID-19 patients with several recommendations for bed slots in intensive care units (ICUs). The patients' major complaints and dissatisfaction with the service charges cross millions of Indian rupees without proper service delivery. Even after spending more than a million, as said by the respondents, causality cases are in millions in the different parts of the country. The role of Indian insurance companies has usually escaped with the poor acceptance rate by showing the reason not covered for COVID-19. Even though Indian consumers have a substantial consumer protection act, there is no proper healing because of poor control mechanisms. Many lost their loved family members and a large amount of money. Finally, many Indians have extraordinary bitter experiences because of the outburst of coronavirus and exploitation of the healthcare industry in most parts of the country.

2.5 Healthcare Consumerism is a Motivation for Change

Healthcare providers need to adopt changes because patients look for better convenience and a good relationship with the providers. The COVID-19 pandemic has pushed healthcare toward consumerism, and consumer-centered healthcare is becoming heavily reliant on digital technology. Approximately 73% of users have opted for digital healthcare tools, such as artificial intelligence (AI) chatbots and telehealth, to monitor their health in the COVID-19 era. Many healthcare systems worldwide have incorporated virtual healthcare and telehealth to ensure social distancing and security. Self-monitoring is another catalyst in healthcare transformation, where

medical devices such as pulse oximeters are widely used to measure oxygen saturation levels at home. Many organizations have recognized the need to extend healthcare delivery beyond hospital settings known as "hospital at home," especially with the spike of the Delta variant of COVID-19, and have been able to diagnose certain diseases. Remote patient monitoring and virtual consultations by doctors and clinicians with continuous interaction and communication mediums such as simple text messages and video clips have improved patient experiences. Significant change can be slow, but the transformation in response to critical trends is becoming more prevalent. As a result, hospitals and healthcare centers cannot just implement things around the edges but need to be innovative and competent in care delivery and operations.

2.6 Healthcare Consumerism: Marketing's New Command

Unlike in the developed world, the consumer community in the developing and developed world has a different perspective to obtain the required healthcare service by neglecting the recommendations of the service providers, mainly because of the monetary involvement in the process. Moreover, most of the public in these parts of the world will not have any health insurance support because of their low income. Therefore, although even health insurance is available, the number of queries to accept claims and many claim rejections without any rationality by these insurance companies lead to the heavy involvement of own money, leading to complete discontentment. Therefore, the healthcare industry can recognize, guide, and engage healthcare consumers while inculcating a sufficient degree of loyalty and has a substantial prospect to change the healthcare situation with the assistance of healthcare consumerism. Thus, the industry should offer consumers more significant involvement in their own healthcare decisions. Even though the kind of involvement is much more complex, particularly in the developing and underdeveloped world, a specific type of confidence would boost up in the minds of consumers because of the discussion or to know their opinion in delivery of the required service. Before offering the expected level of healthcare service, these service providers must know their consumers by developing a more nuanced understanding of consumers' needs, preferences, and values. The targeted market India has a wide variety of consumers, particularly premium, popular, and economy class consumers, in which every class has its buying motives and spending patterns. Many developing and underdeveloped countries have similar situations in delivering quality healthcare services. Surprisingly, a study conducted in Nigeria proved that 42% of healthcare consumers have a neutral perspective, and another 43.3% expressed complete dissatisfaction (Potluri & Angiating, 2018). With the enhanced importance of the service industry in general, the healthcare industry has sharpened the focus on what it takes to excel in the marketing of services (Frei, 2008). Marketing excellence in services requires excellence in three broad areas: internal, external, and interactive marketing. Interactive marketing depicts the employees' skill in serving the client (Grönroos, 1984). External marketing explains the everyday work of preparing, pricing, distributing,

and promoting the service to customers (Kotler & Keller, 2018). Internal marketing describes the training and motivating of employees to service customers well (Marinova et al., 2008). These three are imperative even to the healthcare sector to deliver the best quality and cost-effective service, which is essential to meet consumers in developing and underdeveloped markets. The healthcare sector should show and introduce competent service differentiation and deliver superior quality service by managing customer expectations and incorporating self-service technologies, particularly in these pandemic conditions. The healthcare industry must recognize each service encounter's effects to drive and understand the service expectations of the markets.

Along with the above points, healthcare consumerism is definitely helpful. It adds flavor to the efforts of service providers to understand and deliver the best and most economical healthcare services based on the expectations of the market. However, the reality is different; there is no average healthcare consumer. Instead, consumers from a wide range of experiences have varying clinical and lifestyle needs and hold various opinions and prospects about healthcare. Thus, understanding the average healthcare consumer provides limited information (Cordina et al., 2017). Therefore, adhering to the basics, the healthcare sector must design and develop the total services marketing mix cautiously, keeping in mind the market expectations, market affordability, and awareness of healthcare consumerism. Furthermore, most healthcare consumers are increasingly cautious about how, when, and where they pay for health and healthcare services for themselves and their families due to the economic downturn of the current pandemic. Swiftly, the healthcare sector has to learn the basics and advanced marketing techniques of retailing with savvy marketing and promotional messages. At the same time, convenience has become the new currency, and for health systems and providers to capture a viable position in the minds of consumers, accessibility is a primary consideration (Gandolf, 2021). The entire stakeholder community, especially healthcare service providers, administrators, and marketing professionals, apparently recognize the rise of consumerism exclusively meant to meet and surpass patient expectations and is insidious and has grown to be a leading requirement for healthcare marketing. The present condition is far better than the earlier time of too much economic exploitation. However, during these COVID-19 days, healthcare service providers guide consumers with better and timely information, engage them to prepare them for behavior change, and inspire them to build trust loyalty.

3 Challenges and Opportunities for Healthcare Consumerism in India

Healthcare consumerism should develop a symbiotic consumer-provider relationship and ensure a happy balance between overtreatment and limited accessibility to medical facilities. Focus on consumer experience—patient experience cannot be

ignored, as patient experience could distinguish between healthcare providers. This aspect could make healthcare providers think about providing personalized care to patients. Introduce digital channels—consumers commonly make their own decisions to treat themselves and benefit through different healthcare providers (Lott et al., 1992). Findings have revealed that playing a role in medical decision-making is vital to patients (Strull et al., 1984; Thompson et al., 1993). However, healthcare centers and hospitals should create patient portals and mobile apps to render better patient services and innovate services and outreach based on consumer feedback. Adjusting service prices—pricing is essential as healthcare costs continue to rise. Consumers are responsible for healthcare plan premiums, copays, and out-of-pocket expenses. Based on consumer preferences, cases, and situations, healthcare providers should adjust service prices and suggest cost-effective alternative medicines to increase patient satisfaction and foster consumer loyalty. Redesign marketing strategies, channels, and brand positioning—healthcare providers need to adapt to new open communications channels, such as digital tools and social media to disseminate reviews, information, and advice. Consumers will have conversations and communications on health-related topics (Pagaria, 2020). The older generation may not be traditional with the latest digital technologies, such as patient navigation tools, call center technologies, online appointment scheduling, digital bill paying, and payment plans. In addition, all patients have equal access to the internet, as it may vary from state to region, language, education level, and age and restricts access to medical information (Stacey et al., 2009) (Zeckhauser & Sommers, 2013). Although consumers consider their healthcare decisions to be the most important, the process of choosing and paying for medical services can be a nightmare for those facing financial challenges. It may be discouraged from availing of quality and expensive healthcare facilities. Consumerist patients may have strong opinions about the little medical and scientific information collected over the internet. Nevertheless, they may become impractical and inefficient for practitioners to explain and correct misperceptions within a limited appointment time (Mechanic et al., 2001). Many physicians have mixed feelings about discussing internet-based medical information during their encounters with patients at their clinics (Broom, 2005). At times, consumerism may lead to disagreement and worsening communication between the patients and physicians, raising the negative impact of patient–physician communications during clinical visits (Rhodes et al., 2001).

4 Conclusion

Finally, it is imperative for the entire healthcare sector, irrespective of their magnitude and specialization, to introduce a customer-focused healthcare consumerism strategy that is key to boosting their patients/consumers' experiences and healthcare revenue cycles. The confident introduction of the consumerism strategy carefully considering all the stakeholders' opinions provides reciprocal benefits to everyone.

The budding concept of healthcare consumerism will necessitate a substantial transformation in how healthcare professionals market, deliver, and charge for their services. Notably, healthcare service providers will need to emphasize building their brands as they strive to operate more like a retail business in a highly competitive market. Based on the last two years of experience in tackling the pandemic and the information they collected with their informal research, the authors expect some notable changes in the mindsets of healthcare service providers, service receivers (patients/consumers), and facilitators (insurance companies). However, consumers will continue to pay more for premiums and out-of-pocket expenses, with add-ons such as special COVID-19 coverage extra premiums these insurance companies charge. In addition, most employers will extend their maximum support to mitigate some costs through additional plans. One more notable change we can expect within the backdrop of the current situation is that healthcare service providers will develop more market orientation and introduce more open channels of communication to disseminate information, reviews, and advice through digital media. The healthcare industry is slowly moving toward value rather than volume, particularly in the developing and underdeveloped world, and patient care and service provider compensation will experience a thoughtful transformation. The state of healthcare is constantly refining from exploitation to revolutionize the entire service delivery process. With the advent of healthcare consumerism, keeping in mind the expectations of all industry stakeholders should generate a more efficient, cost-effective system for providing a committed and dedicated service delivery.

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Chapter 14
Empirical Analysis of Health Innovation/Digital Health Entrepreneurship and Resilience in European Countries

Simona-Andreea Apostu

1 Introduction

The complex impact of the pandemic and how this extreme event influenced sustainability are ongoing. We faced for more than one year dramatic changes regarding lifestyle, increased use of digital devices, i.e. working from home, changing the urban landscape, with a lasting impact on transport/other daily services. Economic recovery aftershocks is not enough, and a previous crisis demonstrated fragility and unsustainable effects on social and societal components of development. Therefore, it becomes necessary to draw up a robust recovery associated with resilience plans and, especially, the support provided by countries during the pandemic for citizens.

The world is rapidly changing, and thus, the healthcare system and the medical system must be updated (Cooke et al., 2010). This is not easy work due to uncertain challenges generated by disruptive technologies and systemic changes, regulations and reimbursement models (Cooke et al., 2010; Frenk et al., 2010; Kocher et al., 2010). To solve these challenges, solutions centred on patients are required (Frenk et al., 2010; Kocher et al., 2010; van de Grift & Kroeze, 2016), which are necessary key skills and knowledge. In this context, innovation and design-related education has emerged to address this need for problem-solving skills in medical education (American Medical Association, 2017; Association of American Medical Colleges, 2014; Niccum et al., 2017).

In many countries, healthcare services are not currently provided in a sustainable manner (Chowdhury, 2012), and this has been seen much better with the advent of the coronavirus-induced health crisis. In this context, healthcare entrepreneurship and innovation are growing areas of interest for researchers and practitioners in entrepreneurship and healthcare alike. Considering the health crisis generated by the coronavirus, we have noticed a significant increase in healthcare startups, particularly

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with a focus on data, wearables, artificial intelligence and virtual reality, which make care more accessible (Glover et al., 2021).

For this, our research aims to (a) determine the connection between resilience and health innovation and identify whether health innovation is the main driver in order to achieve community resilience and (b) cluster the countries according to resilience and health innovation after the first year of the pandemic at the European level to detect similarities and differences.

Therefore, the paper is structured as follows. The literature review section is split into two parts. The first part presents an overview of selective studies regarding healthcare innovation and entrepreneurship and digital health entrepreneurship, while part 2 is dedicated to exploring the literature in this field using bibliometric analysis. Section 3 presents the data and methods used in the analysis. Section 4 incorporates the main empirical results, while the last part focuses on conclusions. The findings highlighted the relationship between healthcare innovation and resilience and the need for convergence to a "new normal", which is more resilient, outlining the importance of the health component in long-lasting qualitative development.

2 Literature Review

2.1 Healthcare Innovation & Entrepreneurship

The health system is facing numerous challenges, with physicians improving all aspects of healthcare through innovative changes and business education representing a key driver (Reeves et al., 2011). Bucci (1999) highlighted a significant need for physicians with skill sets to provide innovation and leadership in the healthcare industry. Among these, the most common skills are in business administration, especially in financial management and financial analysis, strategic planning, marketing, accounting and business. Moreover, education and training in innovation and entrepreneurship are focused on the innovation process (Terwiesch & Xu, 2008), recognition of opportunities and capitalization of solutions to complicated and complex healthcare issues and challenges.

The United Nations Educational, Scientific and Cultural Organization Institute for Statistics (UIS) defined innovation as "the implementation of a new or significantly improved product or process, a new marketing method, or a new organizational method in business practices, workplace organizations, or external relations", with four types of innovations registered: product, process, marketing and organization (Reeves et al., 2011).

Therefore, it should be noted that innovation is different from invention (Buxton, 2005), referring to understanding, refinement and adding value to what is already known. Currently, innovation and entrepreneurship are constantly changing due to digital technologies, platforms and infrastructures with implications for value creation and value capture (Nambisan et al., 2019).

Although talent and innovative intent exist, processes of experimentation and innovation are obstructed (Ostrovsky & Barnett, 2014) by the deficit regarding the training methodology regarding innovation (Asch et al., 2015), lack of resources and space for interdisciplinary teams to collaborate (Gubin et al., 2017; Speck et al., 2015).

There are many studies in the literature on healthcare innovation, the main focus being on middle managers' roles (Birken et al., 2012). From all the studies related to adopting healthcare innovation, just a few assessed innovation implementation (Alexander, 2008).

Managers and physicians had an important role in innovation implementation; physicians (Blumenthal & Kilo, 1998; Kralovec, 1990) were the key facilitators in implementing innovations such as communication skills training, practices based on evidence, depression quality improvement (QI) initiatives (Fischer et al., 2001; Levinson et al., 2002; Palinkas et al., 2008), physicians' commitment (Helfrich et al., 2007) and organizational support (Aarons et al., 2009).

Entrepreneurship represents developing ideas (Hassink et al., 2016) to achieve a valuable business and to pull together resources (Jack & Anderson, 2002). Also, entrepreneurship is essential in the case of long-run economic growth, managing discovers and innovations, seeking new opportunities and learning from failure and profiting from success (Kirzner, 1997). The entrepreneur has an important role in society (Salvino et al., 2014), significantly influencing productivity, innovation and economic prosperity (Baumol, 1990). More importantly, entrepreneurship has a key role in improving health, and traditional health diplomacy contributes to sustainable development. Thus, healthcare entrepreneurship can be seen as an effective health diplomacy tool that can spur economic growth, improve healthcare and generate sustainable development in communities (Ramadi, et al., 2019).

As innovations in the healthcare sector are continuously increasing, hospitals are facing mastering innovations created both internally and externally. To support hospitals in fulfilling their mission and achieving sustainable competitive advantage, it is necessary to envision, stimulate, recognize, evaluate and manage both lines of innovation (know-why and know-how) (Lega, 2009).

Figure 1 highlights the most relevant studies focusing on healthcare innovation and healthcare entrepreneurship and studies at the intersection of these two relevant topics.

2.2 Digital Health Entrepreneurship

Digital health or eHealth and healthcare IT represent a range of services and products, including telemedicine, health informatics, and gamification (i.e. behaviour modification), web-based health services (i.e. electronic health records), mobile health applications (mHealth) and others (Patterson & Kant, 2015). Healthcare entrepreneurship is not well defined, and its definition is necessary for society through

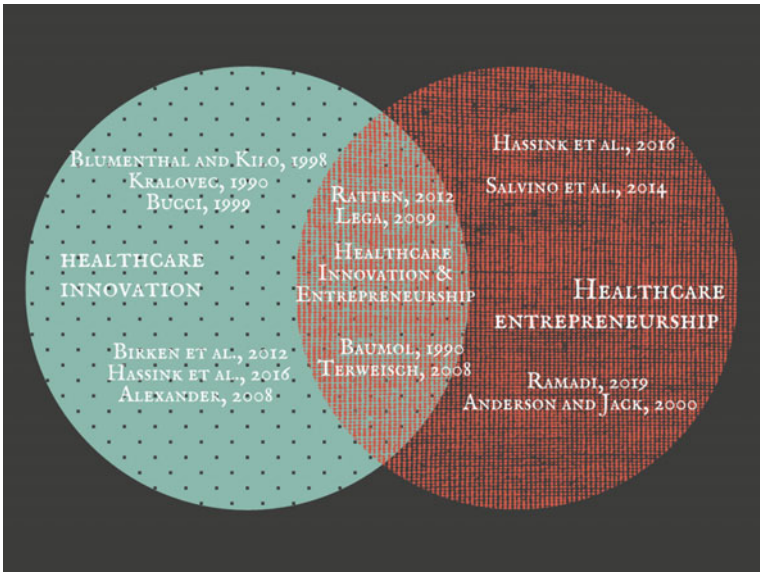


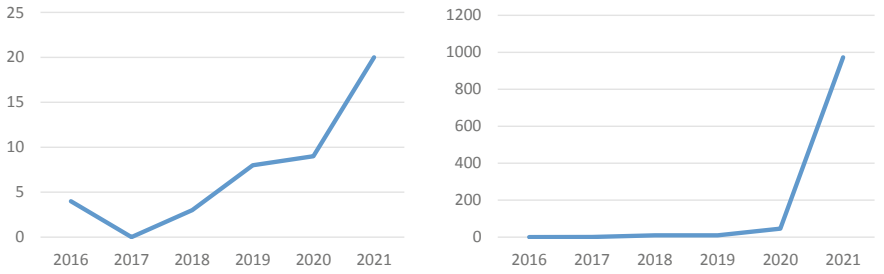
Fig. 1 Main studies regarding healthcare innovation and entrepreneurship (*Source* Authors' own elaborations)

stimulating research and bringing together stakeholders from multiple disciplines to investigate key questions (Glover et al., 2021).

Technological innovation in healthcare is related to knowledge and concerns the know-why, when based on theoretical foundations (competencies), and the know-how when related to practical skills (Lega, 2009). The number of digital health trackers or monitoring devices has increased over time, enabling consumers to acquire personal health (Mooney & Pejaver, 2018).

Openness in digital health platforms may allow data from different consumer health settings to be mined collectively, leading to more entrepreneurial approaches and innovative solutions addressing common public health issues (Mooney & Pejaver, 2018).

The research on digital innovation recognized technology generativity. The attributes or characteristics of digital technologies, artefacts and infrastructures that promote such generativity were identified by Bygstad (2017), Kallinikos et al. (2017), Lyytinen et al. (2017), Tilson et al. (2010), and Yoo et al. (2012). The behaviours of the ecosystem actors and the change processes they undertake that lead to generative outcomes were studied by Eaton et al. (2015). Aspects related to platform architecture and ecosystem governance were studied by Foerderer et al. (2014) and Um et al. (2013).



a) Publications b) Citations

Fig. 2 Dynamics of **a** publications and **b** citations in the field (*Source* Authors' own elaborations)

2.3 Bibliometric Analysis of the Literature in the Field

To create a comprehensive image of the literature regarding healthcare innovation and entrepreneurship and digital health entrepreneurship, we used bibliometric analysis. We investigated all published papers in the Web of Science database related to the association of the words "healthcare innovation", "entrepreneurship" and "digital health", the result being represented by 44 articles from 2016 until 2022.

As shown in Fig. 2, the number of published papers and the number of citations in the area illustrate a hyperbolical progression; there is a jump in the number of publications after 2017 and a huge rise regarding the number of citations after 2020. Thus, there has been growing interest in the field in the last decade, with the main focus being on healthcare innovation.

Analysing the Web of Science field, the articles were published. Figure 3 shows that most articles on the analysed topics are from the category Computer Science/Interdisciplinary Applications (13 papers), Computer Science/Theory Methods (12 papers) and Computer Science/Information Systems (11 papers).

Related to regions, most of the articles are provided by authors in the USA (11 papers), Greece (8) and England (7), as can be observed in Fig. 4, being the most productive in the field analysed.

Analysing the countries' interest in the "healthcare innovation entrepreneurship digital health" topic, using cluster analysis, we have achieved 3 clusters (Fig. 5):

Cluster 1: Australia, Malaysia, New Zealand, Indonesia, Japan, Mongolia, Bangladesh, Nepal, Pakistan, Iraq, Turkey, Estonia, Lithuania, Polonia, Ukraine, Serbia, Kazakhstan, Uzbekistan, Egypt, Libya, Yemen, Oman, Morocco, Tunisia, Benin, Nigeria, Cameroon, Namibia, Zambia, Mozambique, Kenya, Uganda and Ethiopia;
Cluster 2: USA, India, Germany, Italy, Greece and Sweden;
Cluster 3: Canada, Russia, Norway, Germany, Spain, France, Romania, Hungary, Ghana, Saudi Arabia and Brazil.

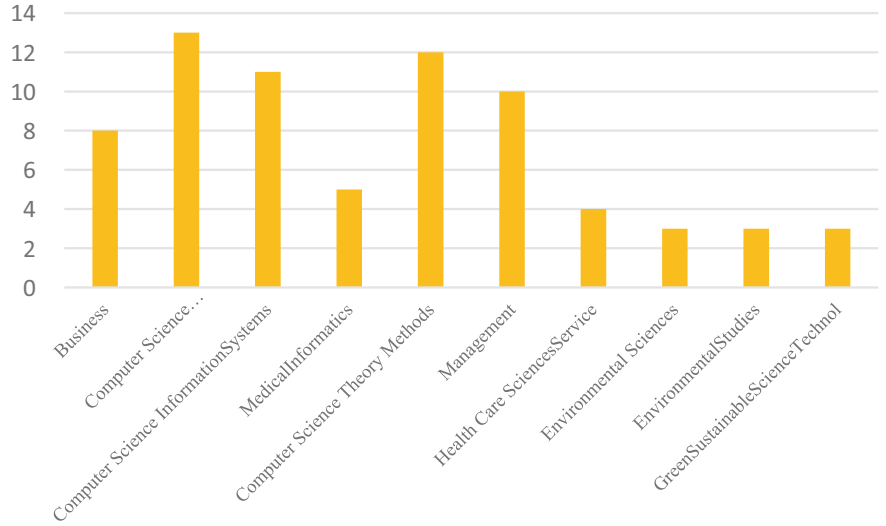


Fig. 3 Publications in the field, according to WoS categories (*Source* Authors' own elaborations)

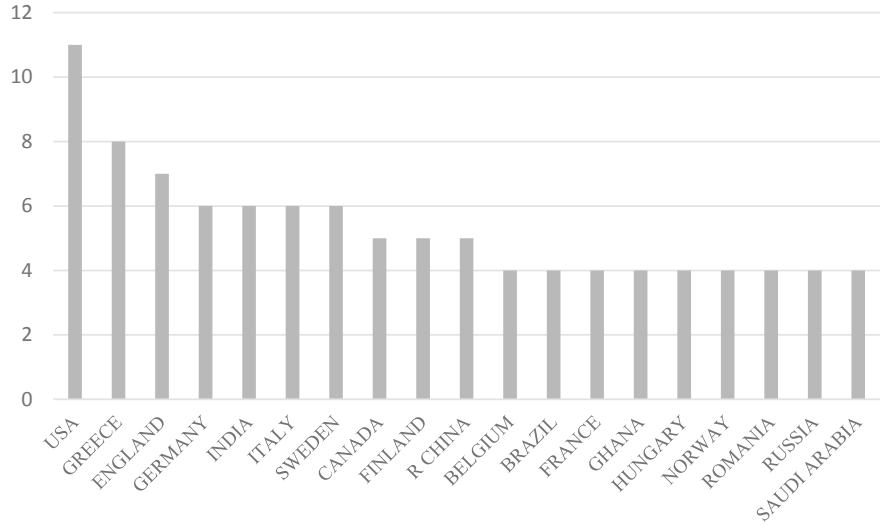


Fig. 4 Publications in the field, according to regions (*Source* Authors' own elaborations)

Cluster 2 is the most productive and contains the most influential countries in the field, followed by Cluster 3, and Cluster 1 contains the countries registering the fewest number of articles in the field.

Regarding journals publishing articles in the field, as shown in Fig. 6, the top 5 journals are represented by Digital Innovation and Entrepreneurship AMCIS 2021 (10

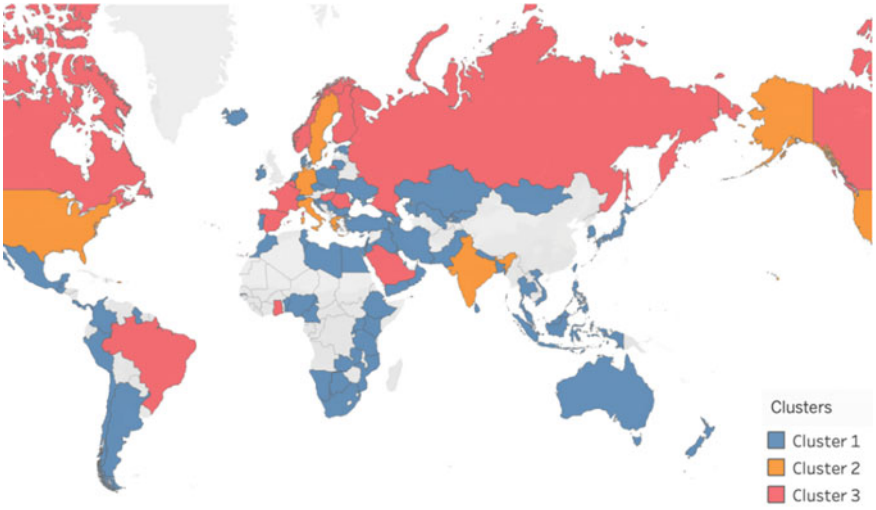


Fig. 5 Clustering countries by the number of publications in the field (*Source* Authors' own elaborations, using Tableau)

papers), Innovation and Entrepreneurship and digital ecosystem (3 papers), Journal of industrial integration and management innovation and entrepreneurship (3 papers), Sustainability (3 papers) and Lancet (2 papers).

Regarding publishers, the Assoc Information Systems published 10 papers, Elsevier published 5 papers, Springer Nature published 5 papers, MDPI published 4 papers and World Scientific published 4 papers (Fig. 7).

Exploring the information offered by the world clouds, we identified the most common words found in the scientific articles in the field. The co-occurrence of authors' words of the publications is investigated, considering a frequency of at least 3 times, a correlation degree greater than 0.5 and a threshold of 0.5. The analysis was performed using the VoS programme. To recognize the common words, we used cluster analysis on a keyword network extracted from the papers. The words that record the highest frequencies of occurrence, apart from the keywords used, are health, management, disease and service knowledge (Fig. 8).

The combinations of words being the most encountered were explored as the most correlated words within the selection of articles. The empirical results (Fig. 8) highlighted 4 significant clusters of the most common combinations in the 79 selected studies in the field. These are:

– Cluster 1: age-cancer-cause-death-disability-disease-global burden-incidence-injuries-life-mortality-risk factors;
– Cluster 2: activity-care-change-communication-development-digital health-digital health technologies-education-experience-healthcare-implication-information-monitoring-need-opportunity-quality-resource-technology;

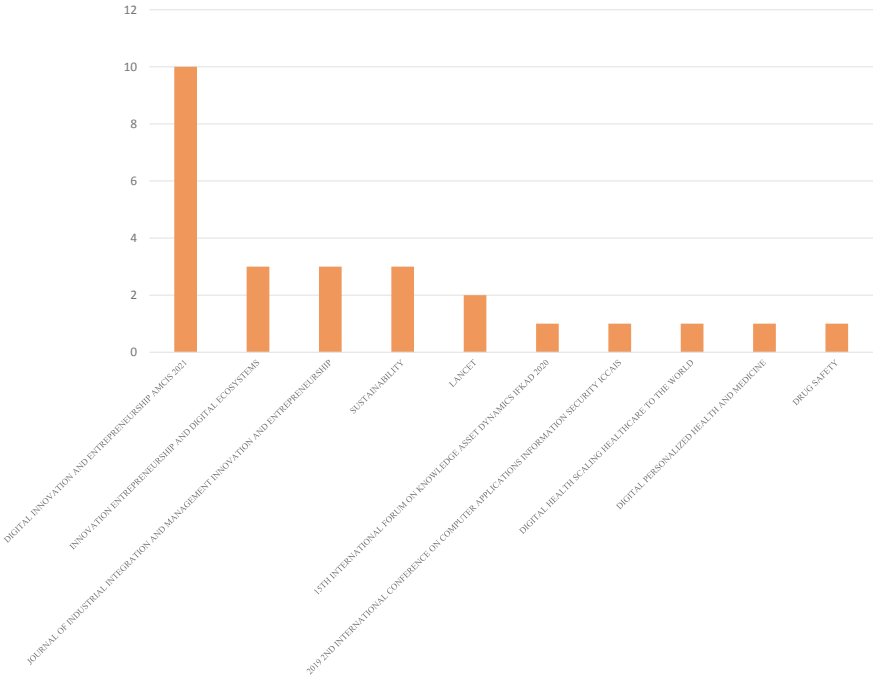


Fig. 6 Journal publishing articles in the field (*Source* Authors' own elaborations)

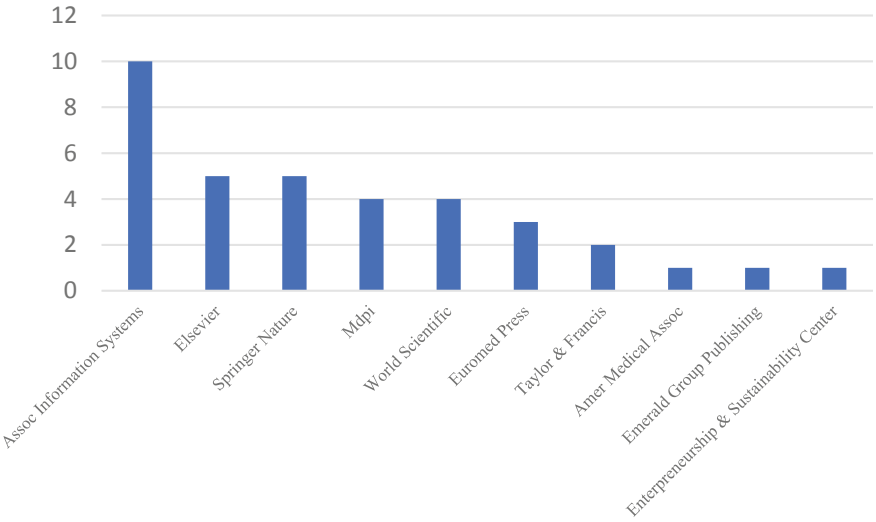


Fig. 7 Publishers of the articles in the field (*Source* Authors' own elaborations)

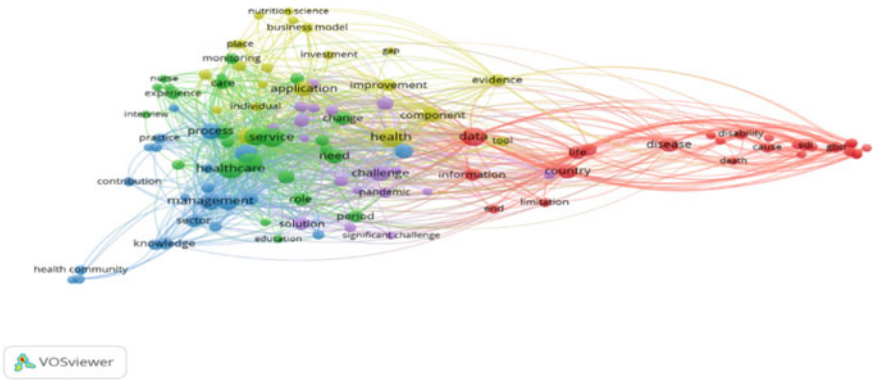


Fig. 8 Most common words and word network in scientific publications' content, using the VoS programme (*Source* Authors' own elaborations)

– Cluster 3: contribution-health community implementation-knowledge management-open innovation-science-society-stakeholder work;
– Cluster 4: application-business capability-efficiency-evaluation-health-hospital-improvement-enjoy-innovation-investment-training-nutrition section;
– Cluster 5: challenge-COVID collaboration-digital transformation-entrepreneurship-environment-government-healthcare delivery-pandemic-solution.

Based on previous theoretical considerations, to identify whether resilience is correlated with healthcare innovation, if healthcare innovation leads to better resilience, the following hypotheses have been created:

H1: There is a strong link between healthcare innovation and resilience in European countries.
H2: Healthcare innovation leads to better resilience.

3 Data and Methodology

To determine the relationship between healthcare innovation and resilience, we analysed two global indices for European countries for the year 2021 on resilience and healthcare innovation, the paper being the first analysis regarding these concepts together. The data are provided by FM GLOBAL and the Foundation for Research on Equal Opportunity (@FREOPP). The sample used consists of 19 European countries due to data availability, and the analysis was performed using Tableau, Excel and SPSS.

To characterize urban resilience, we used the FM Global Resilience Index (FM GRI), which best reflects the level of resilience. It is a composite measure calculated at the country level, varying between 0 (the lowest resistance) and 100 (the highest

Table 1 Variable description

Variables	Components	Source
FM Global Resilience Index	Economic Factors	FM GLOBAL https://www.fmglobal.com/research-and-resources/tools-and-resources/resilienceindex/explore-the-data/?
	Risk Quality Factors	
	Supply Chain Factors	
FREOPP World Index of Healthcare Innovation	Quality Choice	@ FREOPP https://freopp.org/wihi/home
	Science & Technology	
	Fiscal Sustainability	

resistance), and it is calculated on the basis of three factors: economic, risk quality and the supply chain. Additionally, each factor represents the result of four basic factors.

The FREOPP World Index of Healthcare Innovation reflects the healthcare performance in the modern world over a wide selection of measures. The index uses a data-driven approach based on four equally weighted dimensions: Quality, Choice, Science & Technology and Fiscal Sustainability.

The indices included in the analysis description are presented in Table 1.

Performing the correlation analysis, we indicated the existence of a link between healthcare innovation and resilience (Fox, 1997; Jaba, 2002). To highlight whether healthcare innovation influences resilience, we performed a regression analysis, measuring the bound existing between variables and identifying the relative law according to the links between variables (Jaba, 2002). In our case, the regression model can be written as follows:

$$\text{FM\_ GRI} = \beta_0 + \beta_1 \times \text{FREOPP} + \varepsilon \tag{1}$$

To group the countries according to FM_GRI and FREOPP, we used cluster analysis (Ketchen & Shook, 1996) and hierarchical cluster analysis. This implies collection methods seeking to construct a hierarchically arranged sequence of partitions for some given object set to result in a hierarchy based on proximity measures defined for every pair of objects (Köhn & Hubert, 2015).

4 Empirical Results

As shown in Fig. 9, the highest values for the Healthcare Innovation Index are registered for Switzerland, the Netherlands and Germany, and the lowest values are obtained by Poland, Italy and Slovakia.

Analysing the four components of the HII, it is observed that fiscal sustainability has the highest share, especially in Switzerland, the Netherlands, Germany and the

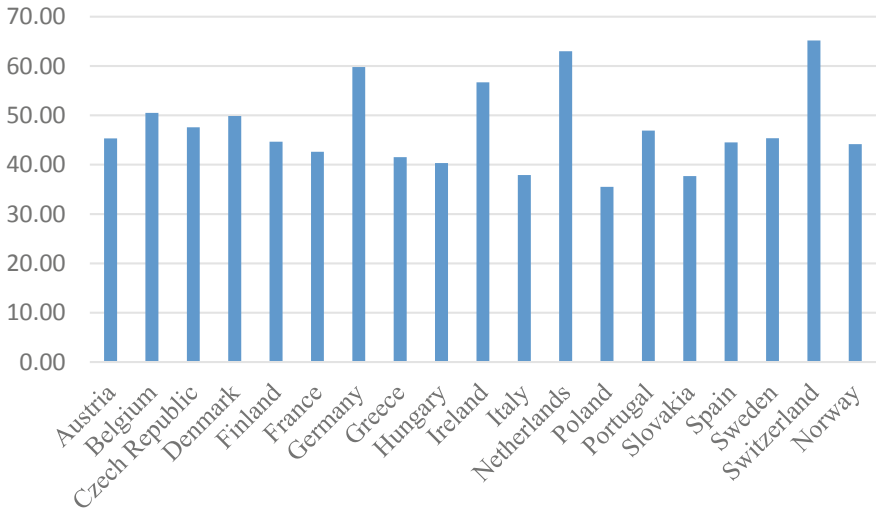


Fig. 9 Healthcare Innovation Index across European countries, 2021 (*Source* Authors' own elaborations)

Czech Republic, and the lowest share is associated with Science & Technology, especially in Poland, the Czech Republic and Slovakia (Fig. 10).

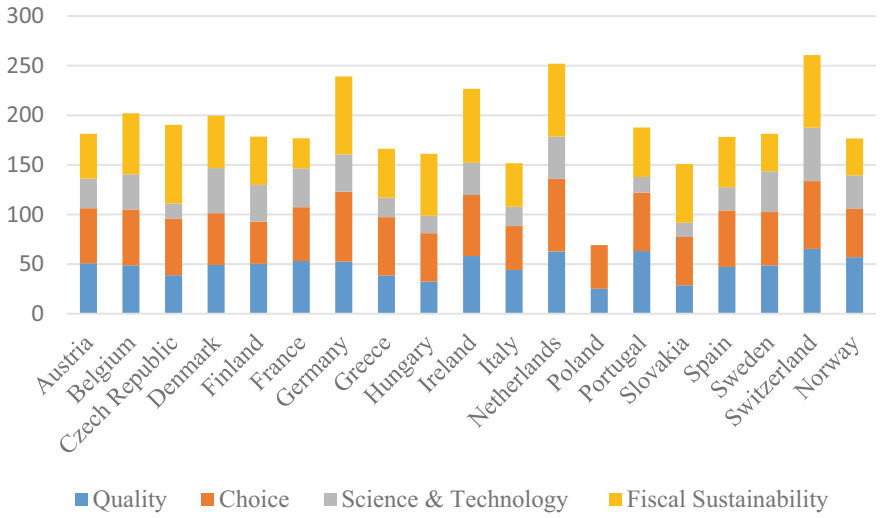


Fig. 10 Healthcare Innovation Index components across European countries, 2021 (*Source* Authors' own elaborations)

Regarding resilience, as shown in Fig. 11, the countries registering the highest resilience in 2021 are Denmark, Sweden, Switzerland and Germany, and the countries with less resilience are Greece, Hungary and Italy.

To examine the sample characteristics, descriptive analyses of the data were conducted. A summary of the descriptive statistics of each variable for the entire sample of countries used in this study can be seen in Table 2. Thus, it was known that the average score for resilience in the case of the European countries in the sample in this study is 86.81, the lowest value is 57.19 and the highest is 100 with a standard deviation of 11.06. The median FREOPP score was 47.32, ranging from 35.52 to 65.15, with a standard deviation of 8.44.

To measure the correlation between FM_GRI and FREOPP, we applied a parametric method (Pearson linear correlation coefficient-PC), confirmed by the nonparametric method (Kendall rank correlation coefficient-KC) (Corder & Foreman, 2014).

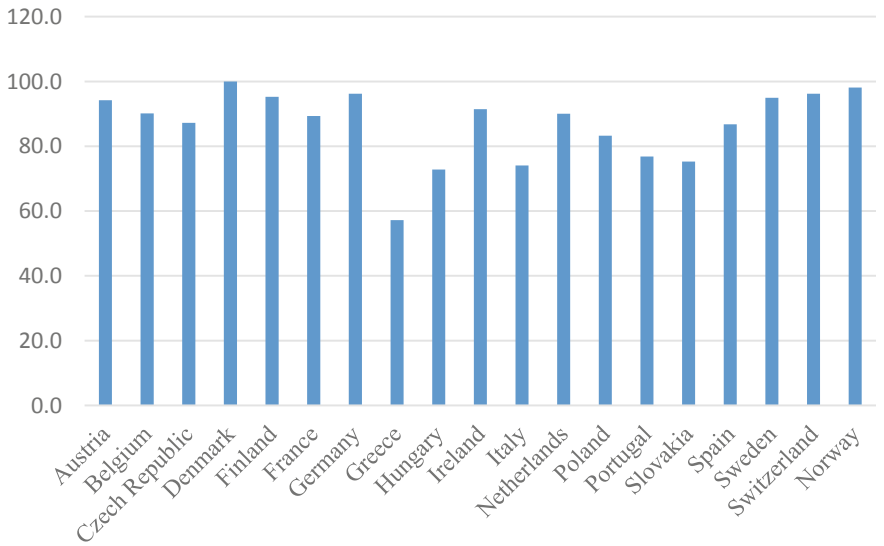


Fig. 11 Global Resilience Index across European countries, 2021 (*Source* Authors' own elaborations)

Table 2 Summary statistics of dependent and explanatory variables

		FM_GRI	FREOPP
N	Valid	19	19
	Missing	0	0
Mean		86,81	47,32
Std. Deviation		11,06	8,44
Minimum		57,19	35,52
Maximum		100	65,15

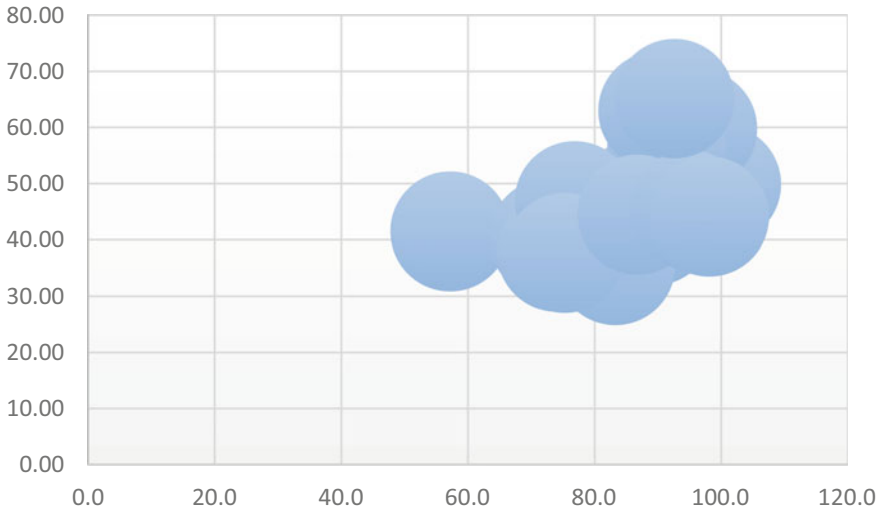


Fig. 12 Correlogram (*Source* Authors' own elaboration)

The Pearson correlation coefficient is 0.52, indicating a medium and positive link between the two variables, confirmed also by the correlogram (Fig. 12), meaning that a country with a high Healthcare Innovation Index will register a high Resilience Index and therefore a high degree of resilience, thus confirming H1.

To analyse whether there is also a dependency relationship between the two indices, we performed regression analysis, where the FM Global Resilience Index is the dependent variable and the FREOPP Healthcare Innovation Index is the independent variable. R^2 is 0.25, meaning that the FM Global Resilience Index is explained by the FREOPP Healthcare Innovation Index at 25%. The FREOPP Healthcare Innovation Index significantly influences the FM Global Resilience Index, with a probability of 95%, confirming H3 (Table 3). Therefore, if the FREOPP increases by one unit, FM Global Resilience Index increases on average by 0.63 units (direct relationship), considering a probability of 95%, confirming hypothesis 2.

Given that at the level of the European countries in the sample, healthcare innovation led to a stronger resilience, we performed a clustering of countries in this regard (Fig. 13). Thus, four clusters were identified:

Table 3 Regression analysis

Model		Unstandardized Coefficients		*t*	Sig
		B	Std. Error		
1	(Constant)	56.93	13.18	4.32	0.0005
	KOF_GI	0.63	0.27	2.03	0.0353

Source Authors' own elaborations

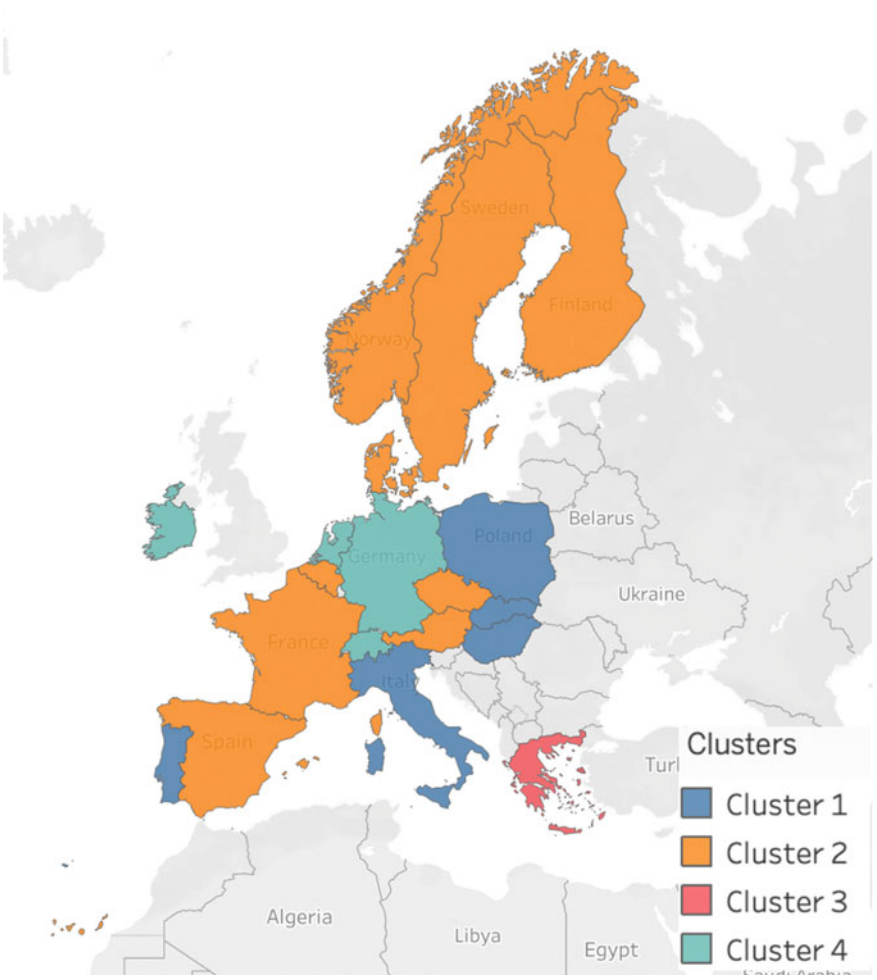


Fig. 13 Clustering European countries according to resilience and healthcare innovation (*Source* Authors' own elaborations)

Cluster 1: Poland, Hungary, Slovakia, Italy, Portugal;
Cluster 2: Spain, France, Belgium, Austria, Czech Republic, Finland, Norway, Denmark;
Cluster 3: Greece;
Cluster 4: Ireland, Switzerland, Germany, Netherlands.

5 Conclusions

The Coronavirus health crisis highlighted the low resistance and resilience facing the entire world towards an uncertain and unpredictable future. Thus, it is necessary to improve resilience around the world, considering the health component. Considering the improvements and evolution in the case of the healthcare system, we analysed the relationship between resilience and healthcare innovation in 19 European countries using the Healthcare Innovation Index and Resilience Index for 2021.

The comparative analysis of the Healthcare Innovation Index and the Resilience Index highlighted an average and positive link between the two indices. Related to dependency, at the level of the sample, resilience is explained 25% by healthcare innovation. Therefore, the health component is essential to reflect the level of resilience and should be included when rethinking the components of resilience. Finally, we clustered the European countries according to the two indices, highlighting the similarities and differences between countries in this regard.

The results indicated that investments in healthcare innovation led to greater resilience to shocks, especially related to health. Therefore, it becomes necessary for the healthcare system to receive more attention and to benefit more investments. Another improvement is represented by the innovative part, updating the knowledge in the field, and including all the novelties, including artificial intelligence, which has very good results regarding health improvement.

Therefore, the policies of the coming years will take into account the main components of resilience and aim as transversal objectives the digitalization of public services, especially in the health sector, and the profound reform of the promotion and business model and product sales. The connectivity and security of digitalized systems will also shape the behaviour of the population through their propensity for digital components, smartness that ensures resilience and sustainability, in its broadest sense—green, adaptive and future-oriented risk assessment.

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Chapter 15
Future Healthcare Payment Models in Medical Entrepreneurship

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1 Introduction

Entrepreneurship is often termed the capacity to create new ventures from new or existing concepts, ideas, and visions. There had been a noteworthy entrepreneurial response to the changes in the scientific and social underpinnings of healthcare services delivery. Nevertheless, a rising portion of the economic development driving healthcare industry expansion is threatened further by the longstanding use of financing models that are suboptimal for healthcare ventures. It is essential to increase the pace of medical entrepreneurial activity as a means of responding to the general economy and markets. However, a lack of capital for new healthcare ventures has been a major challenge for health financing. Health financing is much more than a matter of raising money for health. It is about answering this puzzle: who is asked to pay when they pay, and how the money raised is spent.

Health financing is an imperative part of broader efforts to ensure social protection in health. As such, the World Health Organization (WHO) is the joint lead agency with the ILO in the United Nations initiative to help countries develop a comprehensive social protection floor, which includes the type of financial risk protection and the broader aspects of income replacement and social support in the event of illness. Today, global annual expenditure on health is increasing, with the burden of communicable diseases remaining stubbornly high in some parts of the world, and the prevalence of no communicable diseases—heart disease, cancers, and chronic conditions such as obesity and other global pandemics—are increasing everywhere.

However, the latest scarcity of entrepreneurial activities in the health services sector may also be due to the inability to consider new approaches to partnerships and strategic ventures, despite their mutually beneficial organizational and financing potential. As capital becomes more limited for innovators, those with new and

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creative ideas for health and healthcare improvement must consider techniques for capital acquisition that have been successful in other industries and at similar stages of development. Capital and added expertise can allow entrepreneurs to leverage resources, dampen business fluctuations, and strengthen long-term prospects. In some countries, up to 11% of the population suffers this type of severe financial hardship each year, and up to 5% are forced into poverty. Globally, approximately 150 million people suffer financial catastrophe annually, while 100 million are pushed below the poverty line. There are three critical areas of health financing: raising sufficient money for health, removing financial barriers to accessing and lessening the financial risks of illness, and efficiently utilizing available resources World health organization (2010).

In addressing this, the World Health Organization (WHO) designed universal health coverage that will redress inequalities in the health system. However, in achieving this goal, governments face three fundamental questions: How is such a health system to be financed? How can they protect people from the financial consequences of ill health and pay for health services? How can they encourage the optimum use of available resources? This cannot be accomplished without well-functioning healthcare payment models. This is perceived as the most important element of financing systems that can achieve universal coverage because many countries still depend on direct payments from individuals to health service providers to fund their health systems without any forms of future payment model. Tracking financial resources for health is a precondition for assessing the performance of health financing systems and financial protection, characterizing progress during the health financing transition, evaluating health-system efficiency and productivity, or advocating for health-system policy change. This is necessary in developing future health financing scenarios to assist policy-makers and donors in predicting the extent of services that can be provided and identify gaps where expected funding is insufficient. It is, therefore, expedient to consider an entrepreneurial future payment model that will move more quickly toward achieving universal health coverage.

2 Literature Review

The recent dearth of entrepreneurial activities in the health services sector may be due to failure to consider new approaches to partnerships and strategic ventures in other to develop a financing model in the health sector despite the mutual beneficial organizational and financing potential around the global world. Intently, capital has become scarcer for medical entrepreneurs. It is imperative that those with new and creative ideas for health and healthcare improvement consider techniques for capital acquisition that have been successful in other industries and at similar stages of development. Healthcare is currently in the middle of a transition from a system of payment based on the volume of services provided (fee-for-service) to payment based on the value of those services (value-based care and alternative payment models).

To achieve universal health coverage, countries need financing systems that support people in using all types of health services, such as promotion, prevention, treatment, and rehabilitation, without incurring financial hardship. Today, millions of people cannot use health services because they have to pay for them at the time they receive them. Many of those who do use services suffer financial hardship or are even impoverished because they have to pay on the spot. Globally, all countries, rich and poor, struggle to raise the funds required to pay for the health services their populations need or demand (which is sometimes a different matter). No country, no matter how rich, is able to provide its entire population with every technology or intervention that may improve health or prolong life. However, while rich countries' health systems may face budget limitations—often exacerbated by the dual pressures of aging populations and shrinking workforces—spending on health remains relatively high. The following are different financing models that can be adapted based on the needs and peculiarities.

1. Fee-for-Service: Traditionally, healthcare providers are paid in an FFS model. This is exactly what it sounds like every time you have a blood test a doctor's visit a CT scan or any other service, you (and your insurance company) pay separately for what you have received. Throughout a long treatment or chronic condition, that can add up to huge expenses. It is well known that FFS is draining the entire healthcare system. When paying for volume, a sick patient is worth more than a healthy patient, and this status quo results in uncoordinated care, duplication of services, and fragmentation. After all, the more doctors and providers do, the greater they get paid. Reformers hope to replace the traditional FFS model with something better, and they have come up with many different models of payment that could allow this to happen. However, this creates incentives for healthcare providers to provide more services to patients, regardless of the need for these services, solely to maximize their profits and compensate for losses.

2. Scheme Payment (Community Based Insurance Scheme): This is a health insurance scheme that is made available to low-income earners in socialist countries. It is a prepayment plan where the low-earner and less privileged pay a fixed regular amount. This amount is lumped together by the insurance health sector or the Ministry of Health in the country to attend to health expenses of the populace and other fees and clerical fees.

3. Out-of-pocket: In terms of health insurance, they are expenses that citizens or employees share. It also refers to a portion of the bill that the insurance company does not cover and that individuals must pay on their own. The out-of-pocket healthcare expenses include deductibles, copays, and coinsurance.

4. Cost Sharing: This is referred to as the share costs covered by the insurance company and health institution in the country that own pays out-of-the-pocket. The term generally includes deductibles, coinsurance, copayments, or similar charges, but it does not include premiums, balance billing amounts for no network providers, or the cost of no covered services. Cost sharing comes into play when a policyholder uses medical and/or prescription drug insurance coverage.

5. Capitation: A cap rate or premium is attached to the payment of health services received by citizens or employees in an economy. It is a model in which the health

practitioners and other healthcare personnel pay a fixed amount over every patient within a timeframe. The healthcare providers are paid for each enrolled patient or per member per month. Capitation can be in the form of primary, secondary, and global depending on the relationship of the paying entity and the payment receiver.

6. Copayment scheme/insurance: This is an insurance arrangement whereby the policy/holder/citizen will need to pay a portion of the medical expenses on their own and the insurance company will pay the remaining outstanding amount. Copayment is a fixed amount or percentage that is present for various treatments and services. It has to be paid anytime the policyholder gets a healthcare service. The copayment clause lowers the premium amount for the policyholder.

7. Retrospective Payment: The retrospective payment plans pay healthcare providers based on their actual charges. With a retrospective payment plan, a provider will treat a patient and submit an itemized bill to an insurance company detailing the services rendered. The insurance company, in turn, may approve or deny payment for the treatment or portions thereof, but healthcare providers generally get paid in full for the amounts they bill. It allows patients to receive more attention because providers are not limited to approving treatment plans they can adjust their services to meet individual patients' needs.

8. Prospective Payments: This payment plan warrants a fixed payment rate for specific treatments. While these rates might change over time because of factors such as inflation, they are not adjusted to accommodate the individual patient. Under a prospective payments plan, a healthcare provider will always receive the same payment for providing the same specific type of treatment. The plans pay a fixed rate, so providers and insurers can better manage and estimate costs and payments. Prospective payment plans also have the potential to save insurance companies money, and when that happens, some of those savings may be passed on to the patient in the form of lower annual premiums and copayments. Additionally, prospective payment plans tend to motivate providers to deliver the most efficient care possible.

9. Pay-for-Performance: It is also known as value-based purchasing; it is a payment model that offers financial incentives to physicians, hospitals, medical groups, and other healthcare providers for meeting certain performance measures. It is a scheme that provides financial incentives to health workers or facilities based on the achievements of prospect field performance targets and has been widely implemented in health systems across low- and middle-income countries. However, the success of any P4P program is predicated on the quality and outcomes framework that is used to assess the performance of the healthcare institutions and healthcare providers.

10. Mixed Financing Model: This is a financing model where the approach of financing health services is spread across different existing healthcare payment models in an economy.

11. Global Budget Funding: This model is the predominant one in Canada and in public hospitals in the USA (Sutherland, 2011). Under this system, a fixed amount of funding is allocated among hospitals based on various criteria, including previous budgets, the inflation rate, and major investments in upcoming years. Allocation is independent of the volume and intensity (the amount of care required) of patients

in the hospital. This mechanism functions primarily to control costs and does not provide any financial incentives to shorten wait time or length of stay or to increase quality of care or patient volumes. Peacock and Segal (2000) conducted an economic analysis on the feasibility of implementing a weighted capitation (global budget) formula in the Australian health system at the hospital level and concluded that this approach could be effective for enhancing efficiency, equity, and accountability.

Furthermore, authors such as Jabeen et al. (2021) investigated the comparative analysis of the healthcare systems of Iran and Nigeria using WHO Building blocks. The comparison was based on building blocks of health services deliveries, human resources capacity and training, innovativeness of pharmaceutical services, availability of health information systems, financial patterns to healthcare services and payments, and regulation and governance of the health sector. The study concluded that the national budget should improve the percentage apportioned to healthcare services, delivery of healthcare should be accessible to all classes of citizens, the health insurance welfare scheme of Nigeria, being 5% one of the lowest in West African countries, should be revitalized, they should be a consensus between prescription of modern and traditional medicine, so it has to improve foreign pharmaceutical companies.

Dai and Tayur (2019) evaluated healthcare operations management studies published between 2013 and 2017 in Manufacturing & Service Operations Management, Management Science, and Operations Research and highlighted that the incentive issue as an essential milestone of healthcare operations management is a critical component of healthcare ecosystems. More recently, Mišić and Perakis (2020) studied data analytics-related studies in operations management and included representative healthcare operations management literature on policy-level, hospital-level, and patient-level problems. In contrast to Dai and Tayur (2019) and Mišić and Perakis (2020), this review paper summarizes existing studies specifically on financial incentives and payment mechanisms for these pivotal players in any healthcare system among OR & MS journals.

Tikkanes. Osburn and Mossales (2020) investigated the International Profits of Healthcare System across developed countries. The Australian healthcare system induces their payment system to various age groups through the use of federal and state schemes having the categorical distribution of the population eligible to the scheme (it is funded by tax revenue). The Brazilian healthcare system made use of the SUS Financing method, but to a larger perspective, the healthcare system is slightly porous in terms of the ideology of the out-of-pocket and cost-sharing reality to all the populace in the region.

Canadian healthcare is funded and administered primarily by the country's 13 provinces and territories, and the benefits and delivery approaches vary in terms of the class of citizens. Chinese healthcare is funded primarily via employer and employee payroll taxes for urban settlers, and urban–rural resident basic medical insurance is financed by the central and local governments through individual premium subsidies. The copayment and out-of-the-pocket model is employed in this country. The Danish healthcare system practices a healthcare system that is publicly financed by the government, giving block grants from tax revenue to recognized regions and

municipalities. Other health needs could be met by the copayments model for outpatient drugs, dental care, and other services. English healthcare is attributed to the fact that all residents, either citizens or immigrants, are entitled to healthcare services under the National Health Service that is funded through taxation.

French healthcare sets the national health strategy and allocates budgeted expenditures to regional health agencies that are responsible for planning and service delivery. The French healthcare system adopts the Danish and English healthcare models. German healthcare is a mandatory statutory health insurance scheme that provides inpatient outpatient, mental health, and prescription drug coverage. The health scheme is termed a sickness fund that is deducted from the wages and salaries of employers and workers. The copayments model is also used by the inpatient. India's healthcare is a decentralized approach in the delivery of healthcare to its citizens. The states are primarily responsible for healthcare services through the national health protection scheme that is sectionalized for a specific population and factory workers. To meet their immediate health needs, the out-of-the-pocket model is also attained by the populace due to the poor infrastructural amenities and always rising birth rate.

Israeli healthcare is a universal coverage national health insurance scheme enacted by law. However, residents have the benefits of choosing among the four nonprofit health plans that have similar mandated benefit packages. Italy's healthcare covers all citizens and legal foreign residents, and it is funded by corporate and value-added tax revenue collected by the central governments and distributed to the regional governments. The Japanese healthcare is a universal coverage healthcare scheme, funded primarily by taxes and individual contributions. Enrollment is either an employment-based or residence-based health insurance plan. The system requires an annual household out-of-the-pocket fund maximum for citizens to meet young children's and older adults' health needs. The Dutch Healthcare System merges public and private social health insurance, and it is expected that all residents purchase statutory health insurance from private insurers, which are required to accept all applicants. It is financed through premiums, tax revenue, and government grants. New Zealand healthcare is a publicly funded and regionally administered delivery system. The systems are financed through tax revenue from the central government. Norwegian healthcare is universal health coverage, funded primarily by general taxes and by payroll contributions funded by employers and employees.

Singapore healthcare is a mixed financing system of the public statutory insurance system and MediShield Life. The MediShield covers large bills for hospital care, at a particular limit for individuals, and receives subsidies. Additionally, a health savings account is maintained by the residents. Swedish healthcare is nationally regulated and administered locally. The funding comes primarily from regional- and municipal-level taxes. The regions set provider fees and copayment models at all levels of care.

Switzerland's healthcare is highly decentralized, with states playing a key role in its operations. The system is funded through enrollee premiums and taxes. Social insurance contributions and out-of-payments models. It is expected that residents

will purchase health insurance from the private nonprofit insurer. Taiwan's healthcare is universal and mandatory; it is a single-payer system and is funded primarily through premiums and government subsidies to low-income earners. The contracted private providers of healthcare receive out-of-the-pocket costs for some services and products. The US health system is a mix of public and private, for-profit and nonprofit insurers, and healthcare providers. The federal government provides funding under some programs to some special groups of citizens, and the state also funds some local areas, while others are private insurance provided by employers. The Affordable Care Act allows private insurers to set the benefits and cost-sharing structures with federal and state regulations.

Si Yun-Tan and Melendez-Torres (2017) examined the cost-effect, benefits, and implementation practices of PPS (Prospective Payment System) in middle-income countries. The PPS theoretical idea is to increase efficiency and reduce the triad healthcare problem between providers, payers, and patients. The study was able to empirically conduct a systematic review of health policy journals of 14 databases using Drummond's 10-item checklist, Cochrane Collaboration's tool, and Risk of Bias evaluation to draw the cogent theme of the prospective payment system on the selected continents. The findings revealed that PPS (Prospective payment system) has been able to be beneficial to the demand side and supply side of health parties. The policy and model have been able to curb wastage and improve efficiency and confidence on the part of the parties to healthcare in an economy.

Ellis et al. (2014) examined the comparisons of health insurance systems in developed countries, focusing on who bears the risk, what choices are allowed, how much health spending burdens are redistributed, sources of revenue, cost savings strategies, and the use of specialized and secondary insurance. The study was able to explain the roles and responsibilities and functions of various agents in the health insurance system in the proposed and practiced scheme. It also depicts the dual responsibility of the agents. The four structures of healthcare payments include private goods markets without insurers, reimbursement insurance, conventional insurance, and sponsorship health insurance. The contractual relationship between agents of the health insurance scheme is differentiated following money and service rendered. The breadth of coverage of the primary insurance programs in the developed countries is in a certain higher percentage to the lower percentage. U. population has 83% coverage of citizens who have access to health insurance schemes. The cost-containment strategy includes demand-side cost sharing, supply-side cost sharing, and nonprime rationing.

Robyn et al. (2013) examined the implication and favorable aims of providers' payment modes and community-based insurance schemes in developing countries. The study concluded that the usage of provider payments in developing countries has been able to enhance the sustainability and satisfaction of community-based insurance schemes for patients. The study highlights different advantages of provider payments that spell out the inherent performance of community-based insurance schemes (Table 1).

Table 1 Health payment model and country adoption

Sn	Health Payment Model	Countries
1	Fee-for-Service	Nigeria, Iran
2	Scheme Payment (Community Based Insurance Scheme)	Australia, Canada, UK, Sweden, Germany, India, and Israel
3	Out-of-Pocket	Brazil, China, Denmark, India, Taiwan
4	Cost Sharing	Nigeria, Brazil,
5	Copayment Scheme/Insurance	China, Denmark, Germany, France, Italy, Japan, Netherlands, Norway, New Zealand, Singapore, Switzerland, Taiwan, USA,
6	Mixed Financing Model(a PPS and performance bonus)	China, Germany, Singapore, USA

3 Policy Prescriptions and Recommendations

Every country could raise additional domestic funds for health or diversify their funding sources if they wished to. Options include governments giving higher priority to health in their budget allocations, collecting taxes or insurance contributions more efficiently, and raising additional funds through various types of innovative financing.

- Technological innovation can solve the biggest challenges within healthcare payments—streamlining and modernizing how providers, insurers, and patients interact with every aspect of paying and receiving payment for care. Healthcare providers owe it to themselves and their patients to take advantage of the technologies and data sets that can make the process easier on everyone.
- Countries should protect their citizens by guaranteeing that the bulk of domestic funding for health is derived from a form of prepayment that is then pooled to spread financial risks across the population.
- There is too much reliance on direct payments as a source of domestic revenue for health. Therefore, prepayment and pooling financing options will not only remove the financial barriers to access but also reduce the incidence of catastrophic health spending in achieving universal coverage.
- Countries should consider whether health is receiving its rightful share of government spending and look at possibilities for raising taxes on tobacco, alcohol, and other products harmful to health. Such taxes can contribute substantial additional funding while directly improving population health.
- Establish institutional and administrative arrangements to collect and pool contributions from the various sources (thereby reducing reliance on direct out-of-pocket payments in countries where they are high).
- Entrepreneurial-minded healthcare professionals should apply predictive data and analytical tools to anticipate healthcare needs in a community, ensure care is adequate and needed, and make statistical forecasts about the care that will be required next.

- Developing value-based care partnership models: The coverage and reimbursement gap persists globally, given the insufficient data on precision medicine value-add and payment uncertainty. Further incentive alignment is encouraged between payer, provider, patient, and producer stakeholders to form appropriate partnerships that share risk and recognize the value of precision medicine.
- University-industry collaboration: Medical entrepreneurship should develop academic consortia/partnership models, and industry-minded researchers may be early steps in growing the precision medicine innovation ecosystem.
- Creating national innovation policy instruments for medical entrepreneurs: The innovation policy mix consists of initiatives, e.g., intellectual property legislation, cluster initiatives, market review processes, and federal budgets, that build early national public confidence and market demand for precision medicine approaches that private entities cannot build alone.

4 Conclusion

Financial resources are indispensable inputs to health systems, which are required to purchase medicines and supplies, build health facilities, and pay health workers. However, restricted financial resources are a general constraint faced by all health systems because health financing systems are tasked not only with raising sufficient financial resources to fund the health system but also doing so in a way that promotes equity. Health systems funded according to one's ability to pay, such as those based on income taxes, promote both financial equity and better health. Entrepreneurship is often described as the ability to create new ventures from new or existing concepts, ideas, and visions. There has been a significant entrepreneurial response to the changes in the scientific and social underpinnings of healthcare services delivery. However, a growing portion of the economic development driving healthcare industry expansion is threatened further by the longstanding use of financing models that are suboptimal for healthcare ventures.

Overdependence on out-of-pocket spending diminishes access to care for those who are uninsured or underinsured and risks exacerbating the burden of ill health and increasing poverty due to the high cost of care. The recognized importance of financial protection has led to finding alternative financing options for future healthcare payment models. Medical entrepreneurship is the ability of health professionals to generate innovative business opportunities in the medical profession in response to the needs, tastes, demands, and changes in the fields of medicine, biotechnology, healthcare services, ICT, medical innovations, and social entrepreneurship across the globe.

The major challenges have been identifying financing models that will meet the needs of individuals and organizations. It is a constant challenge to balance priorities: Funds often remain scarce, yet people demand more, and the technologies for improving health are constantly expanding. Such conflicts force policy-makers to make trade-offs in three core areas in terms of the proportion of the population to be

covered, the range of services to be made available, and the proportion of the total costs to be met.

However, medical entrepreneurs are mindful of the challenges, needs, tastes, preferences, changes, and financing gaps in the health sector and therefore are expected to connect entrepreneurially with these market opportunities to provide relevant health-oriented products, services, and technologies using the different financing models as stated above to make medical solutions for the double bottom-line (personal profit and social impact). It is expedient that countries need to apply to innovate governance mechanisms to efficiently manage the annual budget allocation to the health sector and implement health policy that will support the activities of medical entrepreneurship in other to sustained increases in the quantity, equity, and efficiency of health financing as required in achieving universal health coverage and improving health outcomes globally.

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Chapter 16
Healthcare Innovation & Entrepreneurship, Digital Health Entrepreneurship

Muhammad Usman Tariq

1 Healthcare Innovation

Innovation is a new concept itself. The title has made its way to healthcare as an idea adopted from other domains, with the exact definition to those utilized in marketing, business, and technology. The literal meaning of innovation is a new concept, method, and processing the introduction of new ideas, methods, or devices. Healthcare innovation falls under the broader shade of innovations to resolve societal issues. Social innovation motivates new approaches to manage the problems of poverty, health, education, and other human development issues by making system-level amendments. The World Health Organization (WHO) describes health innovation as enhancing healthcare quality, effectiveness, sustainability, efficiency, affordability, and safety. The definition includes new and improved health systems, policies, technologies, practices, technologies, delivery methods, and services that improve healthcare. Developments in patient satisfaction, accessibility to care, research, and education are additional factors to keep in mind. In other words, the eventual objective of healthcare innovation is to enhance the abilities to meet personal and public healthcare requirements and demands by improving the performance of the healthcare system. As a concept, healthcare innovations should capitulate ascendable solutions and enhancements in health policies, delivery methods, technologies, products, services, and systems to improve education, accessibility to healthcare, treatment, outreach, diagnosis, prevention quality, and delivery. It is essential to know what is innovation and what is not? to breakdown the concept of healthcare innovation. The way to answer these questions is to consider the following:

- Issues in healthcare have resulted in solutions to problems of quality, efficiency, safety, effectiveness, sustainability, and healthcare affordability.

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- Solutions that have resulted from issues in healthcare may be considered innovation, as they have resolved issues by introducing a significantly or new approach, process, concept, technology, idea, service, or product. Not all innovations are solutions, and not all solutions are innovations. Some solutions to issues in healthcare are just developments in the field (Garbuio & Lin, 2019)

Just as technological progressions, for example, email, GPS, and mobile phones, explore solutions to the world's communication issues, advancements in healthcare seek to address the problems in the domain. Healthcare is unceasingly fluctuating and adapting. For a solution to a healthcare issue to be an innovation, it must introduce something significantly or new different from other solutions in the domain. The usage of the invention has led to the dilution of its meaning and its understanding in healthcare. Without precision on what innovation truly is, the concept is lightly adopted and implemented. Perhaps a general definition permits for recognition and praise of positive developments and new ideas, products, and methods in the domain of healthcare.

In contrast, there is no ability to develop and accurately identify innovations in healthcare without a current understanding of innovation. Based on technological innovations, progressions in technologies allow for opportunities for process and product innovation. Product innovation includes the new services and goods in the market. On the other hand, process innovation consists of the improvement of the production of services and goods. In healthcare, progress in technologies and practices is based on evidence (Niccum et al., 2017).

2 The Need for Innovation in Healthcare

Healthcare decision-makers are constantly under an immense amount of pressure to provide quality care with restricted resources. Factors such as the ageing population, sharp rise in long-term conditions, decreased funding, increased expectations of patients, and the present era's pandemic COVID-19 make it even tougher to pinpoint a consistent requirement of innovation in healthcare. Insufficient availability of experienced staff is also a severe challenge for healthcare providers, who must appear as attractive as possible to demand the most talented and exclusive potential employees. Innovative technologies and the ever-growing digitalization of healthcare can support this much-required innovation, creating opportunities to enhance attractiveness to staff and patients while enhancing patient efficiency and outcomes (Niccum et al., 2017). Within the healthcare context, innovations must validate a clear advantage compared to what is currently done. For example, the Whole Health Organization Health Innovation Groups explains that innovation responds to pending health requirements by generating new learning and thinking and adds value in enhanced efficiency, sustainability, effectiveness, quality, and affordability. Consequently, healthcare innovation includes various applications from tools, tests, novel therapies, and surgical procedures to new approaches to education, service delivery,

training, procurement, and service delivery models. In the present day's digital world, it is not surprising that the idea of healthcare innovation is firmly interconnected with digital transformation and digitization. In the eyes of the potential staff and patients, many firms have recognized that they require implementing leading-edge digital healthcare to remain competitive. It could involve mediums for a virtual appointment, mobile health application, and novel surgical imaging technologies. Healthcare digitalization improves patient experience and results, but digital technologies also affect healthcare provision. By healthcare digitization, outcomes and patient experience can be enhanced, but digital technologies also influence healthcare provision. From virtual approaches for HCP-to-HCP communication to digital mediums for performing administrative tasks such as updating patient data and records, the possible advantages of existing, new, and disruptive technologies affect the entire hospital organization. For example, benefits in terms of cost reduction, efficiency, ease of use, and time savings can be felt by all those who work in the domain, from practising clinicians to hospital management. With many markets experiencing insufficient skilled staff, reflecting a reputation for innovation is more significant than ever. Being apparent as innovative by groundbreaking technologies and the ever-growing healthcare digitization develops opportunities to boost attractiveness to staff and patients while enhancing patient efficiency and outcomes (Garbuio & Lin, 2019).

2.1 Innovative Healthcare Technologies

Improving Clinical Capabilities

The procurement and usage of trailblazing equipment can make a significant contribution to satisfying staff expectations, enhancing patient experience, and strengthening the reputation of a hospital organization in the view of potential or current patients. For example, endoscopy innovation techniques can enhance the reliability and speed of treatment and diagnosis. Olympus EVIS X1 demonstrates it, an advanced endoscopy system that incorporates innovative, easy-to-use, and novel technologies, for example, extended depth of field (EDOF), texture and colour enhancement imaging (TXI), red dichromatic imaging (RDI), and verified features such as narrow-band imaging (NBI), to help with precise screening and confident diagnosis. These technologies, if combined, intend to facilitate cancer screening and enhance how gastronomical disorders such as colorectal cancer can be treated, detected, and characterized. The ORBEYE is an example of how digital innovation can have innumerable benefits in the operating room, allowing surgeons to carry out better microsurgery, for instance, unlike conventional surgical microscopes, where surgeons must look at the magnified surgical site by viewing down a set of ocular lenses, ORBEYE functions like a digital magnification camera. It delivers a pristine 4K 3D view of the surgical site projected into a large 55-inch monitor. Consequently, the surgeon can obtain a view of the procedure and the entire surgical team.

It positively affects team interaction during surgery and facilitates surgical procedure training for other medical care professionals. Additionally, surgeons can now perform heads-up surgery while looking straight ahead at the monitor instead of down a small and confining set of lenses. Furthermore, positive ergonomic impacts permit surgeons to position their patients better and attain new surgical site viewing angles with ORBEYE (Garbuio & Lin, 2019).

2.2 The Healthcare Innovation Attraction

From the viewpoint of clinicians, innovative and new technologies are attractive as they help in their ability to provide optimal care. For example, EVIS X1 integrates ENDO-AID CAD, a computer-aided detection application that utilizes artificial intelligence (AI) to support clinicians. Furthermore, interaction with leading-edge technology contributes to professional development, permitting clinicians to expand their portfolios and boost their value, which is interesting. ORBEYE, for example, adds an extra layer of value as it can be leveraged for surgical conferences and training, providing a captivating experience to support professional training/development and create collaborations. OBREYE also creates a revolutionary leap in ergonomics in the workplace compared to conventional surgical microscopes that remain uncomfortable and large. Remarkably, the performance ability of heads-up surgery permits a more natural and comfortable working position and may release stress on the surgeon's neck and head if an ergonomic workspace validates a commitment to employees' health and can positively influence their overall safety and well-being (Meskó et al., 2017).

3 How Healthcare Innovation Helps in Economic Growth and Efficiency

Healthcare innovation can make economic growth by enhancing efficiency and increasing productivity while also optimizing patient outcomes. For example, SOLTIVE has the capabilities and features to alter urology, offering value that matters across various urological applications, such as Lithotripsy, Soft Tissue, and BPH (benign prostate hyperplasia) as anaesthetic all-in-one cost-effective and easy-to-use solutions. SOLTIVE uses an innovative energy source that has the potential to dramatically enhance the efficiency of the urology department. In stone treatment, a reduction in operational time by up to half can be attained when utilizing SOLTIVE, freeing up a clinicians' valuable time. Furthermore, an accurately considered design involving features such as quiet operation and an air-cooled and optimized energy system leads to suggestively less maintenance, enhanced energy efficiency, and reduced staff stress. Eventually, all-in-one innovations, for example, SOLTIVE,

optimize workflows to support productivity, staff well-being, and efficiency while driving down ownership costs.

Digital technologies, state-of-the-art, and procedures enhance hospital organizations' reputation, differentiating them from their competitors. Not only does this assist in retaining and attracting patients and clinical staff, but by innovation, hospital organizations have the potential to enhance patient care. Additionally, new technologies can update workflows leading to enhanced time management and, in turn, enhanced productivity and efficiency. Healthcare innovations, for example, ORBEYE, SOLTIVE, and EVIS X1 from Olympus, can enhance a reputation for innovation and at the same time enhance the health experience for staff and patients alike. Whereas these innovations offer some clear advantages, it is vital to note that innovation is beneficial and necessary. Hospital organizations should leverage innovation to stay relevant in the competitive market to progress (Garbuio & Lin, 2019).

3.1 Healthcare Entrepreneurship

The healthcare industry is flourishing. As technology has enhanced and become more widely accessible, many firms are shifting into healthcare or healthcare-adjacent domains, driven by entrepreneurs who witness the value of this emerging market. Simultaneously, healthcare organizations are becoming more numerous and experiencing a unique level of competition. Many of them are starting to accept entrepreneurial habits as a way of survival. In the future, it appears that healthcare and entrepreneurship are connected and that they will commence being linked for some time. The following are three basic ways linked and why it matters (Meskó et al., 2017).

3.2 Business Practices Make the Industry Work

One of the most effective methods of entrepreneurship and healthcare is relevant is how business practices are making the industry work. Healthcare specialists are utilizing business ideas to go ahead, which is disturbing conventional healthcare. Market incentives are pushing investors and skills entrepreneurs into the healthcare sector, and they are exploring a welcome market that is open to novel ideas and technologies. Simultaneously, healthcare is becoming less directed and more open as the sector accepts patients-as-consumers thinking. Medical care providers have to respond by market service provision, which was virtually unheeded in the past (Jayaraman et al., 2020).

3.3 Latest Payment Models Reward Value

For example, conventional clinical models, the fee-for-service models' healthcare employed over current years making money on how many patients are checked, are quickly disappearing. Novel population management models reward healthcare providers for making patients healthy, in contrast to permitting them to make money from only ill people. Shifting this focus changes the treatment scope. Now averting sickness is vital, and evading redundant treatment is the rule. Entrepreneurial healthcare workers are utilizing this chance to introduce health-preserving novelties, techniques, measures, and systems, for example, wearable technologies and fitness applications. It creates a world of exceedingly good services, products, and healthcare that is not the only direction of medical professionals, treatment centres, and health insurance firms (Gubin et al., 2017).

3.4 Technology Shifts Modern Healthcare

Technology is modifying modern healthcare. Entrepreneurial-minded medical care professionals are implementing predictive data and analytical tools to forecast healthcare requirements in a community, guarantee that care is necessary and adequate, and make statistical forecasts about the care that will be needed next. They are also correcting and exposing inadequacies in conventional healthcare and making new models based on what functions. Technology is also becoming more critical as decision-making tools in the healthcare sector get a grip, be it websites that let patients access their lab work or wearable technology documenting patient experiences. There is also the requirement for incorporated data solutions now that so much data are accessible about patient lab work, treatment successes, patients histories, and hereditary problems that a systematic solution to help decision-making is practically needed (Alami et al., 2017). Healthcare entrepreneurship is an emerging domain of interest for practitioners and researchers in healthcare and entrepreneurship alike. There is a vital increase in healthcare entrepreneurship, specifically focusing on artificial intelligence, data, virtual reality, and wearables, that make care more available, keeping in mind the global pandemic and COVID-19 (Gauthier et al., 2018).

3.5 Recent Development in Digital Health Entrepreneurship

Digital health uses communications and information technologies to exchange and share medical information, and it detects opportunities with unique, uncontrolled resources to create user-defined value through digital health innovation. Some examples involve telemedicine, data analytics, business intelligence, electronic medical

records, remote sensing, mobile apps, and patient portals. Digital health entrepreneurship is one of many types of clinical innovation and biomedical research that also involves diagnostics and biopharma, policy innovation, process, medical devices, and care delivery. Digital health activity has gained recognition in a few short years to decrease costs, enhance the doctor-patient experience, and enhance the quality of service and care satisfaction and outcomes. The following are some recent developments:

1. The ongoing evolution of regional digital health ecosystems
2. Stables investment levels in digital heal and latest investment vehicles, such as equity crowdfunding and corporate family and venture office interest
3. Consistency of technologies creating a connection of the Internet of Things, health IT, nonbiomedical innovation, biomedical innovation with medicine applications
4. Health Information Technology is a section of the fourth industrial revolution
5. More health information technology training and educational offerings at the graduate and undergraduate levels
6. Data science applications driving business and clinical objectives and goals
7. Policy and regulatory amendments to accommodate, or affect the implementation and dissemination of digital health innovation involving actions against those who are explored to make confusing claims
8. New digital health business frameworks and compensation policies
9. Customers create a comfort level with digital health technologies at different levels
10. Digital health clinical practices to determine the clinical efficiency of services and products. Financial, clinical, experiential, and workflow endpoints and outcomes are coming into focus
11. Earlier participation of end users in the product deployment and development life cycle
12. Emergence, roll-ups, and consolidation of Big Digital and the group of five (Amazon, Facebook, Apple, Microsoft, and Google)
13. Innovation accelerators, generators, incubators, and centre
14. Educational, medical centre participation
15. Breaking down of academic history public obstacles to research, deployment, implementation, development, testing, commercialization, and dissemination
16. Community-based open innovation systems
17. Group five is changing the IP landscape and making it difficult for startups to create barriers to entry.
18. Cybersliability and cybersecurity should be the centre and front as another risk in product deployment and design.
19. Big medicine digital health strategies are starting to go downmarket to minor medicine
20. International virtual telecare commences to progress, specifically in Asia in the domains of oncology, reproductive services, ageing, and paediatrics

The following five evolutions highlight the significance of technology for people:

- Artificial Intelligence is the new user interface
- Ecosystem powerplays
- Staff marketplace
- Designs for humans
- The unexplored.

Digital health services and products begin to evolve at a nearly daily rate as we shift along the dispersal curve from the channel of let-down up the information slope. However, there are still vital gaps that must be filled if it is to recognize its full potential. Essentially, digital health is not about quadruple and the triple aim. It is about the double objectives of modifying patient and doctor behaviour, and technology alone cannot do that (Meskó et al., 2017).

Medical and health entrepreneurship, the detection of opportunities with unique resources to create user-defined value by deploying biomedical and clinical innovation, is emerging swiftly. After many years of either avoiding opportunities or being deserted, physician entrepreneurs are ultimately trying their best. There are two prime types of medical entrepreneurship: clinical and biomedical. There are apparent differences in the innovation paths for the two:

1. Intellectual property safety is mostly more significant in biomedical entrepreneurship
2. Legal approval can be an expensive, risky, and lengthy process for devices and drugs
3. Compensation and payment for biomedical innovation mainly depend on obtaining accurate codes and third-party payments at high amounts to make a profit.
4. Business models vary and are continuously changing
5. The amount of capital required to get a device or drug to market is offered higher than health innovation by various magnitude orders
6. The Food and Drug Administration (FDA) may not have authority over many health innovations, for example, a digital health app that is not classified as a medical device but instead as something that offers education and information to users.
7. Customers differ in relying on whether the healthcare provider is deploying a biomedical or health product.
8. Authenticating the business model utilizing lean startup methods will be more difficult for biomedical innovators
9. Biomedical entrepreneurship often needs a diversified skill set compared to health entrepreneurship
10. Biomedical entrepreneurship is riskier (Mathews et al., 2019).

Clinical or health entrepreneurship focuses on digital health, business or clinical procedures or policy, and delivery models. Moreover, digital health can be further sectioned into parts:

1. Remote wearables and sensing
2. Data intelligence and analytics; predictive modelling

3. Telemedicine
4. Medical social media
5. Bioinformatics tools
6. Wellness and health modification tools
7. Patient–physician patient portals
8. Digitized health record platforms
9. Decision support systems
10. DIY treatments, compliance, diagnostics.

Unlike biomedical entrepreneurs who are trying to use devices, vaccines, biologics, drugs, and diagnostics, Digipreneurs have to face the following:

1. There is a difference between a market and an industry. Firms that provide services and products comprise the industry. Customers who utilize those services and products include the market. Both the digital health industrial sector and digital health users are a complicated combination of payers, providers, and industry partners
2. Like all digital health investors, seek a significant rate of return with the lowest amount of risk. Providing the foggy legal, reimbursement, and regulatory ecosystem, telling which dogs will eat the food. There have already been prominent digital health failures, IPOs, roll-ups, and consolidations as the markets and industry have commenced maturing
3. Many digital health technologies have not been clinically certified, nor are they required to do so. However, other law firms, the life Federal Trade Commission (FTC) and the Consumer Products Safety Commission, are cautious about digital health product claims that are not associated with research
4. The FDA commences providing periodic guidance documents and rules that fail to clear doubt regarding what is not and what is a medical device.
5. Given the multiple shareholders in healthcare providers, partners, patients, and payers. Feasibility relies upon various customers seeing the value of any given service or product
6. The industry is new, and there is too little research to know which stakeholders, patients, consumers will accept a product and why
7. Scale outdoes innovation. The single most vital characteristic of those firms that have attained substantial follow-on investments are those that have scaled their customer rate quickly
8. Doctors do not have the data they require to prescribe any given digital health technology appropriately
9. Many doctors do not pay to utilize digital health technologies, and they disturb workflows. Furthermore, there are distressing emotional and behavioural barriers to adoption for patients, doctors, and families.
10. There are vital confidentiality, data privacy, and security issues still unsettled
11. Patent protection is not as significant in digital health as it is in Medtech or biopharma. Things shift much more quickly, the product life cycles are much shorter, and time is essential in regard to dissemination and adoption in the patient community.

12. Business models are regularly transforming and are sensitive to the variable tastes of Internet addicts
13. Digital health collections include many clinical and biomedical clusters. However, because digital health is at the boundary of information, sick care, and communication, there are many other factors at play; for example, big data and analytics, metaclusters, cybersecurity, artificial intelligence, and blockchain
14. Investors in digital health are not similar to investors in biomedical industries and technologies
15. Digital health, devices, and drugs; sometimes, there are vital intersections in product development (Petersen, 2018).

4 Uniqueness of Digital Health

Digital health is the new thing that is surrounded by hope and hype. Whether digital health can bend the cost curve and support patients or is just another technology bubble remains to be witnessed. Digital health entrepreneurs must do their due thoroughness with their open eyes and their wallets safeguarded until they are convinced they can overcome the risks (Mathews et al., 2019). There are three types of innovations that can make health cheaper and better. One changes the methods customers use to buy and utilize healthcare. Another utilizes technology to create new treatments and products or otherwise enhance care. The third makes new business models, specifically those that include the vertical or horizontal integration of separate healthcare activities or organizations (Petersen, 2018).

4.1 Consumer-Focused

Innovations in healthcare delivery can result in more effective, convenient, and less expensive treatments for current stressed and gradually empowered healthcare consumers. For example, a health plan can include consumers in the service delivery procedure by offering high-deductible insurance and low cost, giving members more control over their healthcare spending. Alternatively, a health plan and a service provider can emphasize becoming more user-friendly. Patients, after all, are like other customers. They want not only exemplary product-quality care at an affordable price but also simplicity of usage (Walsh & Rumsfeld, 2017).

4.2 Technology

New drug delivery systems, medical devices, drugs, and diagnostic methods offer the hope of better treatment and less expensive care, pain and disruption. For example,

implanted sensors can assist patients in monitoring their diseases more efficiently. Information technology innovations that link many information islands in the healthcare system vastly enhance quality and lower costs by, for instance, keeping patients' different providers informed and decreasing mistakes of commission or omission (Petersen, 2018).

4.3 Business Model

Healthcare is still an amazingly split industry. The healthcare system initiates a range of barriers to each of these valuable kinds of innovation. The barriers can be avoided by managing the six forces influencing healthcare innovation more often than not (Eesley & Miller, 2017). The six forces that impact business model innovation are funding, accountability, industry players, technology, public policy, and customers can support or delay efforts at innovation. In combination or individually, the forces will impact the three kinds of innovation in different manners:

Players

The healthcare industry has many shareholders, each with a plan. These players have considerable resources and can affect public policy and opinion by helping or attacking the innovator. For example, doctors and hospitals sometimes blame technology-based product innovators for the healthcare system's increased costs. Medical specialist wage removes for control of patient care and guarantees battle medical technology and service providers over which treatments and payments are accepted. Outpatient care providers and inpatient hospitals for patients, while independent firms and chains spar over market impact. Profit and nonprofit and publicly financed firms quarrel over their respective rights and roles. Patient advocates seek to impact politicians and policymakers, who may have a different plan altogether, namely, seeking public praise and fame through their votes or decisions (Laurenza et al., 2018).

Funding

Innovation in healthcare faces two types of financial challenges: funding the innovations' progress and determining who will pay how much for the services or products it yields. One issue is the long investment required for new therapies or drugs that need FDA approval. Whereas venture capitalists backing an IT startup may be able to get their money out in three or four years, investors in a biotech organization have to wait ten years even to explore whether a product will be permitted for usage. Another issue is that many conventional sources of capital are not familiar with the healthcare industry, so it is difficult to find investors, let alone investors, who can offer helpful

guidance to the innovator. A regular source of investor confusion is the healthcare sector's complicated system of compensation or payments, typically from the end consumer but a third party—the private or government insurer. The setting raises a set of problems. Most clearly, insurers must approve a new service or product and its pricing before paying. In addition, their viewpoint about a product's value, which determines the reimbursement level, may differ from patients'. Moreover, insurers may be distressed. Medicare, whose associations with its enrollees sometimes last ten years, may see far more value in innovation with a long-term cost impact, such as obesity reduction treatment or a costly diagnostic test, than a commercial insurer, which experiences a twenty per cent turnover (Eesley & Miller, 2017).

An Additional Obstacle Innovations require an appeal to doctors, endorse new products to patients, and vary doctors' opinions. From a financial viewpoint, a physician whom a health maintenance firm pays a fair salary may be less interested in doing a procedure to implant a monitoring device than a doctor who is salaried for such services (Hill et al., 2017).

Policy

Government rules of healthcare can sometimes support innovation and sometimes delay it. Therefore, it is vital for innovators to recognize the general network of regulations that may impact a specific invention and how and by whom those regulations are applied, enacted, and modified. For example, officials know they will face punishment by the politicians and public more for underregulating-approving a dangerous drug, say-than for shrinking the approval procedure, even if doing so delays a beneficial innovation. A firm with a new healthcare concept should also be conscious that regulators may occasionally wrinkle their muscles by firmly interpreting vague rules or punishing an unfortunate innovator for demonstrating their value to the public (Labrique et al., 2018).

Technology

As medical technology advances, recognizing when and how to invest or adopt it is crucially vital. Shift too early, and the infrastructure required to assist the innovation may not yet be in place; wait too long, and the time to get competitive benefit may have passed. Viewing that competition persists in each technology and various technologies among drugs objectified at a disease category. The polio vaccination ultimately eradicated the requirement for drugs, services, and devices to treat the disease, just as kidney transplants have eliminated the need for dialysis. In contrast, detecting an efficient molecular diagnostic method for a condition such as Alzheimer's would significantly enhance the demand for therapeutic devices and drugs (Tuan et al., 2019).

Customers

The engaged and authorized healthcare customers—the passive patients—progressively seem outdated—are a force to be calculated within all three types of healthcare innovation. Customers spend a significant amount of their own pockets on healthcare services, for example, a projected $40 billion on complementary medicine, such as medication and acupuncture, which many traditional medical providers believe to be of uncertain value. Armed with information collected from the Internet, such consumers neglect medical advice they disagree with, opting to avoid certain drugs doctors have prescribed. A firm that leverages and recognizes customers' growing sense of empowerment and actual authority can significantly enhance the adoption of the invention (Gopal et al., 2019).

Accountability

Progressively, authorized customers and cost-pressured payers are asking for accountability from healthcare innovators. For example, they need technology innovators to show cost-effectiveness and long-term security and fulfil regulatory agencies' short-term efficiency and safety needs. Whether the accountability agents are efficient or not, healthcare innovators must do every possible thing to address their often dense demands. Then, innovating firms face the outlook of a fierce backlash from industry critics or the public (Bhavnani et al., 2017).

5 Obstacles to Innovation

The six forces that impact business model innovation can also become barriers to innovation if not pragmatically intelligently managed by policymakers and managers. Particularly, any of the six forces can create barriers to innovation in three domains (Sharon, 2018). First, the presence of intimidating industry players or the absence of helpful players can delay customer-focused innovation. Status quo firms tend to look at such inventions as a direct threat to their power. For instance, many doctors resent direct-to-consumer pharmaceutical marketing or for-profit attempts to offer healthcare in convenient locations, for example, shopping malls, and use their power to fight such moves. In contrast, firms' attempts to reach the customer with new products or services are dissatisfied mainly by a lack of developed consumer distribution and marketing platforms, which would make the mediums work. Rivals of customer-focused innovation may attempt to affect public policy, primarily by playing on a regular basis against for-profit ventures in healthcare or by debating that a novel kind of service, for example, a facility specializing in one disease, will select the most profitable consumers and leave the rest to nonprofit hospitals. Therefore, innovators should be prepared to respond to those looking for accountability for a novel product or service's safety, cost-effectiveness, or efficiency. It can also be challenging for

innovators to gain funds for customer-focused ventures, as less traditional healthcare investors have considerable skills in services and products advertised to and bought by the customer. This hints at another financial difficulty. Customers are not used to paying for traditional healthcare. These obstacles hindered and eventually assisted drive or kill into the arms of competitor-two firms that provided innovative healthcare services directly to customers. Another barrier was the healthcare industry's absence of distribution and marketing mediums for individual customers. Potential mediators were not adequately involved. For many employers, adding this service to their previously offered sponsored insurance would have meant new administrative disturbances with less advantage. The barriers to technological inventions are innumerable. On the accountability front, an innovator encounters the complicated task of conforming with a confusion of often rigid governmental rules, which gradually need firms to show that new products do what they claim securely and are cost-efficient compared to competing products. If funding is considered, the innovator must function with insurers in advance of a launch to show that the product will be suitable for reimbursement. Innovators must consider the economics of insurers and healthcare providers and the associations among them. For example, insurers do not characteristically pay separately for capital equipment; procedure payments that utilize new equipment must cover the capital costs and other hospitals' expenses. Therefore, a novel anaesthesia technology vendor must be ready to assist its hospital consumers in obtaining additional compensation from insurers for the increased costs of the new devices. Even technologies that decidedly decrease costs by substituting labour capital, say, or lessening the hospital stay length, face difficulties. As insurers tend to analyse their prices, they often do not observe the connection between a reduction in hospital labour expenses and the novel technology responsible for it, and they follow the novel costs linked with the technology. For instance, insurers may avoid approving an expensive new heart drug even if it will lessen their payments for cardiac-related hospital admissions over an extended-term (Rivas & Wac, 2018). For apparent reasons, the single-player system delays customer-focused innovation. However, it also highly compels technology-based innovation. The governments' requirement to strictly control expenses translates into less money to spend on the services of severe patients, who are the target of the most technology-based invention. With their buying blow, Unified healthcare systems also keep medical devices and drug prices low, delighting customers but squeezing margins for innovators. The unified nature of the plans would appear to offer the potential for innovation in disease treatment where much integration is needed, but the record is assorted (Nambisan et al., 2019).

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Chapter 17
Alternative Medicine in Health Care: Is the Time not Now to Standardize African Phytomedicine to Indigenize Health Care and Create Entrepreneurial Opportunities?

Ahmed Adebowale Adedeji, Iretomiwa Emmanuel Talabi, and Farouk Oladoja

1 Introduction

Phytomedicine or the use of herbal medicine with therapeutic properties is incorporated into traditional medicine. Varying definitions exist for what phytomedicine is. A phytopharmaceutical preparation, sometimes referred to as herbal medicine, is considered a manufactured medicine obtained exclusively from plants, either in the crude state or as a pharmaceutical formulation (Acharya & Shrivastava, 2008; Rates, 2001). In a broader and more technical sense, phytomedicine can be considered a health practice, approach, knowledge, and belief based on the use of plants, applied singly or in combination, to treat, diagnose and prevent illnesses or maintain wellbeing. It is greatly associated with better health outcomes (Sorkin et al., 2021). Historically, the use of herbal medicine forms a conglomeration of therapeutic knowledge that is deeply rooted in a culture and formed the basis of the early version of pharmacopeias, which was based in large part on natural products originating from botanicals, animals, fungi, and minerals (Quave et al., 2012).

Medicinal plants have a pivotal role in world health care, with approximately 80% of Africans depending on phytomedicine. It has anecdotal records that showed a wide range of use in the treatment of diseases, especially priority diseases of Africa, such as HIV/AIDS, malaria, sickle-cell anemia, diabetes, and hypertension. It is believed

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that these medicinal plants have more beneficial effects than their synthetic counterparts by being safer, more acceptable, more affordable, more culturally compatible, and more suitable for chronic treatments. The international market has recognized huge contributions of some African phytomedicines, which are well known to confer economic benefits to producing countries. This has partly led to an increasing campaign to adapt phytomedicine into the healthcare agenda, as effective health care cannot be achieved in Africa by using orthodox medicine alone (Okigbo & Mmeka, 2006; Oladoja et al., 2021).

Phytomedicine obtained from herbal sources is in demand in most developed nations, as they are used to treat many infectious and debilitating diseases offering therapeutic value for age-related disorders such as memory loss, osteoporosis, and immune disorders. These plant-based therapeutic agents provide outstanding contributions to modern therapeutics from both practical and scientific viewpoints, but the mechanism of action of these medicines and related products is not completely understood. The new-found popularity is due to their excellent successes with treating cases that were given up as hopeless by the allopathic doctors; given their side effect-free treatment. (Mukeshwar et al., 2011).

People on all continents have used hundreds to thousands of indigenous plants for the treatment of ailments since prehistoric times (Levetin & McMahon, 2002). Indigenous healers often claim to have learned by observing that sick animals change their food preferences to nibble at bitter herbs they would normally reject (Huffman, 2003). Many of the pharmaceuticals currently available to physicians have a long history of use as herbal remedies, including opium, aspirin, digitalis, and quinine.

The World Health Organization (WHO) has also reported that an estimated 80% of the world's population presently uses herbal medicine for some aspect of primary health care, making it a major component in all traditional medicine systems and common elements in Ayurvedic, homeopathic, naturopathic, traditional Chinese medicine, and native American medicine (Pandey et al., 2011). In addition to their traditional values, phytomedicine also holds great public and medical interest across the globe as a source of nutraceuticals or novel lead compounds for drug development.

Despite the industrial revolution and advances in organic and computational chemistry and preference for synthetic products, between 70 and 95% of citizens in a majority of developing countries, especially in Africa, still rely on traditional medicine as their primary source of medication (Robinson & Zhang, 2011). There was a decline in the role of herbal medicine approximately 100 years ago following the growth of research-based pharmaceutical industries. This development contributed to the promotion of synthetic medication. Its safety, and functional activity were well elucidated, supporting mass production to reach the target population. Advances in the human genome and increased knowledge of the structure and function of proteins have also contributed immensely.

Plants remain a large reservoir of medicines and have become a part of pharmaceutical prescriptions as plant-derived ingredients. The use of plant material as an indigenous cure in folklore or traditional systems of medicine has contributed to over 121 pharmaceutical product formulations in the last 100 years (Dias et al., 2012; Pan et al., 2014). Plants with medicinal uses are mentioned in ancient texts.

Chinese medicine had the earliest documentation about the use of herbal remedies as far back as 2800 BC. Other indigenous codified medical systems, such as Siddha, Ayurveda, Unani, and Allopathy, use several plant species to treat different ailments (Kumar et al., 2010; Pandey et al., 2013; Rabe & Staden, 1997). Today, over 80,000 species of plants are in use throughout the world, with approximately 80% of the world population depending on plant-derived medicine for the first line of primary health care (Chen et al., 2016; Dev, 1997, WHO 2019). This makes phytomedicine a component of health care that deserves attention to balance risks and benefits in modern medicine through phytomedicine research. The engagement of the research-based pharmaceutical industry has changed paradigm for several reasons, and phytomedicine research lags behind the development in the pharma world, despite its capacity to drive economy positively.

The total sale of phytomedicine shows its popularity and use by people all over the world (Calixto, 2000). Early twenty-first-century analysis showed that the European market alone reached $7 billion in 1997, in which the German market alone relates to approximately 50% of the European market at approximately $3.5 billion, representing approximately $42.90 per capita. The France market corresponding to approximately $1.8 billion was followed by Italy with $700 million and the UK with $400 million. It is remarkable to note that Spain and Netherlands have market sales of $300 million and $100 million, respectively (Okigbo & Mmeka, 2006). Furthermore, almost 75% of the French population had used complimentary or alternative medicine at least once (Enwonwu, 2003), and approximately 60 million Americans over 18 years old use phytomedicine in the cure of colds, burns, headaches, depression, diarrhea, and others (Calixto, 2000) at the turn of the century.

In the late twentieth century, 40% of all drugs listed in the German Physician's Desk Reference are derived from plant material. The leading plants prescribed as mono-preparations in Germany at the time were Gingko biloba, Horse chestnut, Hawthorn, and St. John's wort with very high growth rates that are stronger than most of their chemical competitors. One interesting complementary activity that supports the expansion and acceptability of the use of phytomedicine in Europe and that made the market more developed in the world was the best established criteria for licensing and quality control. It was regarded as a model for other international developments (Gruenwald, 1998).

In the United States, the market for medicinal plants soared after the passing of the 1994 Dietary Supplements and Health Education Act (DSHEA), which permitted labeling phytomedicine as "dietary supplements" and allowing their sale without the oversight authority of Food and Drug Administration (Singh et al., 2009). In India, the sale of total herbal products is estimated at $1 billion, and the export of herbal crude extract is approximately $80 million, of which 50% is contributed by Ayurvedic classical preparations. These are classical economic benefits the plant materials as medicine would readily bring to countries of origin and improve lives of many citizens, hence the need to review the entrepreneurial capability of the healthcare values of the plant medicines.

1.1 Pharmaceutical Companies and Phytomedicine

The pharmaceutical industry plays a unique role in developing new and improved medicines and vaccines to prevent and treat diseases. These efforts have translated into saving millions of lives and helping those suffering from disease to recover and lead more productive lives. These industries have been contributing to the health system in different ways but not without challenges. In 2013 alone, 1813, 599, 475, and 159 drugs were in development for cancer, cardiovascular diseases, diabetes, and HIV/AIDS, respectively, and in 2014, there were 186 ongoing R&D projects related to diseases of the developing world. Investment worth $401 million, the third largest fund in 2013 was dedicated to neglected disease research. It is clear that the contribution of the pharmaceutical industry to health care is enormous.

The new drugs from pharma companies save reasonable costs in terms of medical expenses under different conditions, and over 7,000 different drugs are presently under development globally (PhRMA, 2015). A dollar spent on new medicines for congestive heart failure, for example, in the United States, saved USD 8.39 in medical spending. In Africa, drugs and vaccines against malaria are estimated to have saved, between 2011 and 2015, 1.14 million children's lives. Between 2000 and 2013, immunization campaigns helped to reduce the number of deaths from measles in Africa by 75%. (IFPMA, 2015).

These contributions notwithstanding, it takes 10–15 years to develop a medicine or vaccine (PhRMA, 2014). The research-based pharmaceutical industry currently spends over USD 141.6 billion on R&D per year and an average of USD 1.5 billion to develop a single drug.

The report showed that there was an increase to 215 in 2010–2014 relative to 162 a decade earlier of the number of new chemical or biological entities launched on the world market.

It is obvious that the implication of the investment of the pharmaceutical industry in medicine and vaccines for the population living in developing nations where poverty and poor health systems prevail may be economically unreasonable without workable models on engagement and partnership. The bottleneck associated with taking an herbal medicine or plant through traditional drug development processes has been further complicated with advances in technology and innovative high-throughput techniques in the industry. Certainly, the basis for the bottleneck is sometimes difficult to trace. Could it genuinely be due to insufficient science behind use of the herbs from folk medicine or business diplomacy that favor the pharmaceutical industrial growth; looking into profit directed resource investment.

Thus, opening an additional role in advancing phytomedicine may lead to large cost benefits and quality processing of the current volume daily consumed by the large population.

1.2 Re Engaging Phytomedicine in Global Health

There is increasing evidence in the literature that herbal medicine is increasingly used to enhance general health and wellbeing, alone for specific health problems or with modern medicine (Ekor, 2014; Kenedy, 2005). In developing and developed countries, citizens are becoming more conscious of the value of herbal product use. In 2002, the National Health Interview Survey conducted in the United States reported an estimated 38.2 million adults using herbs and supplements (Kennedy, 2005). The US/Canada Consortium of Academic Health Centers for Integrative Medicine has developed Complementary and Alternative Medicine (CAM) curricular standards for research in integrative medicine and strategies for integrating alternative treatment into clinical care.

It is noteworthy that as the interest of the public in phytomedicine grows for therapeutic application, the reality is that few of the available products have been subjected to randomized clinical trials (RCTs) under the International Conference on Harmonization (ICH) Good Clinical Practice Guidelines to determine the efficacy and/or safety of single-plant herbal, phytomedicine or multicomponent herbal medicines.

The traditional therapeutic claims for use of these phytomedicine have been commonly supported from many *in vitro* and *in vivo* preclinical studies, but standardization of the analytical and study protocols or the data interpretation and validation are lacking. In addition, the translation to human therapeutic use of an *in vitro* and/or *in vivo* biological/pharmacological effect of an herbal medicine may not be successful due to several intrinsic and extrinsic factors: species differences, organ specificity, environmental and climatic factors, cultivation and field collection practices, postharvest handling, storage, manufacturing, inadvertent contamination, substitution, and intentional adulteration. These factors may affect the qualitative and quantitative accumulation of the biologically or pharmacologically active chemical constituents produced and/or accumulated in the herb (Chadwick & Fong, 2006; Li et al., 2008; Mahady et al., 2001; Nchube et al., 2012; Slifman et al., 1998)

With these challenges confronting phytomedicine, it will be an uphill task to attract interest and participation of the research-based pharmaceutical industries to engage in deploying phytomedicine in a similar manner it engages the production of synthetic drug from computational chemistry and bioprospecting. Even entrepreneurs are not attracted to the business lines and opportunities that phytomedicine presents. Therefore, a new framework is required to make phytomedicine research address the gap. One major constraint is putting funds in the uncertain field of exploration, while it is cheaper to use advanced technology to promote new molecule searches and trials. Whatever the case, there is a need for proof of efficacy or safety for the vast majority of herbal medicine through an evidence-based approach and convincing the pharmaceutical industries and entrepreneurs that there is a win–win play out in their participation.

Regardless of how helpful computational chemistry could be, natural chemistry in plants appears more sophisticated and sometimes difficult to manipulate in the lab, an advantage of plants over robotic machines.

2 Why Are Pharma Industries and Entrepreneurs Important?

The pharmaceutical industries pride themselves immensely contributing to the health of people in Africa, despite poor health systems, poverty, and challenging business and regulatory conditions that ordinarily make it unwise to invest in the region. Drugs and vaccines against malaria, for a case consideration, have reduced the burden and saved many lives, especially in childhood. These pharmaceutical industries are notably private companies with well-defined objectives. The engagement of the international agencies, government of nations, and other stakeholders in health and governance from the private and public sectors has had a huge impact through partnership.

The production and business lines, including raw material sourcing, transportation and logistics, human capital, plant growing and plantation, fabrication, authorized community care giver services, drug vendor participation and others, are open to create opportunities in entrepreneurship for a large number of the populace in these communities. This reduces the huge burden of unemployment and the socioeconomic challenges of the populace.

The combined opportunities emanating from taking phytomedicine and phytomedicine research importance will engage not only the few industrial workers in these developing areas but also youths, and able-bodied men and women of the community. These people will be engaged in the chain of research activities, quality assurance, planting or sourcing, trials, production, and marketing of approved phytomedications.

In recent years, the industry, which has incurred huge costs, as shown in Table 1 below, has committed a high share of funds to preclinical and clinical trials of drugs. The outcome may sometimes not justify the huge expense, as the compound may not eventually succeed in quality assessment after several years of waiting. It may be easier to consider herbal concoction for which anecdotal records exist. The trial phases will be shortened, and costs may be reduced.

It is not contestable that medical discoveries from these industries have increased life expectancy and resulted in a better quality of life for many people in the world. Pharmaceutical R&D products, such as vaccines, have proven to be one of the most effective preventative technologies in the fight against infectious diseases, with a vast impact on public health. One goal to rid the world of smallpox, polio, measles, diphtheria, and rubella in many parts of the world is delivering appreciable outcomes in healthcare services. Since 1928, scientists have discovered and developed 19 classes of antibiotics (Resources for the future, 2008), and more arsenals have been found;

Table 1 R&D Costs, 2013 (PhRMA, 2015)

FUNCTION	USD MILLION	SHARE (%)
Prehuman/Preclinical	10,717.8	20.8
Phase I	3,666.9	7.1
Phase II	5,351.3	10.4
Phase III	15,239.2	29.5
Approval	5,395.4	10.5
Phase IV	7,574.2	14.7
Uncategorized	3,668.7	7.1
TOTAL R&D	51,613.5	100

34 new antibacterial compounds are in development, 15 of which are vaccines, and 19 small and large molecules (IFPMA, 2015b).

However, despite these developments, the challenges are clear for developing nations as their economies soar, with outbreaks of diseases, re-emergence of diseases, unrest in different parts, and humanitarian crises. The health systems continue to lose effective service, fake drugs, failure of drug treatment, and unethical practices with synthetic drugs created more challenges of inaccessibility, non-affordability, and unavailability of drugs. The populace began to lose confidence in the healthcare system and would rather combine the traditional and orthodox practice.

In the 1980s, more interest in herbal medicine as a path to drug development increased greatly (Mendonca-Filho, 2006). The inefficiency of conventional medicine, in part due to cytotoxicity or unbearable side effects and ineffectiveness, the abusive and incorrect use of synthetic drugs and, most importantly, the high cost involved in conventional medicine and lack of access to conventional pharmacological treatment, has promoted interest. Additionally, there are limitations of synthetic chemistry, and there also arises the need to find new medicines to combat the emergence of multiresistant pathogens and chronic and difficult-to-treat diseases such as cancer, diabetes, and AIDS.

Although little success is still recorded over the decades of the agitation to incorporate herbal medicine into the healthcare system, phytomedicine remains a choice that offers unmatched structural variety, and its usefulness can be extended by probing biological pathways (Patwardhan et al., 2004).

The development of drugs from herbal medicine was considered to be swifter and more economical as an approach to drug discovery (Pan et al., 2012; Robinson & Zhang, 2011), but in reality, it is an arduous task and involves a high cost between USD 100–360 million and a minimum of 10 years of work, with only 1 in 10,000 tested compounds being considered promising (Rates, 2001). With this challenge notwithstanding, the cost of the development of new synthetic drugs is approximately USD 800 million (Cordell & Colvard, 2005). Thus, the cost effectiveness of modern drug development originating from phytomedicine may attract large pharmaceutical companies to invest greatly.

To achieve this, stakeholders, such as those in academia, agriculturists, farmers, and agribusiness chain builders, within developing countries would be required to participate with the industries to further minimize the cost of investment. This will serve as an incentive and improve the uptake of new discoveries with better profiles that could be obtained from combinatorial chemistry approaches. Reformulating strategies for phytomedicine research may unearth the hidden potential of phytomedicine and attune the processes to meet the standards required of a drug in development.

3 Bridging the Gap to Increase the Engagement of Industries and Entrepreneurs

Reprospecting phytomedicine and phytomedicine research and redefining stakeholder participation and approaches to give the desired standard for phytomedicine should be considered to allow the herbal product to penetrate once again the interest scope of pharmaceutical industries and the business world. In this respect, the following proposals are presented here for consideration and adoption.

a. Establish an institution to systematize the phytomedicine and conduct phytomedicine research and serve as a reference center where proper documentation is done and collections are well kept as herbal chemo repository banks. It will be a hub for designing programmatic approaches and frameworks for conducting phytomedicine research and phytomedicine production and logistic chains for health and economic growth. Our higher institutions, center for entrepreneurship development, and centers of excellence for phytomedicine research and development are well poised for this effort. The health system in each country in Africa and other developing regions would pay special attention to systematizing and scientifically repositioning traditional herbal medicine practices and subject them to rigorous scrutiny for validation of claims and mass production of raw materials. The latter would boost entrepreneurial chains in support of more stakeholder engagement and economic development of the community while still achieving tremendous success in healthy living for their people. Higher institutions of learning and researchers in such communities will play a crucial role in the coordination of phytomedicine research and capacity building in Africa toward engaging pharmaceutical industries and other stakeholders in the healthcare chain.
b. The institution for promotion of phytomedicine would be required to garner government support and policy framework to promote herbal medicine as a part of health system in developing African countries and encourage engagement of academia in research in the phytomedicine in an integrated manner.
c. The regulatory arm of government on herbal medicine should have to work with reference academic or research institution to raise the quality of research on the preclinical and clinical efficacy of herbal products with standard protocols and

rigor to establish that appropriate scientific queries are raised, data and validation of data processes are systematic as obtained in synthetic pharmaceuticals.

d. Since phytomedications come from plants and mostly domesticize to the culture and practice of communities, a compendium of practices across communities and the identification of essential plants would boost documentation. With proper integration of sectors, these health needs could lead the loop into the agriculture and agribusiness production cycle, where farmers and other entrepreneurs become natural raw material production sources for industries. An important outcome of such linkage is increased employability driven through job creation.
e. Strategies or protocol modification should be embarked upon to support the production of quality herbal medicine by Good Manufacturing Practice from source materials. These source materials should be acquired through good agriculture and collection practices (GACP), be botanically validated, and be chemically and/or biologically standardized, with their stability established. The quality assurance process integration will support the engagement of qualified control officers trained under the International Standard Organization (ISO) curricular for productive career life. It will be for others who are graduates of institutions with requisite qualifications in the process and product development chain.
f. The WHO published guidelines for methodologies on the research and evaluation of traditional medicine, and other guidelines should be promoted as standards and integrated into phytomedicine research as a matter of compliance for dissemination of information, publication of findings, and use of the products.
g. The shoddy works on phytomedicine in the public domain by some researchers should be regulated. The universities and editors of journals should raise the bar to recognize a phytomedicine research fit for support, recognition, and publication. Setting standards for systematic investigation that build on good scientific rational beyond descriptive studies are required to measure the contribution of an undertaking in phytomedicine research. Phytomedicine research and publication of findings should henceforth go beyond standalone phytochemical analysis, toxicity studies and ordinary activity assessment. A complete battery of experiments covering all indicators of preclinical assays should be promoted. The availability of several model organisms, for example in *Drosophila melanogaster*, has paved the way for convenient running of such experiments with minimal funding, as low as $500 in an averagely equipped laboratory.

3.1 Quality and Standardization

The quality and standardization procedure demands that a quality assurance framework be provided for herbal medicine research. This will be a "ground-to-table" process spanning from the acquisition of the source material to the production of the clinical formulation for phytomedicine to earn the respect for clinical use.

Standardization should consider starting from the source of herbs acquired by cultivation or field collection through Good Agricultural Practice Guidelines, botanical quality through identification by their scientific names (Latin binomial), and authenticated botanically according to pharmacopeia standards employing macroscopic/organoleptic and microscopic methods. Each herb should be subjected to purity as well as contaminant tests for the presence of foreign matter, toxic metals, pesticide residues, mycotoxins, and microorganisms. Qualitative HPLC–UV or LC–MS analysis leading to the generation of a characteristic profile (fingerprint) and the quantitation of reference marker compound concentrations, including relevant biologically active molecules of an herb extract, should be conducted as part of a product standardization study (Maimaiti et al., 2020; Parveen et al., 2019). Chemical standardization studies of the formulation or product should be performed by quantitative analysis (HPLC–UV or LC–MS). The stability studies of the herbal preparation can be monitored from the day of production by accelerated and/or real-time analysis. A wide range of pharmacological activities and assessment of safety and efficacy are recommended, probably in a whole organism for primary screening, and are prerequisites for further laboratory and clinical investigations.

In addition, where feasible, the mechanisms of action or bioavailability of herbal medicines should be determined. The primary screening for herbal medicine products and increasing clinical evidence on their efficacy would be explainable with extensive investigations of the chemical composition of constituent herbs and of the biological activity of the identified compounds.

A hope for a high prospect is further radiated when more recent advances in natural product chemistry and phytomedicine research were reported on novel methods of drug delivery and nanotechnology to enhance the bioavailability and bioactivity of the phytomedicine. Herbosome technology is one such system. It incorporates phospholipids into standardized active ingredients of herbal extracts, with which it effectively improves the bioavailability of water-soluble bioactive constituents of phytomedicine, such as flavonoids, phenolics, and hydrophilic compounds (Ubong-Isaac et al., 2015; Gunasekaran et al., 2014). The phytomedicine with excellent *in vitro* bioactivity but poor aqueous solubility, larger molecular size, degradation during gastric emptying, and extensive metabolism can now be delivered better to overcome the obstructions. The application of nanotechnology will increase the bioavailability and bioactivity of phytomedicine by reducing the size of the particles, surface modification, aiding targeted delivery, and pharmacokinetics profiling.

4 Responsible Innovation in Health, Phytomedicine, and Sustainable Development Goals (SDGs)

Phytomedicine will require more than just the healthcare infrastructures to weave into the development needs of Africans and the global community that will benefit from the adoption of the medicine.

The concept of responsible innovation in health (RIH) is a novel science, technology, and innovation (STI) approach advanced to protect health systems by "healthy" public policies in the domains that are not directly related to health services but affect the variation in health outcomes such as the environment, housing, transportation, and education.

This STI concept has the potential to support good health and wellbeing (SDG3) and other SDGs related to economic development and environmental sustainability. RIH is described as a collaborative endeavor wherein stakeholders are committed to clarify and meet a set of ethical, economic, social, and environmental principles, values, and requirements when they design, finance, produce, distribute, use, and discard sociotechnical solutions to address the needs and challenges of the health system in a sustainable way (Silva et al., 2018).

Certain SDGs, for example, SDG9 (Industry and Innovation), SDG4 (Quality Education), SDG6 (Clean water and sanitation), SDG7 (Affordable and clean energy), and SDG13 (Climate action), are SDGs that encompass determinants of health. They are of important consideration for the indigenization of health care and the search for alternative medicine for the African population. A preliminary framework that helps identify key knowledge gaps and areas of STI policy within the concept of responsible innovation in health becomes essential to support the development of new solutions for phytomedicine research and practice.

The inextricable connection of science (systematic study of the physical and natural world), technology (the application of scientific knowledge to develop goods and produce goods or services for practical purposes), and innovation (novelty or significant improvement of a product, service, process, and organization or commercial methods) are crucial in deploying phytomedicine as an alternative, affordable, and accessible healthcare alternative for the poverty-ridden African community. The application of STI will open interest within RIH to integrate the social, environmental, and economic dimensions of sustainable development (Lehoux et al., 2018).

With phytomedicine, the primary goal is sustainable health care. However, the industry and entrepreneurs in a balanced manner must operate in the realm of health care for all, balanced with commercial process innovation engagement. Priority is given to ethics, social and environmental principles, value, and requirements.

The design of engagement and process in developing phytomedicine should mark up with lifesaving and healthy living as canvassed in SDG3. The financing, production, and market activities of stakeholders must be ethical and convincingly worthy to address the needs and challenges of the health system in a sustainable manner.

The STI approach that has been in existence since the 1980s to finance, design, and bring new drugs and medical devices to market has in some ways promoted the relegation of phytomedicine off the list of conventional medical practices. It is the undeterring insistence of the populace in this face of failing drug treatment to deploy its use of phytomedicine that reawaken attention given to it. This STI approach will therefore require urgent review for this African Medicine model to find a place (Hopkins & Lazonik, 2014; Lehouk et al., 2014). A sustainable health system should possess certain characteristics for development. It must be affordable to patients and families, employers, and third parties. Can this be said about

the current situation of the orthodox medicine in the midst of economic hardship many nations are going through? An additional characteristic is that it should be acceptable to patients and health professionals, and it should be adaptable to new diseases, changing demographics, scientific discovery, and technological innovation (Fineberg, 2012). Phytomedicine, when properly organized to integrate into health systems, has the capacity to deliver on sustainable engagement of healthcare service delivery to poor Africans.

5 Conclusion

The paradigm shift in the interest of health professionals and stakeholders, scientists and researchers, and pharmaceutical giants toward standardizing herbal products that have abundant raw material that can be readily sourced in Africa and health marketing of phytomedicines will create a huge boost to Africanize medicine and healthcare delivery services. It will boost other sectors relevant to planting and raw material production, especially agriculture, farming, and agribusinesses, and promote trade in herbal products across the globe. Efficacy and safety, the two most trusted attributes that influence consumers' intention to adopt herbal treatment over allopathic or conventional treatment, must be certified with respect to this new medicine route. Advantages should be taken of the growing confidence of people, through their generic attitude and belief that phytomedicines are safer than allopathic medicines and do not exhibit any side effects (Islam et al., 2021).

Modernizing the healthcare system in developing nations should involve the utilization of drugs from natural sources that pass standard protocols for any synthetic substances currently available. All new and old phytomedicine should pass procedures such as identification of active constituents, characterization, pharmacological activity, toxicity/adverse effects, drug interactions, and, most importantly, regulatory requirements. (Barkat et al., 2021). In this way, several other sectors will be stimulated to create more jobs and entrepreneurial ventures. This will include the agriculture sector as related to raw material production and business lines, and trades and commerce for ventures and business start-ups in sales and exportation.

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Chapter 18
Medical Entrepreneurship and Triple Helix Model in the Nigeria Health Sector

Jubril Olukayode Lasisi

1 Introduction

Innovation is one of the most valuable elements for economic growth and the welfare of the nation (Atkinson, 2012). Entrepreneurship is currently the main driving force behind innovations. Due to this importance, scholars of entrepreneurship are paying more attention to academic spin-offs as one of the key elements of innovation at the national level (Feola et al., 2017). For many years, the contribution of academic spinoff companies to economic development has been clearly stated, and a related intriguing discussion of how the entrepreneurial potential of the academic community can be stimulated has developed (Obschonka et al., 2012).

Our society is experiencing different challenges; knowledge becomes the most challenging imperative for solving any challenge. Correspondingly, there is an emerging body of literature that addresses the interaction between universities, industries, and governments. Therefore, the concept of networking is not new in practice. In a modern academic language, this concept is acknowledged as the triple helix model (THM). In the innovation process, the THM emphasized the importance of academia and government. In addition, these actors play a crucial role in the creation of an entrepreneurial society (Samo & Huda, 2019; Yurtkoru et al., 2014).

Over the past two decades, interest in entrepreneurship, particularly in the emergence of new entrepreneurs and enterprises, has grown among health care, governments, individuals, and academics. This interest is based on evidence demonstrating the contribution of entrepreneurship to economic growth, increased productivity, and rejuvenated social and productive networks. Entrepreneurship has been shown to help revitalize regional identity, make the innovation process more dynamic, and create new job opportunities (Irem et al., 2015).

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Medical entrepreneurship is not a new phenomenon. Before World War II, many nurses worked as entrepreneurs. After the war, nurses began to work in public services in many countries due to social and economic changes. Approximately 1% of all nurses work as entrepreneurs (Salminen, 2014). For the implementation of medical entrepreneurship, it is necessary for the individual who constructs the business plan to possess not only an innovative idea but also adequate entrepreneurship abilities. Entrepreneurship in general, to be applied in medicine, needs to be adjusted and customized. The domain of action focuses on the health of the human being—both individual health and public health.

Medical entrepreneurship implies a manager who wishes to take the risk of starting a business in health care, using personal funds or a loan (from banking or nonbanking financial institutions). Medical entrepreneurship may be encouraged by corrective subsidies—the business is funded by the local or central public authority to enhance the benefits provided by the implemented business plan. It is necessary for the initiative to be beneficial for society or at least for a large number of peoples, generating positive externalities—short-, medium-, or long-term marginal external benefits (healthcare services provided are free of charge) (Irina, 2021).

Cai and Cui (2015) maintain that the triple helix model (THM) has not been free of problems. It is criticized for remaining at an abstract level, lacking a solid theoretical basis at a micro level, not adequately addressing the issues emerging when actors adopt each other's roles and lacking contextual sensitivity across countries and social settings. Additionally, although the concept of competence is, at least implicitly, strongly linked to the triple helix literature, it has only recently gained more attention (Ranga & Etzkowitz, 2013).

An entrepreneur in the largest economic and social field is a self-employed to autonomy, control its affairs, and is willing to take risks. On this basis, sociologists such as Wright Mills argued that medicine is the apotheosis of an entrepreneurial profession and ideological and economic self-sufficiency. Self-sufficiency remains a feature of the medical profession, despite ever greater reliance on technology and the influence of ever-increasing regulation of medical practice (Sakhri, 2018).

The unique contribution of the triple helix model (Etzkowitz & Leydesdorff, 1995) to innovation studies is its attention to the heightened role of the university in the transition to a knowledge-based society. This focus contrasts with previous innovation approaches that focus on firm or government firm interactions. The university's enhanced relevance to technology transfer, firm formation, and regional renewal places it in a primary position in a knowledge-based society, in contrast to its secondary role in industrial society (Cai & Etzkowitz, 2020).

Although most innovation approaches consider firms or the industry sector as a key element in innovation analysis (Foray, 2015), all acknowledge the importance of university, industry, and government and their interactions in fostering innovation and entrepreneurship. All approaches share common key principles, such as boundary spanning, interactive learning, and innovation's evolutionary nature, in one way or another, reflecting the basic rationale of the triple helix.

The triple helix is sometimes used as a flag, a guiding heuristic, in a variety of innovation projects and proposals. Even without necessarily being aware of the model,

some projects attempt to achieve a triple helix dynamic, typically by incentivizing universities to play a more active role in industrial and social innovation. Many of its proponents operate in a penumbra well beyond the core triple helix academic and policy community to which they have only an implicit and invisible link. The estrangement between the "inner" and "outer" triple helix communities, whichever they may be, represents both a problem and an opportunity (Cai & Etzkowitz, 2020).

2 Literature Review

2.1 Who is an Entrepreneur? Who is a Medical Entrepreneur?

After several decades of theorizing and some empirical studies, predominantly looking at the impact of entrepreneurs on economic growth, in the early 1960s, the idea of entrepreneurs as individuals with particular psychological characteristics began to be investigated by researchers. As described by Gartner (1989), the main research question is why do certain individuals start new firms when others, under similar conditions, do not? It was suggested that this question had no answer other than "because they have some inner qualities that differentiate them from others." Studies were classified into two schools of thought assessing the personal qualities of entrepreneurs: the "great person" approach and the psychological characteristics approach (Cunningham & Lischeron, 1991). While the former assumes entrepreneurs are born with intuitive abilities that represent a sort of sixth sense, the latter underlines the uniqueness of the values and attitudes that drive entrepreneurial behavior.

Gartner (1989) asserted that the only difference between entrepreneurs and nonentrepreneurs is that entrepreneurs create organizations and nonentrepreneurs do not. For him, a focus on the traits and personality characteristics of entrepreneurs will never lead us to a definition of the entrepreneur or help us to understand the phenomenon of entrepreneurship". He suggests that "look at the dance, not at the dancer. A number of scholars criticize this approach by arguing that an entrepreneur's behavior changes and varies so much that it cannot relate them to a limited set of psychological traits (Aldrich & Widenmayer, 1993; Low & McMillan, 1988; Shaver & Scot, 1991). Drucker (1985) recommends shifting our attention from behavior to the actions of entrepreneurs. Following these academic debates, the emergence of entrepreneurship as a process appeared in the literature.

In contrast, a medical entrepreneur is simply an experienced physician or medical doctor who discovered and seized opportunities for autonomy and profit within a medicare and healthcare system. Many doctors perceive economic opportunities and medical practice as irreconcilable anathema. Moreover, a medical entrepreneur describes clinician, or inventor and innovation director who searches, defines the clinical need, and designs inputs and outputs in terms of medical products and services

that meet the needs of the clinical market, including raising funds for the actualization of medical discoveries (Gruionu & Velmahos, 2015).

From the foregoing, commercial entrepreneurs and medical entrepreneurs share similar attributes, except that the latter is a clinician/medical doctor. Some of the reasons given for becoming an entrepreneur, according to Akpojevwe (2002), include the following:

i. Entrepreneurs are their own bosses; they make their business decisions, and they choose whom to do business with and what work they will do. They decide what hours to work, what to pay, and whether to take vacations.
ii. The entrepreneur offers a greater possibility of achieving significant financial rewards than working for someone else.
iii. It provides the ability to be involved in the total operation of the business, from concept to design and creation, from sales to business operations and customer response.
iv. It offers the prestige of being the person in charge.
v. It gives an individual the opportunity to build equity, which can be kept, sold, or passed on to the next generation.
vi. Entrepreneurship creates an opportunity for a person to make a contribution. Most new entrepreneurs help the local economy. A few through their innovations contribute to society as a whole.

2.2 Concept of Entrepreneurship

The word entrepreneurship comes from a French verb: entreprendre. In the Collins (2003) French–English dictionary, the word entrepreneur is translated as "to undertake," "to launch" and "to begin." In fact, the term dates back to the seventeenth and eighteenth centuries, the eve of the emergence of capitalism and the development of science and technology, when French economists Cantillon (1756) and Say (1827) used it to describe those who undertook new activities (Landström, 2007). At that time, in addition to owners and farmers, they noted a third category of economic actors, those who were ready to take on risk and organize production without knowing the outcome (Landström & Benner, 2010).

Asogwa and Dim (2016) defined entrepreneurship as an art that involves recognizing a business opportunity, mobilizing resources, and persisting to exploit that opportunity. Minniti and Moren (2010)*, in their own view, define* an entrepreneur as "a person who organizes and manages any enterprise, especially a business, usually with considerable initiative and risk."Entrepreneurs tend to be good at perceiving new business opportunities, and they often exhibit positive biases in their perception (i.e., a bias toward finding new possibilities and seeing unmet market needs) and a pro-risk-taking attitude that makes them more likely to exploit the opportunity.

Roth (2014) described entrepreneurship "as the capacity and willingness to develop, organize, and manage a business venture along with any of its risks in order to make a profit." According to Idam (2014), entrepreneurship involves activities that

are necessary to create or carry on an enterprise, while he also defined entrepreneurship as the creation of new organizations. Entrepreneurship is a key factor in any economic activity. For a sector to be competitive and contribute effectively to sustain growth, it requires increased private investment. This development must result in enhanced productivity to stimulate and be proper; it must also generate employment opportunities (Diyoke, 2014).

2.3 Definition of Medical Entrepreneurship

Medical entrepreneurship (ME) is better explained than defined. It is the ability of health professionals to create new business opportunities in the medical profession in response to the needs, tastes, demands, and changes in the fields of medicine, biotechnology, healthcare services, ICT, medical innovations, and social entrepreneurship across the globe. Medical entrepreneurship helps to sustain and develop the functionality, quality, and performance of the healthcare system of a country while making a double bottom line (wellness for the patient and profit for the investors). Medical entrepreneurship accommodates nuances such as healthcare entrepreneurship, public health entrepreneurship, and digital health entrepreneurship. New technologies and disruptive innovations in ICT enable fast and effective delivery of medical services to patients.

Medical entrepreneurship (ME) is the process of engaging in innovation and ventures in the field of health care and the application of entrepreneurship principles to the field of healthcare services, provision and delivery. Evidence has shown that healthcare professionals lack significant training in the business field of health care. The gap between medical training and business training has impaired doctors from becoming an integral part of the entrepreneurial and management world (Talya et al., 2014).

Over the past 20 years, entrepreneurship has grown from a defining characteristic of the individual doctor to a precept influential academic medical center contemporary. The opening of academy entrepreneurship always offered great opportunities to business enterprises that have realized significant benefits to pharmaceutical industries. Only in the last 20 years has academy realized that the source of a business idea (the inventor of the faculty and the institution of sponsorship) should share with the developer of this idea (industry) its human application: it is beneficial to the inventor, the institution, and the entire academic enterprise (Loscalzo, 2007).

At first glance, the entrepreneurial link between academic medical centers and industry seems quite reasonable. Academic physicians and the pharmaceutical and biotechnology industries have a common interest in the advancement of medical knowledge to overcome the disease. Gross intellectual talent academics can naturally be attached to the solid business skills of the industry to achieve successful product development (Selma, 2018).

2.4 Triple Helix Model (THM)

In entrepreneurial research, THM has been widely adopted to understand the innovation process based on entrepreneurship activities (Kim et al., 2012). THM is a basis for unfolding a representative relationship between government, industry, and university for innovation. This model has been described as a cooperative relationship among research institutions, industry and government for promoting innovation in the era of a knowledge-based economy (Shin et al., 2012). The THM pivots on all helices that are interconnected and represents a national innovation system.

According to THM, governmental support at various levels must be adopted for innovative start-ups. In particular, the government is a central body to formulate the set of rules and normative conditions for the implementation of entrepreneurship activities. Similarly, the role of government also includes the provision of financial incentives and the physical representation of incubators and science parks (Fini et al., 2011), which have been shown to be key elements in fostering entrepreneurship and the process of innovation for start-ups.

Second, helices of THM are the contribution of industry in the economy. Universities operating in a business environment have become a useful resource for the development and growth of academic spinoffs (Fini et al., 2011). Numerous studies have indicated that venture capital contributes positively to the establishment of research and development, patents (Kortum & Lerner, 2001), development of professional attitudes among start-ups (Hellmann & Puri, 2002), and resource access and competencies (Baum & Silverman, 2004). Moreover, financial support and the presence of industries in the regional context can influence the creation of start-ups within the economy (Klepper, 2007).

The presence of firms in the region working in similar industries can facilitate the exchange of experiences, knowledge, and information (Deeds et al., 1998). The third helix of THM is academia, which has to promote policies and instruments (Fini et al., 2011; Siegel et al., 2007; Smilor & Gill, 1986) focused on promoting entrepreneurial intentions to become entrepreneurs and create a platform for academic spin-offs. Many studies have highlighted the supportive role of universities, which varies with regard to beneficiaries and the mobilization of resources.

3 Methodology

The study employed a descriptive survey design. The descriptive survey design is used for the purpose of containing data to enable the researcher to test the hypothesis or answer the researcher through the various stages of the research. The population of this research work covers the entire staff in every department of the Federal Medical Centre (FMC) in Abeokuta, Ogun state. The sample size for this research work consists of seven hundred and ninety-four (794) working employees at the Federal Medical Centre (FMC) in Abeokuta, Ogun state.

The study adopted only a cross-sectional analysis through a primary source of data. The instruments used for data collection included questionnaires and interviews. The primary data collection was expected to meet the expectations of the study by measuring the medical entrepreneurship and triple helix model at the Federal Medical Centre (FMC) in Abeokuta, Ogun State, Nigeria. Copies of questionnaires were administered to elicit direct information from the respondents. The research adopts content validity. The questionnaire was originally designed by the researchers, but it was subjected to a critical review by a research expert. The review leads to the elimination of some items and restructuring of others. This is done to ensure the content validity of the instrument. The study employs the test–retest reliability method. This enables researchers to administer the instrument to the same group of audiences at different periods. The researchers then computed the coefficient of the relationship between the two responses obtained at different times.

4 Results/Findings

H_{01}: There is no significant relationship between medical entrepreneurship and the triple helix model of the Nigerian health sector in Ogun state.

To test the hypothesis, the researcher adopted simple regression analysis where the scores of the triple helix model were regressed on the values of medical entrepreneurship. The relevant regression results for hypothesis one are presented in Table 1 (a-c).

Table I outlines the regression results on the significant relationship between medical entrepreneurship and the triple helix model of the Nigeria health sector in Ogun state. From the results reported in Table I, medical entrepreneurship significantly and positively affected the triple helix model of the Nigeria Health sector in Ogun state at the 5% significance level ($\beta = 0.193$, $t = 5.235$, $p < 0.05$). The goodness of fit model presented in Table I (a) shows that there is a positive and significant relationship between medical entrepreneurship and the triple helix model ($R = 0.196$, $p < 0.05$). This is further confirmed by a coefficient of determination (R^2) of 0.038, which shows that medical entrepreneurship accounts for approximately 3.8% of the variations in the triple helix model, whereas 96.2% of the variations remain unexplained. This implies that there are other factors associated with the triple helix model that were not included in the model. Table 4.8(b) provides the results of the regression analysis of the variance (ANOVA). The results indicate that the overall model was statistically significant. This was supported by an F statistic of 27.404, and the p value was 0.000, which was less than the conventional probability of 0.05 significance level. The model regression coefficients presented in Table 4.7(c) help in summarizing the regression model as follows:

$$THM = 26.808 + .193ME \tag{1}$$

where:

THM = Triple Helix Model.

ME = Medical Entrepreneurship.

The regression model above shows that when the value of medical entrepreneurship is constant at zero, the triple helix model takes a value of 26.808, meaning that without medical entrepreneurship, the triple helix model of the Nigeria Health sector in Ogun state was 26.808. The coefficient of medical entrepreneurship was 0.193, implying that a unit increase in medical entrepreneurship leads to an increase in the triple helix model by 0.193 units. Therefore, medical entrepreneurship significantly affected the triple helix model of the Nigerian health sector in Ogun state. This effect is positive, as indicated by the regression coefficient (B = 0.193). Since the significance value (p value) of the t-statistic is less than 0.05, the null hypothesis (H_{01}), which states that there is no significant relationship between medical entrepreneurship and the triple helix model of the Nigeria Health sector in Ogun Lagos State, is rejected.

Table 1 Model summary of regression on the significant relationship between medical entrepreneurship and the triple helix model of the Nigeria health sector in the Ogun State

(a) Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.196[a]	0.038	0.037	5.488

a. Predictors: (Constant), Medical Entrepreneurship

(b) ANOVA

Model		Sum of Squares	Df	Mean Square	F	Sig
1	Regression	825.215	1	825.215	27.404	0.000[b]
	Residual	20,627.539	793	30.113		
	Total	21,452.754	794			

a. Dependent Variable: Triple Helix Model

b. Predictors: (Constant), Medical Entrepreneurship

(c) Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig
		B	Std. Error	Beta		
1	(Constant)	26.808	1.384		19.374	0.000
	Medical Entrepreneurship	0.193	0.037	0.196	5.235	0.000

a. Dependent Variable: Triple Helix Model

Source Researcher's Results (2021)

5 Conclusion

Entrepreneurship and medicine have become connected topics. However, medical entrepreneurship has specific features and is meant to improve health care. The general objective of the study is to review the medical entrepreneurship and triple helix model of the Nigerian health sector at the Federal Medical Centre (FMC) in Abeokuta, Ogun state, while the specific objectives were to determine the significant relationship between medical entrepreneurship and the triple helix model of the Nigeria health sector in Ogun state. The study concluded that medical entrepreneurship has been recognized as an important economic activity that is involved in providing unique products and services. It has been generating employment, wealth creation, and poverty alleviation, among others.

It can be concluded that today, medicine has witnessed a multitude of entrepreneurial opportunities, and new leaders are needed to step into the world of medical innovation to develop areas such as e-Health, food science, the internet of things, and nanotechnologies. Given that the public health system faces many problems and dysfunctions, the best method to solve them would be medical entrepreneurship and a good engine for achieving a developed and self-sustaining economy. Successful medical entrepreneurs are those who understand the needs of the market and can better connect with clients by filling a necessary gap in the available health services. Medicine and implicit entrepreneurship in medicine are in continuous transformation and adaptation to present time demands.

The study also concluded that universities are promoting entrepreneurship that contributes to triple helix configurations. Thus, the role of academia and government is to promote academic incubators and develop technology-transfer infrastructures that play a key role in the development of new venture creation intentions, and there is a need for closer interaction between industry and academia to obtain greater no academic spin-offs, which is key for innovation at the national level and economic development. Last, to be a successful medical entrepreneur, one needs to possess the sterling qualities of an entrepreneur and be given the reasons to become an entrepreneur, the opportunities are limitless, and sky is the beginning.

6 Implications of the Findings and Policy Prescriptions

This study proposed both the theoretical and practical implications of the findings. This study offers some theoretical contributions in the field of medical entrepreneurship and the triple helix model of the Nigeria health sector in Ogun state. From a theoretical point of view, the study instigates the relationship between medical entrepreneurship and the triple helix model. The literature on medical entrepreneurship has mainly focused on psychological and individual factors that have ignored

the triple helix model to analyze the impact of medical entrepreneurship. Moreover, this study provides some practical implications for researchers, health professionals, educationists, and policymakers who are directly and indirectly involved in enhancing the growth of entrepreneurship in the health sector. This study also focused on several implications. First, the government can promote and stimulate entrepreneurial activities among young researchers. In addition, the government can formulate financial policies that encourage new start-ups based on the results of the research. Second, universities can facilitate young researchers with patents and can also introduce promotional activities that create awareness among young researchers and local entrepreneurs. It can also provide incubators that encourage healthcare workers to start their own business. The third implication is that good rapport can be created among pharmaceutical companies that operate in the same environment and encourage young researchers to become entrepreneurs.

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Chapter 19
Diabetic Care Center and Nutrition/Dietetics in Nigeria

Olawale Paul Olatidoye

1 Introduction

Diabetes mellitus is a metabolic disorder of chronic hyperglycemia characterized by disturbances to carbohydrate, protein, and fat metabolism resulting from absolute or relative insulin deficiency with dysfunction in organ systems (IDF, 2014). Recent estimates indicate that there were 171 million people in the world with diabetes in 2000, and this number is projected to increase to 366 million by 2030 (Sarah et al., 2004). This increase in prevalence is expected to be greater in the Middle Eastern crescent, sub-Saharan Africa, and India. In Africa, the estimated prevalence of diabetes is 1% in rural areas, up to 7% in urban sub-Saharan Africa, and between 8–13% in more developed areas such as South Africa and in populations of Indian origin (Motala, 2002).

Diabetes mellitus is a chronic disorder that is not only assuming pandemic proportions worldwide but also poised to affect developing countries worldwide much more than their developed counterparts. The world prevalence is estimated to increase from 425 million people in 2017 to 629 million by 2045 (IDF, 2014), and in Africa, the number of people with diabetes will increase from 14.2 million in 2015 to 34.2 million in 2040, predominantly populated in some of the region's most populous countries: South Africa, the Democratic Republic of Congo, Nigeria, and Ethiopia (Sarah et al., 2004). In 2015, diabetes was one of the leading causes of non-communicable disease (NCD) death, contributing 1.5 million deaths globally (Wang et al., 2015; Zimmet et al., 2014) and 321,100 deaths in the African region (Zimmet et al., 2014).

Non-communicable diseases (NCDs) are chronic lifelong illnesses (IDF, 2014), and approximately 41 million people die globally as a result every year. Generally, it is believed that NCDs affect high-income populations; however, low-/middle-income

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countries are currently experiencing an epidemiological transition from communicable diseases to NCDs. There is a rising trend in NCD prevalence among low-/middle-income countries, where more than 75% (32 million) of deaths due to NCDs globally occur. Each year, 85% of deaths due to NCDs among 30–69-year-olds globally are from low-/middle-income countries (IDF, 2014). Hypertension and diabetes are among the most common types of NCDs that affect people across the globe. It is estimated that 1.13 billion people worldwide had hypertension, while 422 million persons were living with diabetes at the end of 2016 (UNGA, 2011; Zimmet et al., 2014). These two conditions directly resulted in almost 20 million deaths in 2016 alone (UNGA, 2011; Zimmet et al., 2014).

Dietary management is a key cornerstone modality in the attainment of good glycemic control in diabetes mellitus. Dietary management of diabetes mellitus is targeted at improving overall health by achieving and maintaining optimal nutritional status, attaining good glycemic control, and preventing acute and long-term complications of diabetes mellitus. The general recommendation is that carbohydrates should provide between 45% and 65% of the daily caloric intake, fat should be 25%–35% of total daily calories, and protein should be 15%–20% of total daily calories (Naqshbandi et al., 2008; Yu & Zinman, 2007). In Nigeria, there is a delusion among diabetic patients that consumption of carbohydrate foods is associated with hyperglycemia; hence, the popular view that people with diabetes mellitus should completely avoid carbohydrates or take minimal quantities (Naqshbandi et al., 2008).

It is a well-known fact that diabetes mellitus is a metabolic, endocrine disorder directly connected to carbohydrate, lipid, and protein metabolism. Hence, nutrition therapy forms an integral part of diabetes management and diabetes self-management education (Folorunso & Oguntibeju, 2013). Medical nutrition therapy has been introduced to guide a systematic and evidence-based approach to the management of diabetes through diet, and its effectiveness has been demonstrated (Pastors et al., 2002). Additionally, most diabetes guidelines recommend starting pharmacotherapy only after first making nutritional and physical activity lifestyle changes, but this is not always followed in practice globally (Insel & Roth, 2006; Williams et al., 2012). Additionally, it is commonly believed that diabetes cannot be completely cured, but it may be more easily regulated and controlled with the right diet; with strict adherence to nutritionist's advice, diabetic patients may be able to significantly improve their quality of life (Folorunso & Oguntibeju, 2013). Hypertension is one of the risk factors for diabetes, a disease that is a major cause of blindness, kidney failure, heart attacks, stroke, and lower limb amputation (Zabetian et al., 2014). By 2030, it is estimated that there will be 39.1 million cases of hypertension among people aged 20 years and above in Nigeria, with a prevalence of 30.8%. This is a notable increase from the 20.8 million cases estimated in 2010 (Zimmet et al., 2014). Similarly, almost 1.6 million cases of diabetes are estimated to be in Nigeria, and the figures are expected to at least double by the end of 2040 (Mechanick et al., 2012). These results suggest that there is an alarming rising trend of the two conditions in the country, and thus, efforts must be geared toward decreasing this trend at all levels. Although blood pressure (BP) and glucose levels might begin to rise earlier in life, the risk of hypertension and diabetes is higher in middle age. According to a systematic review, the prevalence

of hypertension in Nigeria ranges between 2.1% and 47.2% among adults (Yu & Zinman, 2007). More recent studies in the country have reported adult hypertension prevalence between 26.8% and as high as 51.3% (Zimmet et al., 2014). The mean ages of the respondents included adults in their late thirties and early forties. Men were reported to have a higher prevalence of between 6.2% and 48.9% compared with a prevalence between 10% and 47.3% among women. The prevalence in rural areas ranged between 4.8% and 43%, while it ranged between 9.5% and 51.6% in urban areas (Yu & Zinman, 2007).

The WHO Global Report on Diabetes puts the prevalence of diabetes in Nigeria at 4.3%: 4.4% among men and 4.3% among women (Williams et al., 2012). A systematic review of studies on the prevalence of diabetes in Nigeria suggested that approximately 11.2 million Nigerians (1 out of every 17 adults) are living with the disease. Despite this high prevalence, the average awareness rate of hypertension in Nigeria is low at 17.4%. Recent cross-sectional studies conducted in Nigeria among residents of rural communities and secondary school students revealed a higher awareness rate of hypertension and diabetes. However, these studies did not adequately explore the factors that contribute to knowledge as well as routine screening for the two conditions. To address the rising incidence and prevalence of hypertension and diabetes in Nigeria, it is important to assess the current understanding and perceptions about both conditions among the public. Few studies in Nigeria have explored the level of knowledge of hypertension and diabetes among Nigerians, especially at the community level. This study was conducted as a baseline assessment for the current status of diabetes care and management, effect of physical activity, diet, and lifestyle on the prevention of diabetes mellitus, areas of improvement, and strategies to optimize using secondary data to accelerate the sustainable use of resources and economic burden of diabetes and the use of technology in its management.

1.1 Methodology

This is a theoretical study on the prevention of diabetes mellitus in Nigeria through the exploration of the effects of physical activity, diet, and lifestyle modification. As such, this study applied descriptive statistics to present the current scenario of the diabetic care centers, nutrition, and dietetics in Nigeria. Graphical inspection is a common and useful technique to observe the trend and behavior of any variable. As such, the method used was a systematic review process to search for studies in different reputable journals. This study inspects the trends in some variables through secondary data. The secondary data and other information used in this study were collected from seven main sources: (1) World Health Organization; (2) United Nations resolutions on diabetes, international diabetes federation (IDF) declarations and clinical practice guidelines; (3) Medline database, the internet (e-medicine and Medscape resource); (4) Journal articles; (5) World Health and international diabetes federation (IDF) monographs; (6) Hospital statistics, registry reports and landmark hospital-based studies; and (7) Government estimates.

2 Global Dimensions of Diabetes

The prevalence rate for diabetes in the United States is 10.7%, with more than 24 million people diagnosed with diabetes and approximately 6.7 million with undiagnosed diabetes, generating an annual expenditure of $9800.00 per patient (International Diabetes Federation, 2017). The 2014 Global Diabetes Scorecard by the International Diabetes Federation emphasized the importance of health systems, governments, and diabetes organizations working together to advance preventive policies, financing, and rights to optimize diabetes care on a global scale. This call-to-action in the context of 382 million people with diabetes worldwide and the United Nations resolution A/RES/66/2 (United Nations General Assembly, 2011) to reduce noncommunicable diseases resonates with the missions of US clinical endocrinology and diabetes professional medical organizations to figure out ways to improve diabetes care and reduce the human suffering associated with this ravaging disease. This special issue of Annals of Global Health is dedicated to diabetes care and represents a focused response to the query. Several key components are implicit to the query. First, diabetes is a significant healthcare problem with pervasive adverse effects on society. Second, the scale of the problem is truly global. Third, the problem is a complex descriptor that itself is often relegated to triviality or pure academics. Fourth, the problem can potentially be solved. This multifaceted nature of diabetes requires an assessment of lifestyle, behavior, genetics and epigenetics, and the intrauterine environment, all to create an integrated effort (Zimmet et al., 2014). Moreover, it is not that the problems of one country should be addressed for just that country, but rather that in aggregate, information gleaned from a portfolio of countries can generate emergent ideas to solve the complex diabetes problem globally. One can envision enrichment of current diabetes care models, guidelines, and algorithms with conclusions based on patients from different cultures and regions in the world. Of all the variables that interact with and give rise to diabetes, why would individual countries with arbitrary geographic boundaries be germane? The answer is quite simple: it is governments and their respective healthcare policies and socioeconomic statuses that drive local resource availability and subsequent intervention. Diabetes prevalence rates are increasing the most in rural and low-/middle-income areas, underscoring economics (Zabetian et al., 2014). Cultural differences also have an influence on diabetes phenotypes and implementation parameters such as eating patterns, attitudes toward doctors and medicines, beliefs, religion, linguistics and communication preferences, and lifestyle variables (Lirussi, 2010) as well as the lack of effective guideline adaptations to different target populations (Mechanick et al., 2012). Additionally, understanding the effects of one culture in one country can assist diabetes care for patients of the same culture but in another country. Last, the source of information and weight of evidence vary from one locale to another. In addition to peer-reviewed publications identified by searching PubMed, there are important non-English, gray literature sources that are typically undiscovered and may harbor critical information, particularly regarding indigenous populations (Naqshbandi et al., 2008). Again, the authors were asked to address the context of

diabetes care in their country, viz-a-viz infrastructure and socioeconomics, relevant cultural factors, and information sources from both the white and gray literatures, key drivers for epidemiological transitions, specific management strategies, and resources such as glucose testing and devices, medications, and unique challenges and solutions. This information is then compiled and analyzed, and then major findings are synthesized into a core set of relevant conclusions that can be potentially leveraged into action.

2.1 Deleterious Effects of Diabetes Mellitus

Although there are no accurate statistics on the morbidity, mortality, and economic effects of diabetes mellitus in Nigeria, available records from developed nations such as America indicate that diabetes mellitus may place a huge burden on Nigerians. Specifically, elevated blood sugar levels seem to be involved in the development of the following diseases.

1. Damage to the blood vessels— leaving diabetics prone to cardiovascular disease (diabetics are twice as likely as other people to have hypertension and to develop heart disease).
2. Damage to the retina—leaving diabetics at risk of blindness (diabetics are times as likely to go blind as nondiabetics).
3. Kidney disease—leaving diabetics prone to renal failure. In addition, diabetic patients, compared with nondiabetic patients, have double the risk of pancreatic cancer.

   Furthermore, the diagnosis of any chronic disease produces an impact the patient has to contend with. The emotional reaction to having a lifelong incurable disease, as well as the lifestyle adjustments required by the disease, may constitute a problem for the patient and their family members.

Additionally, diabetes shortens life expectancy by an average of 8 years—7.8 years for men and 8.4 years for women [6]. The risk of premature death among people with diabetes is approximately twice that of people without the disease; furthermore, according to the American Diabetes Association, the total economic costs of diabetes are more than USD 132 billion a year. Diabetes accounts for 1 of every 10th USD spent on health care in the United States, and an estimated 48 million Americans may develop diabetes by 2050. In Nigeria, a poor nation, provided with a poor healthcare system and near nonexistent health statistics, the costs of treating diabetes, in addition to the morbidity and man hour losses due to the disease, could be enormous and devastating.

2.2 Prevention of Diabetes Mellitus

Diabetes mellitus is an incurable non-communicable chronic disease that requires special attention for the prevention and management of the disease. Several studies by researchers recommend the key component factors to be observed in preventing the disease (Borghouts & Keizer, 2000; Hales, 2009, Huxley et al., 2005; Tremblay et al., 1995). Some of the factors mentioned include diet, physical exercise, and lifestyle modification and management.

Diabetes Prevention and Exercise

Exercise has been proven by several authors to enhance glucose tolerance and insulin sensitivity in many ways. Borghouts and Keizer (2000) opined that both acute and chronic exercise may have a significant effect on blood glucose and insulin activity in a positive manner. They also reported in their study that glucose uptake could be elevated after an acute bout of exercise for a minimum of 2 h due to an insulin-independent mechanism as a result of an exercise-induced increase in GLUT-4 receptor in the cell membrane. Additionally, an exercise bout can increase insulin sensitivity for up to 16 h afterward. Chronic exercise training potentiates the effect of exercise on insulin sensitivity through multiple adaptations in glucose transport and metabolism. Exercise heightens the sensitivity to insulin (a great benefit for diabetic patients) and may lower the risk of developing diabetes. In studies of high-risk individuals who exercised, took medication, or did nothing, those who became more active had the lowest incidence of diabetes. Apart from making cells more sensitive to insulin, exercise (endurance and strength training) helps stabilize blood glucose levels. Exercise burns excess sugar and makes cells more sensitive, and exercise also helps to keep body fat at a healthy level and to prevent obesity, a key risk factor for type 2 diabetes. Borghouts and Keizer [8] conclude that exercise plays an important, if not essential, role in the prevention and treatment of impaired insulin sensitivity. Given the epidemic of obesity and type 2 diabetes in the United States and other industrialized nations, these beneficial effects of exercise on carbohydrate metabolism underscore its importance as preventive medicine.

Nigeria Health Indices

Nigeria is a multiethnic nationality in a sub-Saharan African country where most of the Nigerian populations are peasant farmers, whereas others are shepherds, nomadic cattle herdsmen, hunters, and fishermen. The Nigerian population is undergoing a transition with people moving from these traditional rural jobs to urban areas in the thousands on a daily basis to take on semiskilled and unskilled labor. Nigeria is located in West Africa with a vast terrain extending from the humid Atlantic equatorial/coastal southern part to the semiarid northern part with close proximity to the

Sahara Desert. It is a low-/middle-income country with a population of approximately 173.6 million people. The gross domestic product (GDP) per capita is US$2800, 90% of the income is generated from oil/petroleum, and the economy is growing at 6%–7% per annum. Unfortunately, the budget for health in Nigeria often falls much lower than the amount recommended by the International Monetary Fund (IMF) and World Health Organization (WHO). The 2012 total health expenditure per capita in Nigeria was US$161 (compared to US$8895 in the United States), and the total expenditure on health as a percentage of the GDP was 6.1% (compared to 17.9% in the United States). The adult literacy rate for the English language was approximately 57.9%, whereas adult literacy in any language stood at 71.6% in 2010. The health indices of the country are generally poor, with a life expectancy at birth of 54 years (compared with 56 years for South Africa, 71 years for Egypt, and 78 years for the United States), infant mortality rates of 78 per 1000 (compared with 33/1000 for South Africa, 63/1000 for Egypt, and 6/1000 for the United States) in 2010–2014, and crude birth rates of 42 per 1000 (compared with 21.1/1000 for South Africa, 23.5/1000 for Egypt, and 13/1000 for the United States). The country has a twin burden of non-communicable diseases (NCDs) and communicable diseases. The communicable diseases that are rampant in Nigeria are HIV/AIDS (prevalence is 3.2% with mortality of 215,000 people in 2013), malaria (prevalence is 100,000 cases per annum with mortality of 300,000 cases per annum), and tuberculosis (TB; prevalence is 280,000 cases per annum with mortality of 170,000 cases per annum). NCDs are also quite prevalent, with more than 30% of adults suffering from hypertension, as well as 0%–33% suffering from goiter, 7%–18% suffering from asthma, and 20%–30% suffering from sickle cell disease, among others.

Researchers have raised alarm over the increasing rate of diabetes among Nigerians, saying that over 5.5% of the country's population was suffering from the ailment. According to IDF, an estimated 15.5 (9.8–27.8) million adults aged 20–79 years have diabetes in Africa (AFR), representing a regional prevalence of 2.1 (6%). The highest prevalence of diabetes in AFR is between ages 55 and 64. AFR has the highest proportion of undiagnosed diabetes; over two-thirds (69.2%) of people with diabetes are unaware they have the disease. Some of AFR's most populous countries have the highest numbers of people with diabetes, including Ethiopia [2.6 (1.1–3.8) million], South Africa [1.8 (1.1–3.6) million], the Democratic Republic of Congo, and Nigeria. Approximately 45.1% of all adults aged 20–79 years with diabetes in the region live in these four countries [1, 22], and in terms of mortality, in 2017, more than 298,160 deaths (6% of all mortality) in AFR were attributed to diabetes, with the highest percentage of all-cause mortality due to diabetes in the 30–39 age group. Regardless of the obvious huge burden of diabetes faced in Nigeria, Nigeria is still not listed among African countries with the largest percentage of healthcare budget allocation. The countries in sub-Saharan Africa with the largest percentage of healthcare budget allocated to diabetes in 2017 are the Seychelles and Comoros. However, it is widely perceived that prevalence figures reported by the IDF grossly underreport the true burden of DM in Nigeria, given that they are derived through the extrapolation of data from other countries. Vis-à-vis morbidity,

diabetes contributes to the development of heart failure, stroke, renal disease, pneumonia, bacteremia, and tuberculosis (TB); it is known that people with diabetes are 3 times more likely to develop tuberculosis, and approximately 15% of TB globally is thought to have background diabetes as a predisposing factor. Diabetes has a wide range of prevalence across the country. In the rural areas of Nigeria, diabetes is prevalent in 0%–2% of the population, whereas in the urban regions, the figures are much higher at 5%–10%. The difference in prevalence values is often seen as a result of westernization and demographic transition and the progressive shift in the population from rural to urban centers.

3 Food Type for Diabetes: Glycemic Index and Dietary Guidance

The glycemic index identifies foods that increase blood sugar rapidly. This handy tool allows for selecting suitable foods that have much less effect on blood sugar levels. The glycemic index (GI) is a measure of the change in blood glucose following ingestion of carbohydrate-containing foods. Glycemic load (GL) more accurately reflects the glycemic effect and has been defined as the product of the GI of a particular food item and the available carbohydrate content. Therefore, the potential glycemic effect of a meal may be altered by changing either the GI or the carbohydrate content, consequently affecting the GL. Even though simple sugar is readily absorbed into the blood stream, resulting in blood sugar elevation, it should still not be the only consideration when making dietary choices for people living with diabetes. In the same regard, the quantity of available carbohydrates in the diet is also a crucial consideration. Knowledge of the glycemic index (GI) of food types is essential for rational advice on calorie recommendations. The glycemic index is rated on a scale from 1 to 100. Foods that raise the blood glucose quickly after a meal are known as high-glycemic index meals, and they are assigned a value of 70 and above, medium-GI = 56–69%, while foods that release glucose slowly into the blood stream are known as low-GI foods, and their values are 55 and below. Low-GI foods reduce postprandial blood glucose levels, and this knowledge can be used in recommending and planning meals for people living with diabetes. It is apparent that a food meal type with a high-glycemic index classification (Table 2) should not be encouraged in the dietary plan for people with diabetes. However, food meals with intermediate GI may sparingly be allowed.

A number of government agencies and associations have reviewed that scientific evidence and/or have provided some form of dietary guidance related to GI. Public Health England's Scientific Advisory Committee on Nutrition conducted a science review on carbohydrates and health. It was concluded that it is not possible to assign cause–effect relationships for outcomes based on variation in dietary GI, as higher or lower GI diets differ in many ways other than just the carbohydrate fraction. The Fiji Ministry of Health and Medical Services recommends that individuals with diabetes

consume foods with a low GI. Instead of dietary guidance for people with diabetes, the NIH has provided recommendations for GI to individuals with nonalcoholic fatty liver disease or nonalcoholic steatohepatitis. The NIH recommends that such individuals eat more low-GI foods, such as most fruits, vegetables, and whole grains. While recommendations are not provided, based on the American Diabetes Association evidence grading system for clinical practice recommendations, it was concluded that there was supporting evidence from observational studies that the use of the glycaemic index and glycaemic load may provide a modest additional benefit for glycaemic control over that observed when total carbohydrate is considered alone. Diabetes Australia recommends eating more low- and intermediate-GI foods but not excluding high-GI foods. For individuals with prediabetes or diabetes, Diabetes Canada recommends choosing lower GI foods and drinks more often to help control blood sugar. Diabetes Canada's most recent education materials have been designed to support healthcare providers and people affected by diabetes as they learn about GI together. South Africa's Food Advisory Consumer Service has noted that a GI value can assist in selecting foods that are high in fiber, micronutrients and antioxidants, and low in energy, which is the basis of a healthy diet (Food Advisory Consumer Service, 2019). The United Kingdom's Diabetes Guide states that research has shown that choosing low-GI foods can particularly help manage glucose levels in people with type 2 diabetes (Diabetes, 2020). There is less evidence to suggest that it can help with blood glucose control in people with type 1 diabetes. However, the guide notes that not all low-GI foods are healthy choices; chocolate, for example, has a low GI but has a high-fat content. Eating to control diabetes is not just about GI ratings but also about consuming foods low in saturated fat and salt as part of a healthy, balanced diet. Combining foods with different GIs alters the overall GI of a meal, and the benefit of GI can be maximized by switching to a low GI option with each meal or snack.

3.1 Diets for Diabetes Patients

Recommendations have been made that diet for diabetic patients should not be fixed but should depend on factors such as nutritional assessment, requirements, goals, individual preferences, and the cultural milieu (Tariq, 2002). This is because the goals of dietary prescription are to improve the cardiometabolic parameters of the patients, such as blood glucose, weight, abdominal circumference, and blood pressure. Additionally, it prevents and delays the onset or prevents the progression of diabetes complications (ADA, 2008). These are not to be achieved at the expense of pleasurable enjoyment of meals and disregard of cultural values and beliefs. Attention should be placed on the unique needs of special people, such as the growing child or adolescent with type 1 diabetes, pregnant or lactating women, and patients, on meal-related medications, such as insulin or insulin secretagogues, to avert both hyperglycemia and, more importantly, hypoglycemia (ADA, 2008). Studies have shown that with good adherence, a prescribed diet can lower HbA1c by 1–2% within

3–6 months (Pastors et al., 2002). In obese or overweight patients, the prescription should be aimed at moderate weight loss (5–10% of present body weight) (ADA, 2008). This is achievable with a low-carbohydrate and low-fat diet. Carbohydrates with a low-glycemic index should be prioritized. The glycemic index of food is defined as the extent of the rise in blood glucose after consuming the food compared with the rise in glucose after ingesting a reference food (usually glucose or white bread) (ADA, 2008). The glycemic index of a food multiplied by the amount of carbohydrate in the food gives the glycemic load (ADA, 2008). Whole grains and legumes are good sources of carbohydrates because they have low-glycemic indices. Considering the prescription for fats, saturated fats should be limited to <7%, trans fats should be better avoided altogether, and cholesterol should be limited to <200 mg per day (ADA, 2008). Monounsaturated fat is highly recommended. High-protein diets are not recommended. Good-quality proteins provide the 9 essential amino acids. Examples of quality protein that are available in Nigeria are fish, eggs, milk, and poultry. Mineral or vitamin supplementation of the diets of people living with diabetes is not recommended (ADA, 2008). However, special groups such as elderly, pregnant or lactating women, and individuals on a very low-calorie diet may benefit from supplementation (ADA, 2008).

3.2 Food Pyramid

The food pyramid is the scheme used to depict food classes and the appropriate proportion of each class (Sarac & Butnariu, 2020). Adequate diet provides the needed nutrients in a proportion that meets the physiological needs of an individual. The pyramid is subdivided into several layers, where each layer corresponds to the relative amount and class of food. It is triangular and a graphical representation of food proportions designed in a way to support healthy eating. The base is represented by carbohydrates and progresses upwards, followed by vegetables, proteins and fats, and sweets (Sarac & Butnariu, 2020). The progression from the base to the tip represents the relative quantity of each class to be consumed, with the base representing the largest quantity and the tip representing the smallest quantity. Generally, it is recommended to have 6–11 servings per day of carbohydrates (rice, bread, cereals), 3–5 servings per day of vegetables, 2–4 servings per day of fruit, 2–3 servings per day of dairy products, and 2–3 servings per day of fish (Sarac & Butnariu, 2020). The concept here is that no single food has all the needed nutrients in adequate doses, and an appropriate variety is the key. This is illustrated in Fig. 1.

3.3 Carbohydrate Counting

This is a technique used by patients with diabetes to estimate the amount of carbohydrate in their meals. The carbohydrate quantity is determined in grams, in which a

Fig. 1 Food Pyramid (*Source* Georgr [2015])

serving of carbohydrate is reported to be approximately 15 g (Kulkarni, 2005). The healthcare giver and the patient agree on how much carbohydrate must be attained to reach the nutritional goal. An appropriate combination of carbohydrate counting, physical activity, and insulin dosing is important for optimal glycemic control. Carbohydrate counting entails keeping track of the carbohydrate in the diets because it helps to stay healthy and prevent or delay the onset of complications of diabetes. The amount of carbohydrates is often inscribed on the food label.

Carbohydrate counting can be described as follows. It is assumed that the daily calorie recommendation for a man is 1800 kcal per day; it is also recommended that carbohydrate should constitute approximately 50% of this total calorie level, thereby making total calories from carbohydrate, in this instance, 900 kcal. Four kilocalories (Kcal) are derived from 1 g of carbohydrate; therefore, 900 kcal will be derived from 225 g of carbohydrate. This can be divided into 3 meals and 1 to 2 snacks. Carbohydrate counting is not usually advised during a dietary counseling session in Nigeria. Instead, the recommendation used is to restrict one or more forms of carbohydrate (Ugodadi et al., 2019). Most foods consumed are prepared at home or bought unpackaged or without a food label. However, it is now known that the amount of carbohydrate eaten is more important than the type because any carbohydrate consumed in sufficient quantity is capable of raising blood glucose dramatically (Ugodadi et al., 2019).

Carbohydrate counting adds flexibility to meal plans, diet choices, and the timing of meals. It enables patients with diabetes to take charge of their health and to estimate the amount of insulin required per certain amount of carbohydrates (Kulkarni,

2005). Carbohydrate counting also assists the patient in observing how blood glucose responds to different types of carbohydrates and how to respond to it appropriately by adjusting the insulin dose. It is, however, cumbersome for some people. Moreover, in low-resource settings, such as Nigeria, where food labels are the exceptions and there are wide variations in food preparations, it is very difficult to practice food counting without the aid of a registered dietitian (Ukegbu, 2013).

3.4 Calorie Contents of Nigerian Foods and Drinks

Foods are often culturally determined, and Nigeria is a multicultural nation, but there are certain foods that are commonly consumed in most households in Nigeria. There is a need to pay attention to calories to meet dietary goals. Normally, a physically active man requires approximately 2000 cal per day, and an average physically active woman requires 1800 cal per day (ADA, 2002). The main challenge of estimating calories in Nigeria foods is the varied methods of food preparations. Another challenge is the standard of measurement, which also tends to vary. Nutrition education is scarcely available to the populace, especially rural area dwellers (Ojeleye et al., 2014). The tables below show the estimated calories in various Nigerian foods and drinks (Tables 1, 2, 3, and 4) (Ayida, 2020; Edoho, 2020; Oja, 2020; Oluwasogo, 2020).

4 Foods for the Management of Diabetes Mellitus in Nigeria

The need for functional foods that promote healthy status, including diabetes mellitus, is pertinent due to the increasing prevalence of diabetes, particularly in Nigeria. Some of these functional foods (Table 3) commonly used in Nigeria can be incorporated into the dietary plan for people living with diabetes to attenuate hyperglycemia and enhance the effectiveness of the conventional medication for the management of diabetes. The importance of dietary intervention cannot be overemphasized, as diet plays a critical role in diabetes.

4.1 Nutrition and Diabetes

A carefully planned diet, containing the right components of balanced nutrients in an adequate proportion, is indispensable for preventing diabetes mellitus. A balanced diet contains carbohydrates, fats and oil, proteins, vitamins, mineral salts, and water. Carbohydrates are converted to glucose after digestion, and with the help of insulin, this glucose will enter the cells to be used for energy production. However, when glucose fails to enter the cell, it remains in the blood and is filtered by the kidneys into

Table 1 Estimated calories in Nigeria staple foods

Food	Estimated calorie content per 100 g of food	Caloric contents in specific measures
Rice	150 cal	1 tablespoon = 15 cal
Beans	140 cal	1 tablespoon = 15 cal
Yam	120 cal	1 tuber = highly variable
Bread	300 cal	1 slice = 120 cal
Egg	150 cal	1 egg = 70 cal
Granulated sugar	150 cal	1 tablespoon = 30 cal
Sugar cube	150 cal	1 cube = 10 cal
Honey	150 cal	1 tablespoon = 60 cal
Powdered milk	150 cal	1 tablespoon = 40 cal
Snail	100 cal	1 tablespoon = 40 cal
Palm oil/coconut oil	100 cal	1 tablespoon = 40 cal
Akara (beans cake)	100 cal	1 roll = 70 cal
Pap (akamu)	100 cal	1 tablespoon = 90 cal
Roasted corn		1 medium size = 100 cal
Goat meat	100 cal	1 medium size = 100 cal
Margarine/butter -	100 cal	1 tablespoon = 100 cal
Egusi soup		1 serving = 500 cal
Ewedu soup		1 serving = 100 cal
Okra soup		1 serving = 150 cal
Bitter leaf soup		1 serving = 150 cal
Oha soup		1 serving = 180 cal
Stew		1 serving = 200 cal

Source Azeez et al. (2020)

the urine. To prevent this situation, individuals should refrain from refined sugars and consume carbohydrates that contain fibers. Refined sugars have been alleged to contribute to a wide variety of health problems, including obesity, diabetes, heart diseases, and cancer. A diet rich in high-glycemic index foods theoretically may lead to insulin resistance and high-serum triglyceride levels—risk factors for diabetes and heart disease. On the other hand, complex carbohydrates, i.e., carbohydrates with plenty of fibers, are health friendly. Those consuming complex carbohydrates are less likely to develop diabetes than those eating fewer fibers. To corroborate this assertion, it was opined that eating more fruits, vegetables, and whole grains, but no fat or low-fat milk and dairy products, is a healthful way to get the carbohydrates you need. Fiber-rich choices have the added benefit of promoting digestive health and reducing the risk of type 2 diabetes and heart disease. Other forms of fiber-rich carbohydrate sources in Nigeria are cocoyam, sweet potatoes, plantain, water yam, cassava, maize, and grains. Additionally, vitamins are important components of the

Table 2 Estimated calories in beverages ('drinks') in Nigeria

Alcoholic beverage caloric	Estimated calorie content per 100 ml of beverage	Contents in the bottles commonly sold
Gulder	55 cal	1 bottle (600 ml) = 330 cal
Guinness	45 cal	1 bottle (440 ml) = 200 cal
Heineken	35 cal	1 bottle (440 ml) = 155 cal
Red wine (13% alcohol)	70 cal	1 bottle (750 ml) = 525 cal
Champagne	75 cal	1 bottle (750 ml) = 560 cal
Non-Alcoholic Beverage		
Coca-cola coke	42 cal	1 bottle (600 ml) = 250 cal
Fanta	36 cal	1 bottle (600 ml) = 220 cal
Pepsi	40 cal	1 bottle (600 ml) = 240 cal
7 up	42 cal	1 bottle (600 ml) = 250 cal
Hollandia yoghurt	66 cal	1 bottle (1000 ml) = 660 cal
Maltina	56 cal	1 bottle (330 ml) = 190 cal
Chi exotic	52 cal	1 bottle (1000 ml) = 520 cal

Source Azeez et al. (2020)

Table 3 Estimated calories in beverages ('drinks') in Nigeria

Fruits	Estimated calorie content per 100 g of fruit	Approximate calories per average-sized fruit
Apple	55 cal	95 cal
Banana	85 cal	105 cal
Orange	50 cal	65 cal
Pineapple	50 cal	450 cal
Watermelon	30 cal	450 cal
Mango	60 cal	200 cal
Garden egg	25 cal	140 cal
Pawpaw	80 cal	180 cal

Source Azeez et al. (2020)

diet for preventing diabetes mellitus. Vitamins are needed in small quantities, and they are involved in almost every metabolic process in the human body. For example, vitamin D may enhance immune cell functions to help prevent autoimmune diseases such as type 1 diabetes. Harris indicated that a dose of ≥2000 IU daily may have a strong protective effect on children at risk for type 1 diabetes. In addition, vitamins enhance the overall wellbeing of individuals, help to protect against diseases, and facilitate recovery from illness. In Nigeria, vitamins are obtained from a variety of

Table 4 Estimated calories of foods consumed as morsels ('swallows') in Nigeria

Swallow	1 Milk tin of flower or flakes
Amala	1 milk tin of yam flour = 350 cal
Foofoo (fufu/akpu)	1 milk tin of cassava flour = 330 cal
Garri (Eba)	1 milk tin of cassava flakes = 360 cal
Pounded yam	Slices of yam equivalent to 1 milk tin of yam flour = 400 cal
Semovita	1 milk tin of wheat flour = 600 cal
Tuwo (white corn meal)	1 milk tin of corn flour = 450 cal

Source Azeez et al. (2020)

fruits and vegetables, such as onions, tomatoes, citrus, grapes, garden eggs, pepper, spinach, banana, mango, cashew, waterleaf, and bitter leaf. Vitamins are also obtained from food crops such as nuts, cereals, and grains. Vitamin D can also be produced when the skin is exposed to sunlight. Coffee and tea consumption prevent the development of diabetes mellitus. Over the past 10 years, several studies have shown that the consumption of caffeinated beverages such as coffee and tea is associated with a reduced risk of type 2 diabetes. Huxley et al. affirmed that every additional cup of coffee consumed in a day was associated with a 7% reduction in the excess risk of diabetes. They also reported that decaffeinated coffee and tea are beneficial and concluded that high intakes of coffee, decaffeinated coffee, and tea are associated with a reduced risk of diabetes. Such a finding suggests that other components in coffee and tea, such as magnesium, chromium, lignans, and chlorogenic acid, may be involved. Therefore, decaffeinated coffee, coffee, and tea may be consumed to prevent and manage type 2 diabetes. Nutrition/diet remains a key player in diabetes prevention and management, and rightly so, the IDF World Diabetes Day campaign in 2015 focused on healthy eating as one of the key factors in managing type 1 diabetes and preventing type 2 diabetes and highlighted that unhealthy dietary practices increase the occurrence of type 2 diabetes, related complications, and other NCDs. In this light, the IDF encouraged using research evidence strategically, adopting an ethical and effective whole-of-society approach in a public–private partnership to promote the intake of a healthy diet through education and local adaptations of comprehensive lifestyle programs. Nutrition therapy has long been recognized before the era of modern scientific medicine. Before insulin discovery, a starvation diet of very low-caloric content (400–500 cal/day), known as the Allen diet, was commonly used to treat diabetes. Another diet with extreme carbohydrate restriction to approximately 2% and very high fat to approximately 70% was used by Elliot P. Joslin for managing diabetes in 1920, and at that time, diabetes was commonly defined as carbohydrate-intolerance disease. Although a high-carbohydrate diet has been frequently questioned as a major contributing factor to poor diabetes control and weight gain, little has changed for the past 3 decades, and after insulin discovery, the amount of carbohydrates in the diabetes diet evidently was increased to a maximum of 35%–40%

of the total daily caloric intake. As reported in 1994, the American Dietetic Association used the term "medical nutrition therapy" (MNT) to better articulate appropriate nutrition care and processes in diabetes management. However, despite recent progress in the pharmacologic management of diabetes, MNT remains a crucial tool for achieving optimal glycemic control. In the same light, in 2004, the WHO/FAO emphasized that nutritional intervention is an integral part of diabetes management. Regardless of the crucial role of nutrition in the management of diabetes, studies revealed a low adherence to dietary recommendations for macronutrient intake and fruit and vegetable consumption among diabetic patients in Africa. Similarly, low- and middle-income countries (LMICs) face a rapid change in the nutrition transition toward increases in non-communicable diseases, and the resulting major shifts in diet are toward increased refined carbohydrates, added sweeteners edible oils, and animal-source foods, and reduced legumes, other vegetables, and fruits, consequently increasing the severity of diabetes in LMICs. However, controversy remains around the right class of food for diabetic patients.

4.2 Dietary Carbohydrate and Diabetes

The role of carbohydrates in the diet of people living with diabetes is an area of much debate, especially with respect to ideal amounts and types of carbohydrates. The results from the National Diet & Nutrition Survey London revealed that in many countries of the world, cereal and cereal products make the largest contribution to daily carbohydrate intake, principally from white bread, pasta, and rice, and the largest source of carbohydrates in the diet is in fact not sugar. Thus, carbohydrate quality is important in terms of glycemic index and fiber and may have other health benefits, although the quantity of carbohydrate is a more important predictor of glycemic response. However, it is worth noting that these recommendations (Table 1) may not generally be applicable to people living with diabetes in Africa, particularly Nigeria, perhaps due to regional and genetic variation. Additionally, there is no final or conclusive evidence for an ideal macronutrient proportion for all patients with T2D, but rather, there is an emphasis on the individualization of eating plans. Again, when referring to common food carbohydrates, the following terms are preferred: sugars, starch, and fiber. Thus, in view of this, it is important to include foods containing carbohydrates, particularly whole grains, fruits, vegetables, and low-fat milk, in the diet of people with diabetes.

4.3 Dietary Fats and Diabetes

The role of dietary fat has long been studied as a modifiable variable in the prevention and treatment of diabetes, and in general, the type (quality) of fat intake is more important than the amount (quantity) of fat intake. This is consistent with the

recommendations to limit saturated fat, high-fat diet, and dietary cholesterol intake as stipulated by the American Diabetes Association; American Heart Association; and as shown in Table 1. Additionally, the American Diabetes Association in 2004 reported that persons with diabetes appear to be more sensitive to dietary cholesterol than the general public. The quality of fat is generally specified by the relative content of saturated fatty acids (SFAs), monounsaturated fatty acids (MUFAs), and polyunsaturated fatty acids (PUFAs), including the proportion or amount of essential fatty acids, that is, linoleic acid (LA), and a-linolenic acid (ALA), as well as the proportion or amount of long-chain n-3 fatty acids (n-3 LCPUFAs), that is, eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA). Fat is a problem for people with diabetes. The more fat there is in the diet, the harder time insulin has in getting glucose into the cells. In the same regard, minimizing fat intake and reducing body fat help insulin do its job much better. Fatty acids influence glucose metabolism by altering cell membrane function, enzyme activity, insulin signaling, and gene expression, and fat-containing foods may affect the rise in blood sugar and yield a lower GI than similar foods without fat. Recent evidence suggests that a diet high in healthy fat, rich in unsaturated fatty acids, such as the Mediterranean dietary pattern, may, in fact, prevent the development of metabolic diseases such as type 2 diabetes mellitus but also reduce cardiovascular events.

4.4 Dietary Protein and Diabetes

Dietary proteins are important modulators of glucose metabolism. However, its role in diabetes remains an issue of debate. Protein-rich foods increase insulin secretion, leading to lowering of postprandial blood glucose concentrations. In contrast, a meta-analysis, observational studies, and original research report demonstrated that the intake of total protein and animal protein was associated with a high risk of T2DM. In high-animal protein food, red meat and processed meat were associated with a high risk of T2DM, while total dairy products, low-fat dairy and yogurt were associated with a low risk of T2DM, and egg and fish were not associated with a decreased risk of T2DM. In high-plant protein food, soy was associated with a low risk of T2DM. Examining the role of dietary protein and establishing intake guidelines among individuals with diabetes is complex. The 2014 American Diabetes Association (ADA) recommends (Table 1) an individualized approach to protein intake, and among individuals with impaired renal function, the ADA recommends reducing protein intake to 0.8–1.0 g/kg per day in earlier stages of chronic kidney disease (CKD) and to 0.8 g/kg per day in the later stages of CKD.

5 Strategies for the Prevention of Diabetes Mellitus

Several research studies have shown that when carefully thought and locally adaptable strategies are put in place, mortality arising from diabetes mellitus can be reduced coupled with the education of the patients and doctors. Some of the interventions used in diabetes prevention are as follows:

i. **Education**: The basic preventive measures for diabetes prevention are patient education and empowerment. Prevention basically focuses on the common precipitating factors and empowers the patient through education to know how to avoid these precipitating factors. Additionally, early intervention should be instituted to prevent progression to full-blown emergencies. Patients with diabetes must acquire basic knowledge and skills on how to intelligently cooperate with the healthcare team to prevent harmful acute and chronic complications common with diabetes. There should be a regular creation of awareness among the general public about diabetes and its adverse and unfavorable complications. People at risk of developing diabetes should be encouraged to go for screening tests, while those who are already diabetic must be taught the value of monitoring their blood glucose themselves and the implications of keeping different glucose readings. In addition, they must be taught how to handle sick days, such as the continuous use of their antidiabetic drugs, eating foods that are easy to digest, and drinking sugar-free fluids when appetite is lost. They must be counseled to promptly communicate with and/or contact their doctor through the use of mobile phones. They may include creating an emergency line in the hospital by the healthcare team through which patients can readily reach their caregivers. Capacity building through periodic training of healthcare personnel must be ensured to deliver optimum and effective care of patients with diabetes and thereby prevent the development of acute complications.

ii. **Healthcare system restructuring**: There is the fundamental need to critically appraise and restructure our healthcare system by instituting effective diabetes education for patients and training of healthcare personnel. This will bring about the maximization of benefits that may accrue from robust and efficient healthcare structures. Several reports have shown that less than 50% of diabetes patients have attended the diabetic clinic at some point prior to hospitalization. This is a pointer to the fact that signifies a failure of the health system in the country. A novel healthcare model for the care of diabetic persons could be devised and implemented with a significant positive impact on diabetes care. The present healthcare structure and system in Nigeria restricts accessibility to health facilities and does not support high-quality care of persons living with diabetes. A radical restructuring of our healthcare delivery system, such as the introduction of village health workers and the establishment of diabetes centers in all geopolitical zones, could be the right step in the right direction.

iii. **Healthcare financing**: At present, most patients are on the low socioeconomic rung and are paying medical bills from their pockets with no effective health

insurance aid. There is the need for the managing team to carry out compassionate counseling on the issue of compliance with medications at all levels. Moreover, a few percent of the populace can self-finance their healthcare needs on a chronic, lifelong health condition such as diabetes. Hence, the government should develop and speed up the process of ensuring an effective health insurance scheme for the people through the availability and subsidization of antidiabetic drugs. Professional bodies such as the Diabetes Association in Nigeria and endocrine associations must be backed by data on the prevalence, incidence, mortality, and morbidity of diabetes. They must use every opportunity to draw the attention of government to the appalling situation of our healthcare system and infrastructures as it concerns diabetes care. It is this kind of intense and persistent advocacy that will cause the government to realize that non-communicable diseases are taking an equally severe on the health of Nigerians.

6 Conclusion

Diabetes mellitus is an incurable autoimmune disease that affects predisposed individuals irrespective of age, sex, race, or socioeconomic status and can be prevented through physical exercise, diet, and lifestyle modification. Health education, focusing on an appropriate diet, a healthy lifestyle, and physical activity, is imperative for preventing diabetes mellitus. A dietary plan that takes into consideration the appropriate food portions and their glycemic index will provide better blood glucose control. Finally, following a dietary plan that recommends a simple dietary plan that recognizes appropriate food portions and their glycemic index will greatly improve the blood glucose level of type 2 diabetes, improve the metabolic profiles, and ultimately help in preventing the long-term complications of diabetes. Patient information leaflets should be given to patients to enhance adherence. There is a need for the integration of generic medicines into routine care as a way of further reducing the burden of healthcare expenditure on patients. The role or influence of healthcare insurance on medical expenditure among diabetes patients in the Nigerian setting is a potential research topic for the future. Investment in effective diabetes prevention and management has become necessary to battle this global epidemic. It is clear that most of the recommendations for dietary management of diabetes were rationalized by international bodies and, as such, a call for various umbrella of diabetes organizations in Nigeria to further expand research in this regard and consequently stipulate indigenous recommendations to better suit the increasing diabetic population, rather than continual dependence on foreign bodies.

A dietary plan that takes into consideration the appropriate food portions and their glycemic index will provide better blood glucose control. Finally, following a dietary plan that recommends a simple dietary plan that recognizes appropriate food portions and their glycemic index will greatly improve the blood glucose level of type 2 diabetes, improve the metabolic profiles, and ultimately help prevent the

long-term complications of diabetes. Patient information leaflets should be given to patients to enhance adherence.

6.1 Recommendations and Future Direction

Diabetes is a global public health threat and a clinically challenging disease that will continue to be a challenge for primary healthcare physicians in Nigeria and the world at large due to vigorous and constant urbanization and stress. People with diabetes exhibit a network of interconnected biological, clinical, metabolic, social, and physiological factors that directly increase the risk of cardiovascular disease and mortality. Hence, to improve the clinical management of diabetes and prevent complications in patients, the government and private organizations must work hand-in-hand in combating the spread of this disease.

A game-changing public health policy must be put in place; one such policy is well-structured self-monitoring of blood glucose, a system of electronic information, patient education, and health promotion in the community. Dietary intervention is a key factor in the management of diabetes; hence, we recommend that producers of all marketed processed/consumable food items in Nigeria should clearly state the glycemic index as part of the nutritional information. Furthermore, dietary management as an aspect of diabetes care is seen as the turf of nutritionists, and as a result, many physicians have poor know-how on dietary counseling. In this regard, we recommend that professional nutritionists be made available at least in local government areas to sensitize the general public, retrain health practitioners, and make recommendations on nutritional needs, especially for those living with diabetes.

Additionally, by implementing programs such as limiting fast food advertising in print and on media (Television and radio. Regional disease awareness campaigns should be implemented, including early detection and financial support for the afflicted underprivileged. Individuals should be encouraged to create time to take part in regular physical exercises. Healthy diets, prepared with locally available nutrients, should be consumed to prevent diabetes mellitus. Individuals should live an active life. A sedentary lifestyle should be avoided to prevent obesity, which is a causative risk factor in diabetes mellitus. Health education, with emphasis on a healthy lifestyle, i.e., regular physical exercise and consumption of an appropriate diet, should be transmitted to Nigerians by the local, state, and federal governments. Nigerians should be encouraged to inculcate the habit of a regular medical checkup to detect the early onset of diabetes and thus prevent the development of diabetes mellitus. A national diabetes care and prevention policy is highly recommended.

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Chapter 20
Sustainable Innovation in Healthcare Delivery: The Role of Alternative Healthcare Practitioners

Shukurat Moronke Bello

1 Introduction

Technological advancement, the growing expectations of health care consumers, and the dynamics of the healthcare delivery system coupled with growth in chronic and complex diseases such as COVID-19 have resulted in changes in the medical care system (Thimbleby, 2013). Hence, the healthcare industry needs to adapt to a new paradigm in the healthcare process and delivery. This is a new normal, and there is a need for all stakeholders in the healthcare industry to recognize, improve, and sustain the healthcare delivery system. In the healthcare delivery system, medical care is complex, and its complexity may result in inefficiencies and hence the need for the system to develop innovative delivery mechanisms (Cutler, 2011). With the current situation, it is imperative that healthcare practitioners adapt and develop innovative methods for the business of health care. In response, professionals and healthcare practitioners have offered new methods, such as complementary/alternative (medicine) solutions. Healthcare initiatives are implemented in response to changing disease patterns, customer demands, reduced healthcare costs, aging populations, technological advancements, policy initiatives, and political reforms (Nilsen et al., 2020). Thus, deliberate efforts toward the creation of a sustainable healthcare delivery system should be made (Littlejohns et al., 2019).

Alternative medicine has gained global acceptance (Kaboru et al., 2006; Mngqundaniso & Peltzer, 2008) as a method of treating a variety of problems among people of diverse cultures. Traditional healthcare techniques, for example, have been proven to be both economical and essential in most societies, particularly in Africa and portions of Asia. According to the World Health Organization, approximately 60% of the world's population uses herbal medicine to treat their illnesses, while up to 80%

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of the African population relies on traditional medicine for some areas of primary health care. There is also evidence that citizens in several advanced countries are using alternate healthcare delivery systems to meet their needs.

Healthcare institutions are under increasing pressure to provide value-based, high-quality care to patients by improving access, lowering costs, and improving outcomes. These factors increase the pressure to deliver efficient and beneficial interventions to improve patient care. The literature emphasizes the importance of coordination, cooperation, and cross-functional collaboration in achieving implementation success (Khalil & kynoch, 2021). Thus, sustainability is difficult to apply in real-world projects, particularly when dealing with a complex scenario such as health care. Many research studies and evaluation systems have addressed this topic from various perspectives, but many limitations and criticalities remain to be overcome to adequately address actual needs.

Similarly, new innovations in healthcare delivery, such as telemedicine and retail medicine, have emerged in recent years as a result of advances in information and communication technology. The challenge of assessing the long-term viability of innovations poses a challenge for policymakers, researchers, and practitioners. After overcoming this challenge, the ultimate goal is to achieve the sustainability of innovations (Crespo-Gonzalez et al., 2020). Despite the surge in healthcare innovation, little is known about how alternative healthcare practitioners can achieve sustainable innovations in healthcare delivery services.

Sustainable innovation is disruptive because it can result in better business models, improved processes, streamlined resource flows, reduced waste and cost, and even the creation of entirely new market segments, making it more difficult for organizations to defend the status quo (Day, UD). Therefore, this paper aims to answer the following research questions: (i) What complementary and alternative healthcare methods are available in the business of health care? (ii) How can patients be effectively served by healthcare practitioners to achieve sustainable innovation?

2 Literature Review

2.1 Complementary and Alternative Medicine (CAM)

Alternative ways of delivering healthcare services (i.e., complementary and alternative medicine) may optimize healthcare efficiency and sustainability. CAM are medical products and procedures that are not part of conventional medical care. Although the phrases “alternative medicine” and “complementary medicine” are frequently used interchangeably, each term refers to something distinct. In the United States, the National Center for Complementary and Alternative Medicine defines CAM as healthcare practices that are not an integral part of conventional medicine. Alternative medicine is defined as any nonmainstream interventions that are used instead of conventional medicine. However, complementary health care refers to

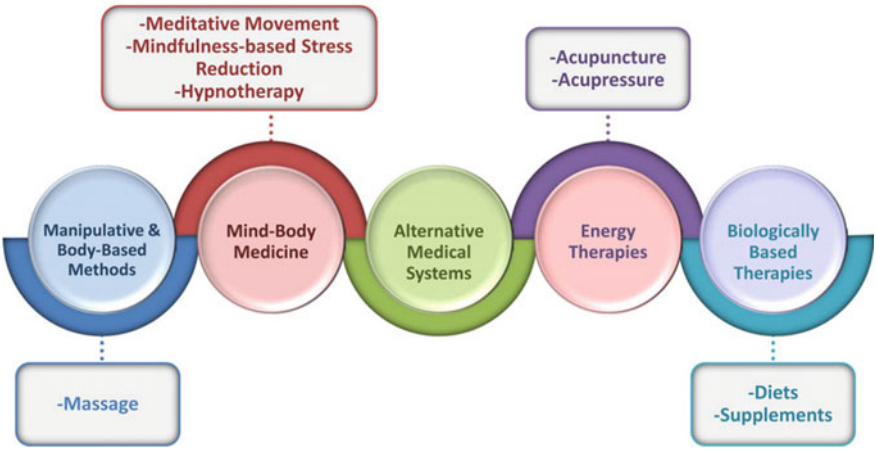

Fig. 1 The 5 domains of complementary and alternative medicine. Put together from NCCIH

treatments that are used in addition to conventional medicine. The practitioners in the system may be grouped into five major practices: manipulative and body-based methods; mind–body interventions; alternative medical systems; biologically based treatments; and energy therapies (see Fig. 1).

Manipulative and Body-Based Methods

Manipulative and body-based practices in CAM are based on manipulation. Manipulation is the application of controlled force to a joint to move it beyond its normal range of motion to aid in the restoration of health. Chiropractic and osteopathic manipulation, a type of manipulation practiced by osteopathic physicians, are two examples. It is used in conjunction with physical therapy and instruction in proper posture, as well as massage. or movement of one or more body parts. These include chiropractic and osteopathic manipulation, massage therapy, reflexology, and rolfing. Surveys of the US population suggests that between 3 and 16% of adults receive chiropractor manipulation in a given year (Astin, 1998, Manipulative and Body-Based Approaches, 2010).

Mind–Body Interventions

Mind/body interventions focus on helping the individual achieve generalized relaxation. This is done through a repetitive focus on a word or sound and the adoption of a passive attitude toward intrusive thoughts. Relaxation exercises have been found to be effective in reducing chronic pain or anxiety associated with stressful experiences (Gaitzsch et al., 2020; Vijay et al., 2008).

Alternative Medical Systems

Alternative medical systems are entire systems of health theory and practice (including traditional Chinese medicine, Ayurvedic medicine, naturopathy, and homeopathy) that developed separately from conventional medicine. These systems typically use a variety of methods that fall under the CAM umbrella (herbal remedies, manipulative practices). Traditional Chinese medicine relies heavily on the use of "energy"-based practices such as acupuncture and Qigong, based on the belief that the uninterrupted flow of energy through 20 meridians is necessary for the maintenance of health (Challman & Myers, 2011).

Biologically Based Treatments

Biologically based therapies involve substances found in nature, such as herbs, vitamins, dietary supplements, and foods, to treat illness and enhance health. Worldwide, these products are extraordinarily popular, and billions of dollars are spent on them in the United States alone. Herbal medicines are considered dietary supplements and have provided guidance for investigating botanical drug products, including complex formulas, and valuable sources of information and grant support for clinical and basic research on botanical drug products in the United States. Herbal remedies refer to substances found in nature, including herbs, foods, and vitamins. These substances are broadly classified as dietary supplements. The term *dietary supplement* is specifically defined by the Dietary Supplement Health and Education Act (DSHEA), enacted in 1994, as a product, other than tobacco, taken by mouth and intended to supplement the diet, including vitamins, minerals, herbs, and a number of other nutritional supplement products. Forms in which dietary supplements may be sold include extracts and concentrates, tablets, capsules, gel caps, liquids, and powders (Burks et al., 2019; Romm, 2017).

Energy Therapies

According to the National Center for Complementary and Integrative Health (NCCIH), this category of complementary therapies involves the use of various types of energy fields. Energy medicine is a method to transmit healing energy to the patient's body through the hands of a practitioner. There are nine different schools of energy medicine: biofield energy healing, spiritual healing, contact healing, distant healing, qi do, therapeutic touch, Reiki, polarity therapy, and qi gong. There are several approaches to energy medicine, such as hands-on, hands-off, and distant healing, where the healer and patient are in different locations. Interestingly, 57% of trials with distant healing intervention showed a positive treatment effect on any medical condition (Astin et al., 2000).

2.2 Innovative and Sustainable Health Care Delivery

The effects of innovation on delivery are numerous and contribute to a firm's revenue growth, increased productivity, and customer satisfaction. The advisory committee on measuring innovation in the twenty-first century defines innovation as follows: innovation in the healthcare system can be new services, new ways of working and/or new technologies. In the healthcare system, innovation can enhance life expectancy, improve quality of life, reduce health care costs, and provide a mechanism for diagnostic and treatment options. Berwick et al. (2008) define healthcare delivery innovation" as any new product, service, or redesign of care that moves health systems toward the "triple aim" of improved patient experience, improved healthcare quality, and decreased costs. These are conceptualized not only as practice improvement projects but also as entrepreneurial, potentially high-risk, and highly scalable new products or processes driven by consumer adoption (Ostrovsky & Barnett, 2014).

In the healthcare sector, innovation can be consumer focused, technology based, and a new business model (Herzlinger, 2006). Innovative delivery in health care can result in more convenient, more effective and less expensive treatment for today's time-stressed and increasingly empowered healthcare consumers. However, innovation in the healthcare system can be hindered by hostile industry players who may view innovation as a threat, financial challenge, unfavorable government regulation, and challenge identifying the targets for the adoption of new technology. Hence, healthcare innovators must prepare to respond to and deliver a sustainable healthcare system that can be easily maintained and functional from the environmental, social, and economic points of view to comply with the diverse interests and needs of all stakeholders (Buffoli et al., 2013).

Sustainable thinking is part of an alternative healthcare delivery system. According to Molero et al. (2021), sustainability is an important point of attention for the public at large, for governments, and for the healthcare system. Previously, the term sustainability has been mostly related to environmental degradation. One of the very first official articulations of sustainable development was made in the Burtland Report, published by the United Nations in 1987, in which sustainable development was defined as "development that meets the needs of the present without compromising the ability of future generations to meet their personal needs". Currently, the significance of sustainability has evolved and is related to other aspects, such as the wellbeing of patients, healthcare employees, and the community. The definition of sustainable development proposed by the European Union (EU) is broader and more holistic and considers the multiple facets of all sustainability policies, including economical, human, and environmental facets.

Hence, a sustainable structure should be defined as one that ensures the preservation of resources, is practical from ecological, social, and economical perspectives, and meets the interests of different stakeholders. The ANH defined sustainable health care in 2006 as "A complex system of interacting approaches to the restoration, management and optimization of human health that has an ecological base, that is environmentally, economically and socially viable indefinitely, that functions

harmoniously both with the human body and the nonhuman environment, and which does not result in unfair or disproportionate impacts on any significant contributory element of the healthcare system."

3 Methodology/Approach

The methodology used in this research was a desk-based approach. Searches were performed through electronic tracking and snowballing of references. Literature search of peer-reviewed journal articles published in English language in academic databases: Science Direct, Web of Science, Google Scholar, and PubMed. Articles were considered if they looked at innovation in health care, sustainability in health care, medical entrepreneurship, alternative medicine, alternative healthcare practitioners, and healthcare delivery. Reviews were conducted on abstract and full text. Data were extracted on study characteristics, definitions, terminology, theoretical frameworks, and methods.

4 Insights

4.1 Alternative Health Care Practitioners

Alternative health practitioners, such as medical and mental health professionals, are tasked with treating a wide range of mental, emotional, and physiological disorders, although their methods differ significantly from the conventional model. Instead of relying on drugs, alternative medicine practitioners use treatments such as aromatherapy, herbal therapy, and massage therapy to help their patients release tension and endure less discomfort. Alternative care practitioners use a variety of modalities and work in a variety of settings, from clinics and hospitals to a patient's home. An alternative health practitioner can help relieve chronic pain, asthma, and other chronic ailments, such as stress, by utilizing the body's natural healing abilities. Alternative health practitioners offer hope to those who have exhausted their options with conventional medicine. They also provide treatments that are frequently more effective and have fewer negative side effects. Furthermore, by treating the whole person, an alternative healthcare practitioner goes beyond simply treating an illness and instead assists a person in achieving balance and vibrant health. This emphasis on health makes people feel empowered and proactive in taking preventative measures to prevent the onset of chronic diseases. Instead of being a passive recipient of drugs, the patient takes an active role in their own health. Rather than eradicating or suppressing the "bad" factors that cause illness, alternative health practitioners focus on increasing a person's health-promoting forces. They promote health and wellbeing by frequently collaborating with medical doctors to treat specific disorders. The practitioners in

the industry are osteopathy, naturopathic doctor, massage therapist, acupuncturist, chiropractor, reflexologist, homeopath, Ayurveda, reiki practitioner or master, aroma therapist, and prophetic medicine practitioners.

Osteopathy

Osteopathy is a form of alternative medicine that treats and strengthens the whole body, not just injuries, illnesses, and diseases. Osteopaths use their hands and fingers to find problems and exert light pressure and precise positioning in areas that need work. They can identify areas that are not functioning the way they should, disrupted organs that are affecting your overall health, and previously injured areas. Even after just one session, it is common to feel relaxed or at peace.

Naturopathic Doctor

Naturopathic doctors are trained to help people be proactive with their health by helping them make healthy lifestyle choices and adjustments based on their individual situation. Their work is driven by the concept that the whole body must be treated on the road to better health. It is one of the most popular forms of alternative medicine that often helps even the toughest of medical conditions and situations, especially for people with chronic illnesses and pain who have never previously found relief.

Massage Therapist

Massage therapy is a very well-known form of alternative medicine. Many physicians encourage and refer patients to seek this type of treatment because of its many proven benefits. Massage therapists target muscles affected by an injury or medical condition and trigger points that are not necessarily near the affected area but contribute to pain.

Acupuncturist

Acupuncture can be an effective form of alternative medicine for a variety of health problems. The needles are inserted very quickly, and for most people, they barely feel that they are going in. Regardless of belief in the traditional or modern sense, many have benefited from this type of treatment.

Chiropractor

Chiropractors treat certain disorders related to the spine, nerves, and joints. They manipulate or adjust areas causing or contributing to back pain, muscle spasms,

cramping, chronic headaches, and joint problems. By adjusting the joints, they aim to improve joint function and reduce pain and inflammation.

Reflexologist

A reflexologist applies pressure to specific points in the hands, feet, and ears. The points they focus on are believed to be connected with organs and all parts of the body. It is believed that putting pressure on these points or reflexes causes a reaction that helps the flow of energy. It is another style of treatment that is often considered after the patient has tried other treatments and medications without seeing an improvement. Scientific evidence is lacking in regard to reflexology, but there is a reason people take reflexology, recommend it, and even praise it.

Homeopath

Homeopathic doctors take a similar approach as a general physician by getting your medical history and examining your symptoms. The focus of treatment is not to treat or mask a symptom; instead, homeopathy works to address the cause and the principles of the medicine support treating symptoms. Because of how widespread homeopathy is, it is no longer considered an alternative medicine in some European countries.

Ayurveda

One of the oldest forms of holistic and Hindu medicine, Ayurveda, has found its place in Western society and all around the world. The practice involves the impact and interaction of one's body with the five elements–ether, air, fire, water, and earth. Herbs, massage, and diet changes are often part of the treatment plan. Herbs, massage, detoxification, and diet changes are often part of the treatment plan. This could involve changing your diet, where you live, relationships, or even your daily habits.

Reiki Practitioner or Master

Reiki is a natural and spiritual form of healing that makes the patient very relaxed and at peace. It is known to drastically reduce stress, a major factor in draining the body of energy and its ability to heal. Not every city has a Reiki Master, but it is building a larger following as more people seek natural types of treatment. Reiki is a natural and spiritual form of healing that makes the patient very relaxed and at peace. Reiki Masters teaches students to find and leverage their life force energy to improve their health and wellbeing.

Aroma Therapist

An aroma therapist does use essential oils and is highly skilled in applying these oils and creating combinations that may help with the healing process. The idea is that each ingredient carries the life force of what they came from. Essential oils are believed to have the ability to stimulate and strengthen the body's ability to heal itself. Aromatherapy is usually used in combination with other natural medicines. According to the Canadian Federation of Aroma therapists, the certification process consists of lengthy education and testing in anatomy, physiology, essential oils, and aromatherapy. There is also a significant amount of other training and forms of certification available around the world, supporting the notion that aromatherapy is a widespread and popular form of alternative medicine.

Prophetic Medicine Practitioners

In Islam, prophetic medicine is the advice given by the prophet Muhammad with regard to sickness, treatment, and hygiene as found in the hadith. Prophetic medicine is distinct from Islamic medicine, which is a broader category of medical practices rooted in Greek natural philosophy. The literature of prophetic medicine occupies a symbolic role in the elucidation of Islamic identity. In the words of one of the contemporary scholars, Seyyed Hossein Nasr, Ṭibb-un-Nabawī—Prophetic Medicine is: The medicine of the Prophet' is in a sense part and parcel of the Prophetic Sunna with all that this participation implies. No amount of "scientific" detraction from such medical instruction can diminish its significance or efficacy for those who see the Prophet ﷺ as the Perfect Man through whom God revealed His final revelation to the world. Prophetic medicine includes treating patients with ruqyah, hijamah (cupping), black seeds, camel urine and milk, henna, honey, and truffles.

4.2 Global Practices of Alternative Healthcare Delivery

The global complementary and alternative medicine market size was valued at USD 82.27 billion in 2020. It is expected to expand at a compound annual growth rate (CAGR) of 22.03% from 2021 to 2028 (Complementary and Alternative Medicine Market Report, 2021). Government initiatives play a major role in propelling the demand for integrative health and complementary medicine practices by strengthening targeted expenditures, setting up government facilities, and releasing guidelines to ensure appropriate usage of complementary and alternative medicine (CAM). In 2020, direct sales had the highest revenue share of more than 73%. Because of the tremendous growth in medical tourism, treatment provided through direct sales is expected to lead the market in the coming decade. This trend is bolstered by government funding to improve treatment facilities and promote alternative medicine. To expand their businesses, various local acupuncture and Ayurveda practitioners and

entities intend to investigate the direct distribution of complementary medicine as well as alternative therapies.

Furthermore, research focusing on the use of traditional medicines for the treatment of COVID-19 patients is expected to gain traction in the coming years. Government officials around the world are eager to promote traditional alternatives for the treatment of COVID-19 patients; however, it is critical to adhere to the traditional research standards established for all other drug candidates.

This trend has specifically emerged after research studies performed on the potential of different medicinal plants to offer effective treatment to COVID-19 individuals, which is expected to have a positive impact on CAM market growth (Complementary and Alternative Medicine Market Report, 2021). Complementary and alternative medicine varied in use by countries around the world. The variation can be explained by regulation governing the use of CAM (Kemppainen et al., 2018), cultural practices, and some demographic factors. There are differences in the demographic characteristics and health status of users according to recent studies. The use of CAM is greater among those with health problems and more common among women and those with a higher education. For example, females, those in higher socioeconomic groups and those of middle age, have all been found to be more frequent users of CAM (Fjær et al., 2020; Kemppainen et al., 2018). Similarly, the density of doctors, gatekeeping functions of the healthcare system, and the cost of out-of-pocket payments in primary health care are all factors that may influence the prevalence of CAM use at the country level. Table 1 depicts the NCHS Data Report (2018) on the United States population use of CAM among adults.

In addition, there is widespread use of CAM among European countries. In 2020, Europe had the largest share of 33.35% (Complementary and Alternative Medicine Market Report, 2021).

Complementary and alternative medicine has grown in popularity throughout Europe and includes a wide range of procedures that are less reliant on modern medication, such as acupuncture.

Asia and African countries, alternative medicine has been in use for centuries. From 2021 to 2028, the Middle East and Africa are expected to grow at the fastest CAGR of 24.78%. The region has seen a significant increase in the number of practitioners of alternative medicine. Several research studies on the demand for herbal medicines in Middle Eastern countries have been conducted. These studies conduct targeted analyses of factors such as medicinal plant consumption, availability, and

Table 1 NCHS Data Report (2018) on the United States population use of CAM among adults

% of Population		Men	Women	Non-Hispanic White	Non-Hispanic Black	Hispanic
Yoga	14.3	8.6	19.8	12.1	9.3	8.0
Meditation	14.2	11.8	18.3	15.2	13.5	10.9
Chiropractor	10.3	9.4	11.1	12.7	5.5	6.6

affordability across the region, thereby boosting market growth (Complementary and Alternative Medicine Market Report, 2021).

5 Discussion

Despite a large body of literature suggesting methods for improving sustainability in healthcare systems, there is no consensus on feasible strategies for implementing sustainability measures in health care delivery. Healthcare structures contribute to the maintenance and improvement of public health, but their environmental impact can have a negative impact on the wellbeing of humans and other organisms (Capolongo et al., 2015). Western health care is currently dominated by the use of pharmaceutical drugs, and most indicators would suggest that these approaches have had very limited value in dealing with some of the most serious scourges facing human health, such as chronic diseases, psychiatric diseases, and even certain infectious diseases. Pharmaceutical-based approaches to health care do not fare well in terms of cost/benefit, and a paradigm shift is required if mainstream Western health care is to deal with the ever-increasing burden on the healthcare system, especially given that this burden will be exacerbated by an aging population.

The dichotomy between complementary and alternative medicine (CAM) and orthodox/allopathic healthcare approaches has resulted in increased vilification of each approach's protagonists. The use of scientific methods of evaluation that do not lend themselves well to CAM approaches has allowed the "medical establishment" to marginalize CAM approaches. This has occurred although the establishment has made no significant improvements in its offering to the majority of the population, which is either forced or chooses to accept pharmaceutical-based medicine as the most effective and scientifically validated form of medicine. Thus, a paradigm shift is required for all forms of healthcare to be bound by sustainability principles, which is the most certain way of providing a level playing field for all healthcare modalities (Verkerk, 2009). It promotes approaches that are compatible with the complex biological and energetic systems that make up our bodies.

"Think globally, act locally" has never been more important for global population health and wellbeing. Professionals who have dedicated their careers to safeguarding their communities' health are taking the lead in addressing the numerous serious challenges that conventional medicine poses to healthcare delivery. Healthcare professionals innovate on the skills and techniques they will need to adopt and promote socially and environmentally sustainable practices in healthcare settings. As a result, to promote human wellbeing and health, healthcare facilities must be sustainable. Healthcare sustainability strategies, on the other hand, must ensure that the quality of service provided by healthcare structures, as well as access to and affordability of health care, are not jeopardized for both businesses and customers to benefit. As a result, for healthcare institutions, having a multidisciplinary team of practitioners tackling multiple areas of sustainability has become critical.

6 Conclusion

Alternative health care is becoming more popular. Because people's attitudes toward health and health care are changing, so is what is commonly accepted as standard practice. A strong partnership between the patient and doctor is one of the hallmarks of this type of health care to treat not only the body but also the mind, emotions, and spirit. The emphasis in this approach is not only on curing disease but also on preventing it and assisting the patient in achieving an optimal level of health through a variety of means.

Practitioners need to establish strategies for sustainable alternative healthcare delivery due to global awareness and the importance of alternative healthcare delivery to the global healthcare system (Davis et al., 2018). Therefore, practitioners must be sensitive to changes in the healthcare system and new demand in healthcare delivery. Hence, ongoing innovation is required to keep up with the changing and dynamic nature of delivery.

6.1 Implication of Findings and Policy Prescriptions

The critical role of alternative healthcare practitioners in promoting sustainable medical care is critical to ensuring the health and safety of their patients both within and outside of healthcare settings (Corvalan et al., 2020). Leadership begins at the highest levels of the organization by incorporating sustainability into the organization's strategic plans. Human resources must commit to forming teams to educate employees on sustainability practices and ensure that the processes are widely implemented. Alternative healthcare practitioners have a tremendous opportunity to champion the sustainability movement and have a long-term positive impact on the industry as well as the long-term health of their patients, communities, and the world. Industry leaders should strive to make the healthcare delivery system more innovative and sustainable by promoting ethically manufactured and environmentally friendly products and services through policies that promote ethically manufactured and environmentally friendly products and services.

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Chapter 21
Alternative Medicine and Healthcare Delivery: A Narrative Review

Ibrahim Adekunle Oreagba and Kazeem Adeola Oshikoya

1 Introduction

Alternative medicine, also referred to as complementary medicine, is described as a broad set of healthcare practices that are not part of that country's own conventional health practices and are not fully integrated into the conventional healthcare system (WHO, 2019). The definition of complementary and alternative medicine (CAM) varies from country to country as determined by their culture, beliefs, and practices. Paoloni et al. (2022) defined CAM as any practice aimed at achieving healing and wellbeing of humans from any ailment, which has not been scientifically tested and/or verified. For these reasons, they differ completely from conventional pharmaceutical drugs and are not included in the practice of conventional medicine (National Institute of Health, 2005). The World Health Organization (WHO), however, classified CAM under three broad headings (WHO, 2019): *traditional medicine*: "this refers to the knowledge, skill, and practices based on the theories, beliefs, and experiences indigenous to different cultures, whether plausible or otherwise, used in the maintenance of health as well as in the prevention, diagnosis, improvement or treatment of physical and mental illness; *complementary medicine*: this is otherwise called alternative medicine and refers to a broad set of health care practices that are not part of that country's tradition or conventional medicine and are not fully integrated into the dominant healthcare system; it is often used interchangeably with traditional medicine in some countries; and *herbal medicines*: this comprises herbs, herbal materials, herbal preparations, and finished herbal products, that contain as active

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ingredients parts of plants, or other plant materials, or combinations". It is undoubtedly that a given CAM practice in one country may be a conventional medicine in another country. The way traditional medicine systems operate, and their philosophy depends on the prevailing conditions, environment, and geographic area they first evolved from; however, a common philosophy is a holistic approach to life, equilibrium of the mind, body, and the environment, and an emphasis on health rather than disease.

The US National Center on Complementary and Integrative Health (NCCIH) has classified the CAM system into five main groups (NCCIH, 2005): (i) whole medical systems, comprising Chinese medicine, naturopathy, homeopathy, and Ayurveda; (ii) mind–body interventions; (iii) practices based on biology such as traditional Chinese medicine and other nonbiological substances; (iv) manipulative and body-based practices, comprising chiropractic and osteopathic manipulation; and (v) energy medicine such as biofield therapies and bioelectromagnetic-based therapies. The National Federation of Physicians, Surgeons, and Dentists in Italy recognized nine CAM systems, which were considered socially relevant according to the European Parliament and the Council of Europe (Paoloni et al., 2022). The nine recognized CAM systems are (i) acupuncture; (ii) phytotherapy; (iii) anthroposophical medicine; (iv) Ayurvedic medicine; (v) homeopathic medicine; (vi) traditional Chinese medicine; (vii) homotoxicology; (viii) osteopathy; and (ix) chiropractic. These CAM systems are used for diagnostic, therapeutic, and preventive purposes and are used concomitantly with conventional medicines (Paoloni et al., 2022).

It is interesting to note that integrated medicine and health (IMH), which involves combining CAM with conventional medicine when appropriate, is being practiced in most Western countries. In Europe (Fjær et al., 2020), Latin America (Guido et al., 2015), North America (Horrigan et al., 2012; Ng, 2020), and China (Wang & Xiong, 2012), some CAM therapies are being offered in public and private hospitals and are sometimes reimbursed by insurance companies. Some traditional medical schools, including over 75 North American medical institutions in the Academic Consortium for Integrative Medicine and Health, provide education about integrative medicine and therapies (Nielsen et al., 2019). Considering the global spread of CAM use across all age groups and its integration into conventional medicine, it is important to prioritize research on the quality, efficacy, safety, and regulation of this practice.

Worldwide, most ingestible CAMs are categorized as food supplements and products; thus, their regulations may not be as stringent as those for pharmaceuticals (Thakkar et al., 2020). The quality of some CAMs has been doubted, and their safety has not been scientifically evaluated in most cases (Barnes, 2003). Various CAM researchers and expert opinion leaders (Thakkar et al., 2020) have expressed concerns over the quality, efficacy, safety, and regulation of CAMs, which have not been well addressed in the literature. The National Center for Complementary and Integrative Health (NCCIH) and other National Institute of Health (NIH) offices, such as the National Cancer Institute in the US, are funding some CAM research with priorities on quality, efficacy, and safety. Findings from such works would guide CAM consumers to make an informed choice.

Previous WHO global surveys have indicated a considerable challenge for most member states in traditional medicine as a lack of adequate technical guidance on research and evaluation of the quality, efficacy, and safety of CAM treatments (WHO, 2000, 2019). The increasing demand for research guidance was also propelled by the adoption of the 2009 World Health Assembly resolution (WHA62.13), which encourages the appropriate development of traditional medical systems to harness their therapeutic benefits (WHO, 2020). However, inadequate evidence supporting the safety and efficacy of traditional Chinese medicines has led to the formal recognition of these therapies, thus limiting their incorporation into the revised WHO International Code of Disease (WHO-ICD) (WHO, 2020). This paper, therefore, reviewed the quality, efficacy, and safety of CAMs from global perspectives to guide users in making informed choices. Furthermore, the paper highlights the role of CAM in healthcare delivery, its entrepreneurship prospects, and its implementation in the digital age.

2 Literature Review

2.1 Quality of Complementary and Alternative Medicines

The quality of herbal products and supplements in the market is generally not an issue compared to conventional medicines. However, more concerns are now arising for some complementary medicines due to the increasing spate of reported adverse toxicity. In the UK, for instance, manufacturers of licenced conventional and complementary medicines are required to demonstrate to the Medicines Control Agency that their products are compliant with the standards for pharmaceutical quality, safety, and efficacy (Barnes, 2003). This would suggest that complementary medicines are manufactured in accordance with the guidelines of good medical practice (EMA, 2021). In contrast, Australian law requires that a complementary medicine be assessed for safety and quality of its constituents but not efficacy (Thakkar et al., 2020).

The WHO and the European Medicines Agency (EMA) emphasize the quality aspects of medicinal products from natural herbs that are on the market, excluding those that contain chemically isolated ingredients or mixtures (WHO, 2019; EMA, 2021). The reliability of the plant identity, authentication for quality, preparation, labeling, and how it should be prepared as an herbal material are ensured in the WHO and EMA guidance documents (WHO, 2000; EMA, 2021). In the preparation of herbal materials for manufacturing, the guidance documents also define qualitative and quantitative specifications of active ingredients, a description of the method of preparation, control tests of starting materials, manufacturing, and stability tests. The issue surrounding quality assurance or quality evaluation in CAM therapy is limited to herbal medicine and products. It, however, varies from one country to another. For instance, in Thailand, Indonesia, and India, good manufacturing practice regulations for CAM medicines are at variant from those for conventional medicines. The

manufacturing site is often inspected regularly, and government-authorized laboratory tests for safety and toxicity are required for product registration (WHO, 2019). In contrast, Sri Lanka, the Republic of Korea, Myanmar, and Nepal ensure the same registration processes for both herbal medicines or products and pharmaceuticals (WHO, 2019). However, some countries, such as Nepal, have yet to follow good manufacturing practices for herbal products.

2.2 Efficacy of Complementary and Alternative Medicines

Randomized controlled trial outcomes are considered the strongest evidence for safe clinical uses and efficacy of CAM. Further evidence establishing the physiologic mechanisms of action of CAM, such as modification of gamma-aminobutyric acid (GABA) activity in the brain by valerian, provides weak or no evidence of efficacy on clinical outcomes. The use of CAM over long periods of time provided only self-rated evidence of efficacy, which is considered to be lower quality evidence. These three types of research outcomes supporting CAM efficacy are recognized by the National Center on Complementary and Integrative Health (NCCIH, 2005).

Peer-reviewed journals, systematic and meta-analysis reviews, expert panel consensus documents, and reliable textbooks are replete with CAM information; much of it has been published in English and other languages (National Institute of Health, 2005a). Among the numerous CAM therapies that have been studied, many are found to be effective and/or comparable to conventional treatment. In contrast, some were ineffective or yielded conflicting and inconsistent results (Ventola, 2010). Some CAM therapies have not been tested in definitive randomized controlled trials. Many factors have been reported to limit the study of CAM efficacy, including a large number of variables being investigated in CAM studies involving holistic or whole systems and modalities, which may be partially or totally uncontrolled, limited funding for research in CAM therapies due to their low cost and inadequate reimbursement; CAM products and therapies regulations do not require proven disease-specific efficacy. The Food and Drug Administration (FDA), in accordance with the Dietary Supplement Health and Education Act (DSHEA) of 1994, allows marketing of dietary supplements and use of CAM products and devices with great restriction on efficacy claims (Dwyer et al., 2018). This suggests that manufacturers of dietary supplements and CAM products can generally claim, without providing evidence for safety or efficacy to the FDA, benefit to the structure or function of the body, such as improvement in general wellbeing or specific-organ health. However, such claims cannot be used to treat specific diseases, such as hypertension, diabetes, and dyslipidemia. Recently, the FDA announced its determination to stiffen DSHEA and the regulation of CAM products and dietary supplements, particularly on issues relating to safety and efficacy claims (FDA, 2016).

Herbal medicinal products are an integral part of CAM, as patients, the public, the media, and many other groups consider their use to be different from conventional treatment. The pharmacological activity and clinical efficacy of some herbal

medicinal products have been proven, and their use is widely accepted alongside conventional medicines. Standardized Senna preparations are used as a laxative and are considered conventional medicines (Aronson, 2016). Some western countries, such as Germany, have established the use of plant herbs as an art of science (Schulz et al., 2000). Their herbal medicinal products, otherwise called phytomedicines or phytotherapeutic agents, are prescribed in an evidence-based practice to promote rational phytotherapy. This practice of herbal medicine use contrasts with traditional herbal medicine (THM) and other traditional systems of health care, including Ayurvedic, African, and Chinese medicines used across Europe, North America, and developing African countries, which often involve the use of herbs that have not been rigorously investigated scientifically in humans.

It is quite challenging to design studies investigating the efficacy of CAM therapies beyond those faced with conventional therapies. CAM therapies may be unstandardized, as evidenced by the availability of different systems of acupuncture and variation in the contents and biologic activity of extracts from the same plant species. Unstandardized diagnoses can impact CAM efficacy. For instance, many CAM therapies, including THM, homeopathy, and acupuncture, based their diagnoses on the unique characteristics or experiences of the patients, in contrast to the evidence-based diagnoses deployed in conventional medicine (Tabish, 2008). CAM treatments are often administered, irrespective of the clinical status of a patient. Invariably, CAM treatments often include patients who may be excluded from randomized controlled trials in conventional medicine because of comorbidities. It is almost impossible to double- or single-blind a patient in the efficacy study of CAMs. Reiki practitioners, for instance, cannot be blinded as to whether they are using energy healing (Bowden et al., 2011). Standardizing outcomes may not be easy in CAM studies due to outcome specificity to individuals or focusing on general health rather than focusing on objective and uniform measurements. It may also be difficult to design placebos or control interventions for CAM devices and/or therapies. For instance, in massage therapy, the effectiveness of the therapy may be the touch, the specific body part massaged, the specific massage technique used, or time spent on the patient.

Despite the challenges enumerated above, many high-quality studies of CAM efficacy have been successfully designed and conducted. A systematic review of studies evaluating control acupuncture processes and devices showed that using carefully designed placebos, the effects of some CAM therapies on the overall clinical response can be determined (Zhang et al., 2015). Further evidence supporting the efficacy of CAM is shown by some outcomes that some CAMs are more efficacious than placebo or noninferior to conventional treatments (Tabish, 2008). Other high-quality evidence for the efficacy and safety of interventions integrating CAM and conventional medicine treatments into IMH therapies has been reported (Ventola, 2010; National Institute of Health, 2005b). The WHO considers well-established, randomized controlled clinical trials as the highest level of evidence for efficacy in its guidelines (WHO, 2000). Clinical studies are therefore required to justify the efficacy of herbal ingredients proclaimed to have health benefits to facilitate their acceptance as herbal medicines across different regions and cultures.

2.3 Safety of Complementary and Alternative Medicines

Randomized controlled trials to assess the safety of most CAM therapies have not been extensively conducted, yet many of these therapies are claimed to have a good safety record. Many CAM therapies involving nontoxic botanicals, mind–body techniques such as meditation and yoga, and body-based practices such as massage have been used for ages with almost no evidence of harm or are not potentially harmful. However, there are some safety concerns for herbal medicine products and the use of an alternative approach to treat life-threatening conditions, such as meningitis, cancer, pneumonia, and sepsis, that can be effectively treated with conventional medicines. This poses the greatest risk to alternative medicine, notwithstanding the risk of direct harm from the specific therapy used.

Safety data of CAM use in humans obtained from sub-Saharan African countries were self-reported or observational adverse effects and may not be totally reliable (James et al., 2018). However, toxicity from certain botanical or supplement preparations has been reported (Hudson et al., 2018). Many popular medicinal plants have demonstrated toxicity in experimental and observational studies. For instance, *Lantana camara* for treating malaria and other diseases has been associated with hepatotoxicity in several animal species, which heightens the concern for chronic use in humans (Sharma et al., 2007). Another antimalarial and antidiabetic plant, *Momordica charantia*, which is commonly used in Ghana (Komlaga et al., 2015; Van Andel et al., 2012), has resulted in fatal hypoglycemia in children (Raman & Lau, 1996). Similarly, hepatotoxicity has resulted from herbal medicinal products containing pyrrolizidine alkaloids (Neuman et al., 2015), rhizome of *Atractylis gummifera* (Bouziri et al., 2010), chaparral (LiverTox., 2017), germander (Goksu et al., 2012), greater Celandine (*Chelidonium majus L.*) (Pantano et al., 2017), Jin Bu Huan Chinese herb (LiverTox, 2018), kava (Teschke, 2010), and pennyroyal oil (LiverTox, 2020). Nephrotoxicity has been reported following the use of herbal products containing aristolochic acid, even in small amounts (Upton & Romm, 2010). Ephedra is a component of the Chinese herb ma huang and herbal supplements constituting approximately 1% of herbal products in the US market (Bent et al., 2003). Palpitations, heart attacks, strokes, seizures, and sudden deaths have been reported following the use of ephedra supplements (Bent et al., 2003). It is also responsible for 62% of herb-related reports to poison-control centers in the US (Summaries for Patients, 2003).

The supposedly poisonous plants are well known in THM, and their toxic constituents are avoided or used cautiously in herbal supplements. Even when constituted into medicinal products, their presence is below toxic levels and rarely results in any fatality when administered appropriately. However, surreptitious constitution of high toxic levels of the poisonous plant may occur in herbal supplements since rigorous premarketing evaluation of food and herbal supplements is often not conducted globally. A ban on herbal supplements containing poisonous plants has been implemented in many western countries (Allen et al., 2014; Colombo et al., 2020). The FDA issued a consumer advisory in 2020 warning the public about the

potential toxicity of some herbal supplements (FDA, 2020). However, many of the herbal supplements banned in the US and Europe are still abounding in the Asian market (NCCIH, 2022; Colombo et al., 2020).

Contamination of African herbal concoction, Chinese and Ayurvedic herbal preparations with heavy metals and bacteria (Ernst & Thompson-Coon, 2002; Kalumbi et al., 2020; Luo et al., 2021) or contamination of Chinese herbs, African herbal concoction, and spiritual water with other drugs have been reported (Snyman et al., 2005; Mingzhe et al., 2019; Keshari, 2021). This can therefore compromise the safety of such CAM therapy. Potential interactions between CAM therapies, such as botanicals, micronutrients, some dietary supplements, and St. John's wort, a cytochrome P450 inducer, has been reported to reduce the activity of antiretrovirals and immunosuppressant drugs (De Maat et al., 2001; Bordes et al., 2020). The interaction may be clinically significant when the drug has a narrow therapeutic index.

Physical manipulation of the body can result in injury such as nerve or cord damage due to spinal manipulation when the patients are at risk, while bruising may occur in patients with bleeding disorders (Ayoubi et al., 2020; Forsyth et al., 2020). To avert injuries due to physical manipulations, patients should patronize formally trained and professionally licenced practitioners. Complications are less common with qualified chiropractors and acupuncturists.

To mitigate the adverse effects of herbal supplements containing aristolochic acid, plants similar to aristolochia are subjected to systematic analysis at the point of importation before they are cleared for domestic use in the US (Romm, 2009). Traditional herbal medicine practitioners should be vigilant about herbal products and supplements that are likely to be tainted with aristolochic acid plant parts, thus ensuring that prescribed products are well controlled to avoid adulterants. Furthermore, alerts about harmful dietary supplements are available at the FDA safety alerts and advisories website (https://www.fda.gov/food/recalls-outbreaks-emergencies/alerts-advisories-safety-information). In the past, the FDA did not stringently regulate the production of dietary supplements. Consequently, some dietary and herbal supplements were adulterated by dilution or contamination. For instance, a study reported that 32% of botanical supplements were short of the main active ingredient on the label, and 20% contained contaminants, which were physiologically active compounds aside from the expected ingredients or the labelled constituents (Newmaster et al., 2013). Another 21% of the botanical supplements contained fillers that were not listed on the label (Newmaster et al., 2013). FDA regulations, however, are now stricter and require compliance with good manufacturing practices to achieve improved quality and safety of supplements (FDA, 2016).

2.4 Regulation of Complementary and Alternative Medicines

Globally, particularly in many African and Asian countries, CAM practice is rendered outside the national healthcare systems mostly by nonregulated individuals. It is therefore likely that the practice is not rigorously monitored by government through

legislative safety mechanisms and reporting systems compared to conventional medical systems. Even those CAM practices and products that are regulated in resource-limited countries rarely have adequate structures in place for monitoring, assessing, reporting, and punishing erring individuals who have perpetrated harmful practices (Sharad et al., 2011). In a setting where CAM has been integrated into conventional medicine, conventional healthcare practitioners may not have good knowledge of CAM products or therapies (Valli & Giardina, 2002) and may also be unaware that their patients are seeking CAM providers or using CAM products (Eisenberg et al., 1998). Although some countries have national pharmacovigilance systems and the capacity to gather information about CAM-related adverse effects, only a few patients or CAM practitioners are aware of this, leading to underreporting (Perez-Garcia & Figueras, 2011). Dietary supplements, including herbal medicinal products, are manufactured, sold, and marketed in the US without necessarily demonstrating their safety and efficacy, as required for conventional drugs (FDA, 2017). The FDA is, however, required to monitor the toxicity of dietary supplements for them to be withdrawn from the market. Therefore, dietary supplements are primarily regulated through postmarket surveillance, and if found unsafe, approval can be withdrawn (FDA, 2017). Most natural products in Canada are classified as a subclass of medicine called natural health products (NHPs) and are being regulated by Health Canada. NHPs are regulated under the Natural Health Products Regulations (NHPR) enacted in 2004 (Health Canada, 2016).

3 Discussion

3.1 Role of CAM in the Healthcare Delivery System

The role of CAM in the healthcare system cannot be overemphasized. This is quite evident in the prevalence of CAM use by virtually every stratum of the community. Approximately 80% of the population internationally uses natural products (Ekor, 2014), which is an increase of up to 95% in developing countries (Robinson & Zhang, 2011a, 2011b). However, the frequency of CAM is different between countries, and it varies from 5% to 74.8% in the general population. (Frass et al., 2012). For example, in a Nigerian urban community study, approximately two-thirds of the respondents used CAM (Oreagba et al., 2011), while they were sold freely in herbal shops and community pharmacies (Oshikoya et al., 2013). We have also studied the important role of herbal products in specific infectious disease conditions, such as malaria (Ishola et al., 2014), typhoid fever (Oreagba et al., 2011), and HIV (Oshikoya et al, 2014). Factors driving CAM use include other treatments not being helpful, concerns or experiences of adverse effects of conventional medicine treatments, and prolonged conditions (Abolhassani et al. 2012, Sharples et al., 2003). Additionally, it has been seen that patients who seek unconventional methods of complementary and alternative medicine are mostly those with chronic diseases, with the most frequent

use in musculoskeletal disorders such as back pain, depression and anxiety, diabetes mellitus, and cancer (Frass et al., 2012; Abolhassani, 2012; Adib-Hajbaghery et al., 2014; Ernst & Cassileth, 1998). The role of CAM in the provision of primary health care is highlighted in some sub-Saharan African countries' health policy documents within the context of limited access to essential health services, especially among the rural poor. (Campbell-Hall et al, 2010; Sambo, 2011).

Considering the high utilization of CAM across sub-Saharan Africa, it is necessary for policy decision makers, researchers, and health professionals to recognize CAM healthcare practices as integral to the health-seeking of populations and develop an effective response that safeguards their health and wellbeing. A proper policy and practice response to increasing CAM use requires an in-depth insight into the nature of CAM use, including the profile of CAM users as well as the drivers and barriers that facilitate and limit the use of CAM. In response to this, the WHO recognition of CAM and the Africa regional strategy on CAM led to policy formation in 36 countries and research promotion, including the establishment of CAM research centers in some countries such as Nigeria, Ghana, and South Africa. This regional plan has also promoted the inclusion of CAM courses into the curricula of healthcare training institutions in countries across the continent. (Chitindingu et al, 2014). It has also promoted the training of CAM practitioners and the local production and cultivation of medicinal plants, as well as the establishment of intellectual property rights for traditional medicine knowledge in a few nations. (Kasilo et al, 2010). Despite these significant landmarks, the development and implementation of a CAM policy across Africa remains elusive; furthermore, there is inadequate CAM research infrastructure and insufficient regulation of CAM products and practices. (Kasilo et al, 2010).

3.2 Entrepreneurial Prospects for Complementary and Alternative Medicines

The desire for health and wellbeing is driving the rapid growth of the complementary and alternative medicine (CAM) industry and points to a new role for healthcare professionals, including business opportunities for medical groups. CAM represents the opportunity to grow the revenue of outfits, expands the tool kit for assisting patients with healthcare issues, and increases market share by proactively responding to consumers. (Hofgard & Zipin, 1999). The recognition and popularity of CAM has dramatically increased in many developed countries since the 1990s. This could be attributed to the aging of the population, prevalence of chronic diseases, and concern about the adverse reactions to chemical drugs. All these aspects have contributed greatly to the worldwide popularity of CAM. In the United States, consumers spend over $34 billion per year on CAM therapies spent outside the conventional healthcare financing system. This out-of-pocket expenditure is evidence of the fact that CAM therapies have benefits that outweigh their costs. In Canada, CAM are often employed when conventional healthcare costs are too high for the patient. Additionally, CAM

and genetic testing are seen as the moneymakers driving private medical clinics given that innovation and expansion in health care is usually driven by profit. Many people desire CAM, so its provision and products can comprise a lucrative business, often with low-service delivery costs. For this reason, there is notable current consumer and government interest regarding whether CAM may save money compared to the costs of conventional health care. Further research of CAM should include the cost benefits of the delivery of CAM, costs of the harms from conventional health care and the combinations of drugs people use alongside CAM. (James et al, 2018).

3.3 Complementary and Alternative Medicine in The Digital Age

The Internet has rapidly changed the way health care-related products and services are marketed directly to consumers. CAM products and service providers are prime examples of direct-to-consumer healthcare marketing via the worldwide web. This may lead to possible harmful outcomes from inappropriate use of CAM With the high prevalence of CAM use in the population, there is equally an abundance of online resources available on the internet. Some of the online resources may require subscriptions, while the majority are freely accessible to the public online. With such easily accessible information, the consequence is the ease at which false, misleading, or inaccurate information can be disseminated to the public. This elicits several concerns for the safety and wellbeing of consumers, especially amidst the tendency for patients to trust health information found on the Internet (Sbaffi & Rowley, 2017; Vega et al., 2011), as well as perceive CAM as safe, thus, not feeling the need to take necessary precaution (NCCHI 2020). In addition, healthcare providers and researchers may use these online resources to gather information about CAM treatment choices and management plans for patients. There is therefore a need for a thorough assessment of the quality of content for these online resources. The study by Ng. Jeremy et al. (2020) provide a comprehensive list of web-based online resources containing CAM-specific information that are readily available on the internet. Furthermore, the study uses a special evaluation instrument (Charnock et al., 1999) to provide an overview of the content quality of these online resources. The findings from these quality assessments can benefit healthcare providers, researchers, and patients in selecting suitable web-based resources to obtain high-quality, evidence-based CAM information.

4 Conclusion

The use of CAM therapies and products has exponentially increased globally. Many patronize them in developing countries, mostly due to cultural acceptability, availability, and cost. In contrast, they are used in developed countries because they are natural and perceived to be safer than conventional medicines. There has been a growing concern about the quality, efficacy, safety, and regulation of CAM therapies and products coupled with their ever-increasing role in healthcare delivery. While various attempts continue to establish the efficacy and safety of various CAM therapies and products in humans, their quality assurance and regulations are not reassuring, particularly in developing countries where availability and access to quality health care are poor. Although there is subtle evidence supporting the quality, efficacy, and safety of CAMs, much of the evidence is inconsistent due to the varied CAM types and regulatory policies from country to country. CAM therapies and products require cautious and responsible use globally. To address these long-standing concerns about the safety of CAM from a digital perspective, recommended online portals provide healthcare professionals, researchers, and patients with a list of resources evaluated for quality, which could be used to compile comprehensive and evidence-based information about interactions or adverse effects associated with CAM.

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Chapter 22
Digital Innovation in Healthcare Entrepreneurship

Ramat Mohammed-Nasir, Kazeem Adeola Oshikoya, and Ibrahim Adekunle Oreagba

1 Introduction

The COVID-19 pandemic that started towards the end of 2019 shattered the global economy, causing the worst recession that could result in digital entrepreneurship in the healthcare system (Shamsrizi et al., 2021). Entrepreneurship is the activity of setting up a business or businesses and taking on financial risks with the sole aim of making profits (Gohmann, 2012). It can be simply described as self-employment. Digital entrepreneurship, on the other hand, is described as entrepreneurial pursuits occurring on a digital platform (Giones & Brem, 2017). Digital entrepreneurship is, therefore, defined as the potential entrepreneurial gains that can be designed, chased, and achieved through the deployment of technological media and other information communicating systems (Giones & Brem, 2017; Davidson & Vaast, 2010). It is, therefore, unarguable that digital entrepreneurship plays a significant role in many forms of business (Gohmann, 2012; Richter et al., 2017). The prospect of digital entrepreneurship is dependent on digital media tools and information technology (IT) (Giones & Brem, 2017). The ability to digitalize a business asset, a service performed by a business or the core elements of a business contributes to the birth of digital entrepreneurship (Kraus et al., 2019a, 2019b).

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Advances in technological development are ever increasing at all times, and digital entrepreneurs are quite aware of the potential opportunities the growth can generate (Richter et al., 2017). To key into these opportunities, many entrepreneurs are beginning to transform their businesses digitally. Digital transformation would involve redesigning business practices to accommodate digital technology in all aspects of the business (Bounfour, 2016). More opportunities are, therefore, available to digital entrepreneurs through the use of digital networking. Such opportunities include the ability to respond to messages and offer constructive criticism and suggestions to a business (Kraus et al., 2019a).

It is unarguable that digitalized businesses are leveraging technology to create economic and social benefits across various fields of human endeavour. Digital innovation makes it possible for businesses to improve their existing products and processes or to create new products entirely. Most Western countries, such as the United States, United Kingdom, Russia, Germany, Japan, and China, are world economy leaders due to their organized deployment of technology, innovation, and entrepreneurship (UNCTAD, 2021). For instance, in the global economy propelled by networking and digital technologies, many businesses are becoming smaller, with only one individual partnering with many people abroad. Innovative digital technologies, such as social media, big data, and mobile and cloud solutions, are paving the way for new collaborative methods, leveraging resources, product and service design, development and deployment over open standard's, and shared technologies (Markus & Loebbecke, 2013). Invariably, they influence business activities through opportunities for employment generation. For instance, Amazon.com (https://www.amazon.com/) is an American multinational technology company that focuses on e-commerce, cloud computing, digital streaming, and artificial intelligence (Zangoei, 2016). It has enabled millions of people around the world to become entrepreneurs who are also responsible for creating employment.

Despite the benefits and challenges facing digital entrepreneurship, research in this field is limited. In a recent review, only a few articles were identified on this topic (Kraus et al., 2019a, 2019b). Digital medicine has been defined as technology-based products that have a direct impact on diagnosing, preventing, monitoring or treating a disease, condition or syndrome (Steinberg et al., 2015). Digital medicine companies are incorporating and building on existing business models in technology and biomedicine to bring transformational new products to the business world and eventually reshaping medicine. Several opportunities have with digital medicine, and many more are still evolving. For instance, the evolution of the technology sector has revolutionized the old, familiar and conventional business models, thus opening up more important new avenues for innovation in medicine. The new approaches have enabled fast and seamless data gathering for health and disease, at high volume, for low cost, which are collected and delivered in real time by means of abundant devices, sensors, and applications (Steinberg et al., 2015). The implications of many of these factors are readily apparent in clinical practice. For example, telemetry medicine has reduced the need for office visits, while a few other merits are being further explored (Antonicelli et al., 2008). Another innovative development in healthcare delivery is in the area of bioinformatics, which has emerged as a new field in health informatics.

It has supported the emergence and continuous developments in molecular biology (Wulfovich & Meyers, 2020) and clinical research in precision medicine (Van Driest et al., 2014). Notwithstanding, further evolution of the field of health informatics has been reflected in the introduction of new concepts such as electronic health records (EHRs), data standards, and public health informatics at the national health systems delivery level (Zajicek & Meyers, 2018). These changes are beginning to shape health services in this twenty-first century.

Despite the successes thus far achieved by digital entrepreneurship innovation in health, acceptability and implementation of this concept may vary from one country to another, particularly in developing countries (Hassibian & Hassibian, 2016), while exorbitant cost and lack of infrastructure may be major challenges for take-off in some countries, such as sub-Saharan African countries (Cunningham et al., 2016; Safi et al., 2018). This paper, therefore, generally aimed to explore the impact of digital technologies on healthcare entrepreneurship and, specifically, to summarize the extent to which digital technologies have recently innovated the healthcare system from the viewpoints of three major stakeholders: clinicians, patients, and researchers. We also discussed the challenges, drawbacks, and limitations facing digital technology in health care.

2 Advances in Healthcare Innovation and Digital Health Entrepreneurship

In 2001, the National Academy of Medicine (NAM) in the United States recognized information technology (IT) as a potential means of promoting, providing and achieving safe, effective, patient-centred, timely, efficient, and equitable health care (United Nations, 2018). The committee of this noble Academy was hopeful that IT in health care would immensely transform the health system. It is heartwarming to note that over the past two decades, this prediction has come to the past as unprecedented technological advances in health care have evolved and are still evolving while pushing back the boundaries of diseases (Topol, 2012). This digital revolution has brought new, previously unimagined systems and solutions to being and into limelight. For instance, digital technologies have aided rapid tests of diabetes, HIV, and malaria instead of sending samples to a laboratory. 3-D printing has revolutionized the manufacture of medical devices, orthotics, and prosthetics. Digital imaging has improved the quality of radiographic imaging and allows electronic reporting on the spot or remotely (van der Stelt, 2008). Telemedicine, remote care, and mobile health (m-health) have helped transform health care by delivering patient care at homes and strengthening care in hospitals, homecare, and clinics (Gajarawala & Pelkowski, 2021). Artificial intelligence (AI) is being used to improve the mobility of paraplegic patients and to develop new drugs (Drew, 2022; Grimm et al., 2021). Machine learning is helpful in predicting disease outbreaks and in optimizing healthcare services (Syrowatka et al., 2021).

The global prevalence of mobile phones and digital technologies has revolutionized the approach to managing our personal health. Health information now abounds on the internet, many of which may be correct or incorrect. Patients now Google their symptoms seamlessly and self-diagnose their ailments before presenting to a doctor's office. Digital technologies are also used to enhance the training and performance of healthcare workers and to address numerous lapses in healthcare systems. NEJM Catalyst was birthed in 2015 by the New England Journal of Medicine (NEJM) Group as a resource for clinical decision-making and policy-makers as well as healthcare leaders seeking to transform the healthcare system through innovation (Lee et al., 2015). This resource tends to provide valuable perceptions on the need for changes in healthcare systems, types of effective innovations that are trending, and how the changes have been implemented in various organizations. These are achieved via case studies, live and webcast meetings, videos and podcasts of talks and discussions by renowned leaders, and other approaches to provide perception into the most challenging health problems faced by healthcare organizations.

In the context of business and entrepreneurship, innovation refers to both new ideas and the application of such ideas to solve an existing or unresolved problem (Maranville, 1992). Innovation can, therefore, be viewed as a wide range of activities planned to originate or invent and enhance ways of solving problems, the entire processes involved, and the results. Consequently, it is conceivable that the healthcare system and industries dedicated to regularly enhancing the quality, value, delivery, and general well-being of the entire population would embrace innovations. An opinion survey of healthcare leaders in the United States in 2017 identified hospitals and health systems, IT in the healthcare system, and primary care as the key areas needing innovations (Dafny & Mohta, 2017). The respondents unequivocally believed that innovations are key to improving health care and that innovative changes are likely driven by factors outside the health system (Dafny & Mohta, 2017). Healthcare chief executive officers, hospital administrators, and doctors all were of the opinion that critical change for hospitals and health systems in general and in health IT in particular would likely emerge from the centre point of kick-off, which is beneficial to digital health entrepreneurs.

Despite the opportunities, benefits, and high embracement of innovation in health entrepreneurship, the process is often complex (Lipsitz, 2012; Rouse, 2008; Plsek & Greenhalgh, 2021). Such systems are not straightforward, vigorous, and characteristically disordered, with emergent problems and unexpected outcomes (Rouse, 2008). Consequently, innovation in a specific area of health care is a potential source of unanticipated problems in other areas.

Watcher (2017) investigated digital technology innovations that have changed medical practice in the United States and noted that digital imaging began in the United States in 2000; its acceptability and use have increased from 8% in hospitals to over 75% in hospitals in 2008. Electronic health records (EHRs) and computerized prescribing started rather late compared to digital imaging in the United States. Both innovations were faced with complex problems, many of which have not been fully resolved. It is expected that digital prescribing would make prescription reading seamless for pharmacists, but unfortunately, it was reported that a serious digital

prescribing error was perpetrated despite an automated, error-checked steps inbuilt in the electronic prescription and dispensing system. The error involved a 16-year-old patient being given an overdose of sulfamethoxazole-trimethoprim that was almost 38 times higher than one tablet that should have been administered. Consequently, the patient developed a serious adverse effect manifesting as a seizure lasting 6 h to control, and the patient required intensive care unit admission for several days to recover fully. Awareness of such risk has led to obvious hesitancy among healthcare workers to adopt unproven solutions. Watcher (2017) therefore advised caution against the imperceptive trust of digital technology.

Another limitation to adopting new innovation in health entrepreneurship is the reluctance to change, which may be due to a complex adaptive system or innovation fatigue among end-users (Christiansen et al., 2017). In an observational study of the allocation of physician time in ambulatory practice performed by Sinsky et al. (2016), it was reported that for each hour physicians spent providing direct clinical care to patients, they spent an additional 2 h to do administrative work electronically within the clinic and outside office hours. However, with great technology, providers may remain reluctant to be burdened without concrete reasons. Thus, without overwhelming evidence of impact and worth, innovative digital health solutions may never be adopted at all.

3 The Impacts of Digital Technologies on Healthcare Innovation

Digital technologies are electronic tools, systems, devices, and resources that generate, store or process data (Khin & Ho, 2020). They include social media, the internet, multimedia, and mobile phones. These resources are now an essential part of health care and revolutionising the practice of medicine globally. They have significantly improved operational efficiency with regard to the quality of medical care. The innovative changes have significantly enhanced the general understanding of both healthcare workers and patients. For instance, in the twenty-first century, Australia has adopted My Health Record (MyHRC), an innovative digital technology in health care, to improve healthcare services for clinicians and other health professionals and to empower consumers in providing positive health management experience with a patient-centred approach (Medhekar, & Nguyen, 2020).

Notable areas where digital technologies have enormously impacted health care are discussed below:

3.1 Electronic Health (eHealth)

eHealth encompasses the use of modern electronic information and communication technologies (ICT) to deliver quality health care without healthcare providers and patients having direct contact with each other, but they interface via electronic means (Trent, 2012). The services that can be provided by eHealth include electronic health records (EHRs), physical and psychological diagnosis and treatment, telemedicine, vital sign monitoring, electronic prescribing (ePrescription), and teleconsultation (eConsultation).

Computers are now essential components of most medical practices. Electronic capturing and recording of patient information affords one the opportunity to generate ePrescriptions, which have many benefits, such as links to software that identifies medication errors and highlights risks from drugs or risks for potential drug–drug interactions (Porterfield et al., 2014). Bioinformatics is known to play a leading role in clinical research that involves the applications of molecular medicine and pharmacogenomics in achieving precision dosing of drugs (Trent, 2012). In a similar vein, *e*Health drives can lead the way in translating molecular medicine into clinical practice.

PediDraw, a web-based tool for drawing a pedigree in genetic counselling, and other software programs enable documentation of the family history of a patient as well as aid collection of genetic resources for medical research (He & Li, 2007). Computer-generated algorithms are useful for clinically actionable *decisions in* genomic research and allow the implementation of such discoveries in clinical practice (Van Driest et al., 2014).

The application of eHealth technologies for the management of various chronic diseases, such as asthma and allergic conditions and cancer, is abounding in the literature (Alvarez-Perea et al., 2021; Lewis et al., 2016). Clinicians and patients now communicate effectively via ICT media, which are cost-effective for preventing, controlling, and treating chronic diseases as well improving the quality of life of the affected patients (Marcano Belisario et al., 2013). Despite these success stories, many aspects of eHealth remain uncertain and are being further investigated. In these instances, study evidence is scant, of lower quality, or inconsistent (Matricardi et al., 2020). The eHealth has also availed academic researchers the opportunity to compile previously scarce or unavailable data and allowed their analyses with novel tools, otherwise known as "big data." The role of eHealth became more appreciated during the emergence of COVID-19 in late 2019, which ushered in physical distancing rules and movement restrictions all over the world.

3.2 Improved Storage and Access to Medical Information and Data

One of the greatest benefits of the digital revolution has been the ability to store and access data. Healthcare professionals can now retrieve patient data from anywhere globally very rapidly. Additionally, the intranet and internet have enabled healthcare professionals to share medical information rapidly with each other, thus allowing them to take expert opinions that would result in more efficient patient care, especially in emergency cases. The electronic storage, access, and sharing of medical data through personal devices or systems of clinical electronic patient records support current developments in record-keeping and communication between patients and health professionals (Schwartz et al., 2014). Portable data storing devices or services are now abounding in the market. They include health identity cards, tags, badges, wristbands, and wrist watches, which are capable of storing and allowing access to health information of individuals wearing them. Information that they store may include personal details such as name, address, blood group, genotype, allergies, present health conditions, and medical history (Patil et al., 2016). These devices or services are readily available in the market for purchase. They enable doctors to be aware of any existing medical conditions, such as food or drug allergies. They can also enable authorities to identify one and respond faster during medical emergencies locally or when travelling abroad. However, if such devices are accessed by an authorized person, personal information may be misused, and one's privacy may be violated and compromised.

3.3 Big Data

Data analysis in health, especially in the setting of public health, refers to data transformation for the main reason of gathering evidence and knowledge to guide decision- and policy-makers on health issues. "Big data" largely refers to large and complex data sets that are tremendously more difficult to process and analyse than traditional data (Dash et al., 2019). Large and unmanageable data sets often require databases for storage and state-of-the-art analytical methods. Based on the enormity and complexity of the data sets, they are distinctively described as big data (Dash et al., 2019). Data with large volume often have varied content and require higher speed to generate and process than required in a typical traditional software system.

Other researchers have defined big data using "the 3 Vs," vis-a-viz *variety* (refers to the linking of many data sets from heterogeneous independent sources in a single data set); *volume* (refers to a large number of observations and variables per observation from different sources); and/or *velocity* (refers to real-time or frequent data updates, which may be fully or partially automated) (Psaty & Breckenridge, 2014). Other definitions have expanded the scope to include three additional Vs: *value* (referring to

clinically relevant information); *variability* (for instance, seasonal or secular disease trends); and *veracity* (referring to data quality) (Baro et al., 2015).

Big data, in the healthcare system and industry, are usually generated from hospital records, medical records of patients, the results of laboratory and other diagnostic investigations, the results of clinical examinations, and electronic devices used for patient monitoring and diagnosis (Luo et al., 2016; Zillner & Neururer, 2016). They can also be generated from biomedical research, particularly those that are relevant to public health care (Luo et al., 2016). These data need to be appropriately managed and analysed to enable derivation of relevant information. For instance, in a clinical epidemiologic study, the availability of records of 100 million patients for safety monitoring would enable the detection of adverse cardiovascular effects of rofecoxib (Merck, Kenilworth, NJ, USA) in 3 months instead of 5 years (McClellan, 2007; Trifirò et al., 2014). Large data sets are also helpful in ruling out harmful associations in a Nordic collaborative study on the safety of antidepressant use in pregnancy. Less than 2% of pregnant women who used selective serotonin reuptake inhibitors (SSRIs) in pregnancy had babies with birth defects in 3% of live births (Furu et al, 2015). In this study, it took the pan-Nordic study to assemble a study population of over 1.5 million pregnancies with ~ 73,000 malformation cases, including ~ 33,000 SSRI-exposed pregnancies with over 1,300 cases exposed to SSRIs (Furu et al., 2015). The study convincingly showed a null association between maternal use of SSRIs and major birth defects, providing reassurance to pregnant women with depression and their physicians.

Gathering of big data by clinicians, within the shortest possible time, is achievable through digital technology. Digital technology has been helpful in conducting epidemiological studies, clinical and academic research, and clinical trials, which allows rapid data collection from a very diverse and large population compared to previous traditional data (Ehrenstein et al., 2017; Inan et al., 2020; Thakur & Lahiry, 2021). Data collection driven by digital technology permits meta-analysis studies to be performed and allows healthcare professionals to sustain their innovative techniques and trends. Access to big data would enable clinicians to recognize health-related risk factors and recommend appropriate and effective preventive or interventional measures.

3.4 Improved Lines of Communication

In the Western world, beeper and pager were the tools for communication among healthcare workers in the past, while face-to-face communication and phone calls were the major means of communication between healthcare providers and patients (Goyal et al., 2018; Reddy et al., 2003). These modes of communication have been overridden by digital technology, which now serves as a communication tool between healthcare professionals and patients. Healthcare professionals can correspond via email, smartphones, text messaging, chats, or calls. Doctors send mail-out letters to patients for longer times, reminding them of their appointments and blood work.

Digital technology has made all these much easier and much more cost-effective. Additionally, health professionals can make their own webinars and videos and use online platforms and social media to communicate with other professionals remotely (Ventola, 2014). Teleconferencing has made it easy to communicate among health professionals who are far and near. In contrast, the use of technology as a means of communication in health care has not been fully deployed in the developing world. In a recent study evaluating the mode of communication between patients and health professionals in Ghana, almost all the healthcare professionals surveyed in the study communicated with their clients via a face-to-face medium (Dongyele et al., 2021). Almost all forms of communication between hospital management members and the general public were performed through letters and officiasl memos (Dongyele et al., 2021).

Many social media tools for healthcare professionals are available, which include social networking platforms, blogs, microblogs, wikis, media-sharing sites, and virtual reality environments (Ventola, 2014). These tools have been used to improve or enhance professional networking and education, organizational promotion, patient care, patient education, and public health programmes (Farnan et al., 2013; Peck, 2014; von Muhlen & Ohno-Machado, 2012). A major drawback of these tools is that there is a tendency of misinformation through dissemination of poor-quality information by impostors, denting of professional image, infringement on patient privacy, infractions on personal-professional limits, and licensing or legal issues (Lambert et al., 2012; Peck, 2014; Ventola, 2014). These potential problems are prevented by institutional and/or organizational guidelines in place for health professionals who are using the media (Chauhan et al., 2012; Dizon et al., 2012; Lambert et al., 2012; Ventola, 2014).

3.5 Electronic Health Records

The introduction of digital technology has revolutionized the maintenance of patient medical records, which has transformed from paper records to electronic medical records (EMRs) or electronic health records (EHRs). Paper records are characterized by missed charts, damaged papers, incomplete or improper documentation, and misplaced records (Stausberg et al., 2003). Sometimes, medical records may be retrieved quite late during emergency visits, especially if patients visited at night or during the weekend and patient waiting time may be prolonged (Teviu et al., 2012). Referring patients could be a herculean task since the process would require the attending physicians to send a large box containing the patient chart, and the results of various investigations conducted and documented the history of the patient. Medical records for patients attending multiple specialty clinics, such as dentistry, psychiatry, and rehabilitation centres, or a medical record being kept by an internist may not be available for review by a new specialist attending to the same patient. Luckily, EHRs have changed this narrative, thus making life easier for both healthcare providers and patients. Access to EHRs has resulted in a centralized storage of all patient data and

faster access for improved care and better outcomes (Tsai & Bond, 2008). EHRs also enable faster, smoother, and easier medical billing, thus reducing the waiting hours at the clinic (Stausberg et al., 2003; Tsai & Bond, 2008).

EHR is simply an electronic storage of a patient's medical history that is maintained by the provider over a long period of time. Information stored may include all of the essential administrative and clinical data that are relevant to that person's care under a particular provider. Such information includes demographics, progress and follow-up notes, problems, medications, vital signs, past medical history, immunizations, the results of laboratory tests, and radiology reports (Seymour et al., 2012). The EHR automates access to information and has the potential to streamline the clinician's workflow. The EHR also has the ability to support other care-related activities directly or indirectly through various interfaces, including evidence-based decision support, quality management, and outcome reporting (Tsai & Bond, 2008).

It is reassuring that EHRs have brought unquantifiable progress to health care and have strengthened the relationship between patients and clinicians. Easy access to patients' data, timeliness of the outcomes, and availability of the data would enable providers to make better decisions and provide better care. EHR has impacted patient care by reducing the incidence of medical and medication errors due to improved, accurate and lucid medical records. EHR further impacts patient care by making health information readily available, eliminating the duplication of tests, reducing delays in treatment, and enabling patients to be well informed to make better decisions (Seymour et al., 2012). An EHR that shares information between multiple healthcare providers allows a clinician to swiftly learn about critical laboratory values. This type of information sharing provides knowledge that is a step towards improving a patient's overall health outcome in the long run. In study, evaluating the opinion of physicians on the use of EHR showed that 71% of the respondents equipped with an EHR system reported that it enhanced general care of their patients (Jamoom et al., 2016). Another study indicated that physicians were generally satisfied with EHR use, and their understanding of its impact on patient care was generally good (Williams et al., 2019). The physicians' satisfaction with EHR was dependent on their perceived efficiency of the resource. Another study evaluating the impact and benefits of EHR among physicians reported that access to EHR enhanced the overall care of patients, enabled them remote access of patients; chart, and alerted them to potential medication errors and critical laboratory values (King et al., 2014). There are different types of EHR systems based on the way they are configured. Each has unique merits and demerits, depending on the unique needs and requirements of a clinical practice (Neal, 2011; Tharpe, 2020).

a. **Physician-hosted system**
   This system simply suggests that all data be hosted on a physician's own servers. A physician is responsible for purchasing hardware and software for the EHR, as well as the continued maintenance and security of the data stored on the servers. An EHR system hosted by a physician at his medical practice may be beneficial for larger practices capable of covering the overhead costs of the complex software.

Having on-site servers also helps data to be processed quickly from the EHR system, thus making it a very reliable source of information.

b. **Remotely hosted system**
This system shifts the storage of data from a physician to a third party, and the entity must deal with maintenance, data backup, and security. This type of resource transfers data maintenance from the physician or medical practice to a third party elsewhere. This shift of responsibility might be attractive to smaller practices or any healthcare provider who wants to focus more on collecting the information and not storing it. This information resource tends to eliminate some of the stress that is IT related and capable of dividing the physician's attention from their patient's care and well-being.

c. **Remote Systems**
Remote systems are of three different types (Tharpe, 2020):

- ***Subsidized*:** A subsidized system involves a relationship with some entity that subsidizes the cost of an EHR. Generally, a physician forms this relationship with a hospital, which then controls the data. Keep in mind that a remote system involving a subsidizing entity can bring up certain legal issues, including antitrust and data ownership concerns.
- ***Dedicated*:** A dedicated host system means that physicians store EHRs on a vendor's servers. These servers are usually in specific locations. A physician cannot control most aspects of data storage with this system.
- ***Cloud:*** One of the most popular EHR remote systems is a cloud or internet-based computing system. A physician does not need to store data on their own servers, but a vendor stores it "in the cloud." This means the data are always stored away somewhere secure on the internet and can be accessed through the vendor's website.

3.6 Telemedicine and Telehealth

Both telemedicine and telehealth are often used interchangeably; however, there is a distinction between the two terms. Telemedicine is a subset of telehealth and refers solely to the provision of healthcare services and education over a distance through the use of telecommunications technology (Saljoughian, 2021). Telemedicine involves the use of electronic communications and software to provide clinical services to patients without telemedicine technology and is frequently used for follow-up visits, management of chronic conditions, medication management, specialist consultation and a host of other clinical services that can be provided remotely via secure video conferencing and audio connections (Haleem et al., 2021).The term telehealth includes a broad range of technologies and services to provide patient care and improve the healthcare delivery system as a whole. It is different from telemedicine because it refers to a broader scope of remote healthcare services than telemedicine. While telemedicine refers specifically to remote clinical services, telehealth can

refer to remote nonclinical services, such as provider training, administrative meetings, and continuing medical education, in addition to clinical services (Suresh et al., 2021). According to the World Health Organization (WHO) (WHO, 2021), telehealth includes "Surveillance, health promotion and public health functions." Telehealth is, therefore, a subset of eHealth, which includes the delivery of health information, for health professionals and health consumers, education and training of health workers and health systems management through the internet and telecommunications. It is important to note that the WHO (1998) also uses the term "telematics." They define "telematics for health as a composite term for both telemedicine and telehealth, or any health-related activities carried out over distance by means of information communication technologies." Generally, telemedicine is simply telehealth, but not all telehealth is telemedicine. Both are part of the larger effort to expand access to care, make health management easier for patients and improve the efficiency of the healthcare delivery network.

Telehealth has been able to extend the care of patients to people living in many rural places around the world where there is a dearth of healthcare providers. This service is cost-effective and capable of identifying those who need emergency care. Presently, psychiatrists often deliver counselling via telehealth for patients who are unable to physically come to their clinic. The role of telemedicine in reducing the cost of treatments in radiology, prisoner health care, psychiatry, and home health care has been reported (Charles, 2000). Telecommunications are also being used to provide education and training to healthcare workers residing in remote areas (Conde et al., 2010).

The COVID-19 pandemic disrupted medical and transportation systems globally, and most patients could not access health care. The barrier to accessing health care during the pandemic was addressed using telemedicine and telehealth. These technologies were able to increase access to mental health services in rural areas, reduce COVID-19 exposure for high-risk patients, and offer continuity of care for COVID-19 patients with other comorbidities (Oluyede et al., 2020). Although, during the COVID-19 pandemic, telemedicine and telehealth were unable to address all medical needs, such as emergencies or carers of chronic health conditions, they were useful for preliminary screenings and follow-up visits of most patients (Ramirez et al., 2021).

3.7 Mobile Health (mHealth)

Mobile health (mHealth) broadly refers to the use of mobile communication technologies to aid health information in the delivery of health care and to support wellness (Andersen et al., 2022). mHealth offers several benefits over traditional methods of healthcare provision by permitting convenient, real-time and portable access to information and services. In their portable forms, including mobile phones and other wireless devices such as Bluetooth, they have the ability to facilitate the transformation of health services and data delivery by reaching widely to people in far and remote areas.

mHealth is currently an integral part of healthcare services and includes health call centres and emergency number services. Conventionally, mHealth depends on the prevailing telephone communication infrastructures, in addition to functions such as lifestyle and wellness apps, health promotion and wearable patient monitoring devices or sensors (WHO, 2011). Upon entering an individual's information into a mHealth app or patient use wearable devices, care providers receive a more holistic and quantified description of patient behaviours and treatment results. The WHO has recognized voice messages, short messaging services (SMS); third-, fourth-, and fifth-generation (3G, 4G, and 5G systems) mobile telecommunications; global positioning systems (GPS); and Bluetooth technology as the major components of mHealth (WHO, 2011).

An estimated 2.5 billion people globally are known to own a mobile phone, suggesting a high tendency for mHealth to facilitate remarkable access to specialist clinical diagnostics and treatment advice (WHO, 2022). Nearly, half of doctors in the United States have discussed mHealth with their patients, and one-fifth have been asked about mHealth (Rowland et al., 2020). The number of mHealth apps has increased rapidly in the recent past. Health and wellness apps are the fastest growing category being developed, with over 100 000 mHealth apps available on the market in 2014 (Pai, 2014). The mHealth app market for monitoring devices rose to nearly 65% in 2017 and is primarily focused on independent monitoring of age-related problems, management of chronic diseases and postacute care services (Agnihothri et al., 2020). Apps for diagnostic services and health system strengthening services are also on the increase in the market (Rowland et al., 2020). Mobile technologies are equally increasing access to medical education and training for healthcare professionals. Despite the high prevalence and popularity of mHealth, only a few of their interventions have been carefully studied, and their efficacy is not evidence-based (Rowland et al., 2020).

mHealth affords the opportunity to actively involve individuals in their own health care as never before and promotes healthy lifestyles through communication of disease prevention practices. Participation goes beyond the utilization of healthcare services; individual healthcare users also provide data related to disease and public health concerns. mHealth aids in the timely collection of public health information, which is already digitized. Large amounts of data are often collected via mHealth, which is useful for research and policy implementation to improve the effective use of healthcare facilities.

The progress made in mobile technologies, coupled with reduced hardware costs and an ever-increasing market for health-related apps, has significantly enhanced mHealth use and its incorporation into other eHealth services. Many people can now use their portable mobile devices to access health information and navigate healthcare services wherever they are across the globe. Similarly, doctors, nurses, and other healthcare professionals now use mobile devices and apps to access patient information and other databases and resources. mHealth is swiftly growing in low-income countries due to the rapid proliferation of mobile phones that have advanced technological development in such countries (Hoque et al., 2020).

The potential benefits of integrating mobile technology into the health sector cannot be overemphasized. It promotes effective communication in healthcare settings and supports health professionals and patients when making decisions about their health. Notable examples of mHealth apps that focus on a range of health issues are malaria, HIV infection, tobacco and alcohol control, vaccinations, diabetes, and maternal health (Abaza & Marschollek, 2017). Evidence is abundant in the literature supporting that mHealth is very effective in widening the coverage of healthcare programmes (Cao et al., 2022; Osei & Mashamba-Thompson, 2021). mHealth has been successfully employed in this conatext by the Russian Federation with programmes targeted at improving prenatal health care, tackling injectable drug abuse, providing education on and improving the care of HIV-infected and AIDS patients, and reducing tobacco use (WHO, 2016a). The United Kingdom also key to this wide mHealth coverage by embarking on programmes addressing tobacco use, wellness and lifestyle behavioural change, diabetes management, and individualized healthcare advice (WHO, 2016a).

The United Nations recognizes the alliance between the WHO and the International TelecommunicationUnion (ITU) to form a new global programme focusing on the use of mobile technologies to enhance the prevention and treatment of non-communicable diseases (NCDs) (WHO-ITU, 2022a). This laudable initiative is called "Be He@lthy, Be Mobile" (BHBM), which takes a more holistic approach to mHealth by aiding governments in building their capacity for running large-scale health programmes using elements of mobile technology and telecom infrastructures that are incorporated into broader healthcare services (WHO, 2012). Each country is charged with the responsibilities of institutionalizing the programmes within health and ICT and engaging their ministries of health and communications to be a part. It is expected by now that the initiative would have helped implement and strengthen mHealth services in several countries, covering a range of income groups and disease areas. As of 2021, mTobaccoCessation is already in use in Costa Rica, the Philippines, Tunisia, and India; mDiabetes is holding sway in Senegal and Egypt; mCervicalCancer is being operated in Zambia, mCOPD has been deployed in Norway, and mHypertension is in use in the United Kingdom (WHO, 2022; WHO-ITU, 2017). It is quite impressive that the goal of mHealth services complementing existing healthcare services is coming to fruition (ITU, 2016).

The available mHealth solutions consist of mainly text messaging services. The interventions target NCDs through awareness, education, screening, surveillance, treatment, and condition management. The two key partner countries in BHBM, Norway and the United Kingdom, have joined multiple sectors of society to strengthen connections within eHealth and innovation communities (ITU, 2022a; WHO-ITU, 2017). They also share existing digital assets and foster the development of strategies, documents, and tools. BHBM has also developed a global toolkit for setting up mHealth programmes for different disease areas, knowing well that mHealth can potentially support control of the disease (WHO-ITU, 2017). The goal of this initiative is to enhance the prevention, treatment, and enforcement of NCDs, minimize the socioeconomic effects of NCDs, chronic illnesses and disabilities, and save lives by expanding evidence-based and cost-effective mHealth services globally

(WHO-ITU, 2022a, 2022b). The WHO and ITU are collaborating with the European Commission to discuss the development of a mHealth knowledge and innovation focus to promote collaboration between research and private stakeholders (ITU, 2022b). Consequently, this initiative will bring innovative products and services to the market faster, thus improving strategic policy-making on mHealth.

3.8 Online Education or eLearning in Health

eLearning refers to online education involving the use of electronic technology and media for training and education. It is useful to improve the quality of education and increase access to learning in remote and isolated locations or those with inadequate local training facilities. It can make health sciences education available to a broader audience and make better use of existing educational resources. The WHO has recognized eLearning as a valuable medium for patients and individuals to receive education. It was identified as a means of combating the global shortage of health workers globally. Consequently, eLearning has contributed to achieving universal health coverage by improving the knowledge and skills of health workers and increasing the number of trained professionals with specialized or general skills (WHO, 2016b).

Currently, students interested in pursuing a career in health care can complete their healthcare degree or certificate courses completely online. This enables them to study where they want, from whichever school they want and in their own time. The availability of online education for healthcare professionals has eliminated the need to travel long distances and take time off work. For instance, Harvard Business School offers online certificate courses on digital health (https://pll.harvard.edu/course/digital-health?delta=0), which can be offered by students from far and near without physical presence on campus. Another example of an open education resource is massive open online courses (MOOCs), which offer an innovative new approach for the delivery of higher education (Ibn El Ahrache et al., 2013). MOOCs are a form of e-learning resource that are freely accessible to all and sundry through the internet and are fast becoming a popular way of gaining education. Other common sources of eLearning include videos and educational materials offered via the websites of health service providers, public–private partnerships and health-related associations and organizations such as the Global Health Learning Centre (https://www.globalhealthlearning.org/courses).

eLearning in health is well recognized and well implemented among the Member States of the European Union (EU). A survey evaluating Member States about their use of e-learning for students and professionals in health-related fields indicated that 71% of Member States use e-learning for training health professionals, 66% use e-learning for educating health sciences students, and 94–96% use the resource for students to improve their access to educational content and healthcare experts and to train health professionals (WHO, 2016b).

To further recognize digital competence as an essential skill for individuals in Europe, the European Commission's Digital Agenda for Europe persuaded EU Member States to inculcate eLearning into the national policies for education and training (European Commission, 2010). Furthermore, the European Commission has proposed actions (opening up education) to enhance ICT in education to support students, teachers, institutions and professional development and to create jobs and strengthen the workforce (European Commission, 2013). Health professionals who are savvy in ICT to support health are likely more capable of teaching and supporting their patients to use technology for their own health care.

3.9 Health Apps

During this era of the digital revolution, several hundreds of health apps have been developed, and more than 350,000 health apps are available from various app stores globally (Olsen, 2021).These apps availed patients the opportunity to monitor their health and illnesses, educate them medically through the provision of health information, allow them access to the results of laboratory investigations, and alert them when the results are abnormal and alert them when their check-up time is due (Olsen, 2021). Health apps also permit healthcare workers to swiftly check and review laboratory test results, enable them to recommend appropriate drug doses and dosing regimens for a patient and source other urgent information that may be needed. The COVID-19 pandemic has helped to increase the proliferation of symptom-checker apps, such as a contactless thermometer, apps to manage lateral-flow-test results and apps that act as vaccine passports for travel (John Leon Singh et al., 2020). Many new and existing digital health tools have also helped citizens mitigate some of the health impacts of COVID-19.

In the United Kingdom, the National Health Service (NHS) app, which uses independent digital platforms, has helped users access their medical records, conduct health assessments, arrange and conduct video appointments, and order repeat prescriptions (May, 2021). The app also provides an archive of reliable health symptom and diagnosis information. The NHS app is free and the most downloaded app in the United Kingdom, with the users' growing rate from 200,000 in January 2020 to over 16 million in September 2021 (May, 2021). Through this medium, nearly 3.2 million repeat prescriptions have been ordered, and over 268,000 doctor appointments were booked between June and September 2021 (NHS, 2021). The increase in NHS app use is similar to the trends seen in the use of health and fitness apps.

Health apps are now focusing on health-condition management rather than wellness management, as the proportion of such apps has grown from 28% in 2015 to 47% in 2020 (Olsen, 2021). Apps for specific chronic health conditions, such as mental health, diabetes, and cardiovascular disease, are trendier than those for other diseases (Olsen, 2021). Mental health apps that have been tested, trusted, and evidence-based can help improve access to advise and support the patient and help

to reduce symptoms of anxiety and depression (Chandrashekar, 2018). More beneficially, these apps can be used concurrently with traditional, face-to-face therapy, as well as a medium for synchronous or asynchronous support from a mental health therapist (Olsen, 2021). Evidence is abounding that these types of platforms have increased healthcare accessibility by removing social stigma and the challenge of hospital visits for in-person appointments. Additionally, they facilitated healthcare access for those previously deprived of face-to-face therapy (IESO, 2020).

3.10 Drones

Drones are unmanned aerial vehicles (UAVs) that are capable of flying without the on-board presence of pilots but have the capacity to be autonomous even with various functions and uses (Naeem et al., 2021). Their remote pilots can control them from varying distances, which is dependent on their automation and autonomy. Drones were used earlier in the 1990s by military organizations to fight wars (DeBusk, 2010). However, in recent years, interest has been generated for their use in commerce, industry, and recreations. As the cost of drones has decreased due to advances in technology and AI, sensing technologies and autonomous guidance, navigation, and control capabilities, they have become viable options for wide-range deployment, particularly in healthcare services. The current global situation is that healthcare services and medical resources in remote and underserved communities are limited to road transportation and physical face-to-face interactions in the hospital; however, drones may be a feasible option in providing these services in a more effective manner.

Current research has explored the use of drones for natural disaster relief, search and rescue missions, and transfer units (Doherty & Rudol, 2007; Amukele et al., 2015; Narayanan & Ibe, 2015; Thiels et al., 2015; Htet, 2016). However, there are limited studies on the usefulness of drones in telemedicine and transfer units. Drones are now more efficient than before due to the current technological advancements. The presence of cameras, GPS, and diverse sensors in the device have enhanced their autonomy and efficient fights (Scott & Scott, 2017). Furthermore, the advent of new lithium batteries now allows drones to cover a long distance, while the presence of mobile phone or tablet software increases accuracy in tracking and navigation (Scott & Scott, 2017). These mobile applications also make it highly intuitive and easy for all audiences to control a drone. However, regulatory issues in airspace have limited the potential use of drone technology for public services around the world (DeBusk, 2010). The major reason why airspace regulatory agencies block or restrict certain uses of drones is to preserve the air safety of manned aircraft and people on the ground by gradually analysing the risks and knowing the modes of operation and then slowly deciding restrictions and operating laws (DeBusk, 2010). Due to these limitations, there is a dearth of research on the use of drones in health care.

Drones are particularly useful in marginalized communities since they lack infrastructure and transportation systems to allow for the delivery of necessary health

services and supplies within a timeline. They are able to travel fast at a speed of 40–60 miles/hour (Lippi & Mattiuzzi, 2016) and can overcome topographic challenges that would be very challenging to overcome by other forms of transportation. Work is ongoing by some organizations that are attempting to develop drones capable of delivering a wide range of health services to underserved communities. For instance, Aidronix, Mexico (Unicef, 2019), is developing a high-value light-duty unmanned aerial transport system that aims to reach out to marginalized communities in need of medical assistance. One of the projects is to develop aerial bridges from distribution centres installed at strategic locations to supply medical supplies to rural communities. Furthermore, the Stanford Center for Innovation in Global Health, in collaboration with Aidronix, commenced research in 2017 to create and evaluate the feasibility of drone telemedicine units. This pilot study was conducted in Mezquital, a highly marginalized municipality of Durango, Mexico (Wulfovich et al., 2018). These pilot projects will use UAVs as telemedicine units, which will incorporate basic but technologically advanced digital health systems. For instance, these telemedicine drones will incorporate FDA-approved digital health devices, including devices capable of monitoring ECG activity, pulse, blood pressure, temperature, oxygen saturation, and ultrasound (Zhao et al., 2015). These devices can be incorporated into the drone via small stand-alone devices or a mobile phone. These UAVs will use highly secure networks that will allow patients to connect to healthcare providers immediately with limited broadband.

4 The Limitations, Challenges, and Drawbacks of Digital Technologies in Healthcare Innovation

Despite the ubiquitous digital technologies that have transformed healthcare globally, the entire process is still evolving and incompletely free of challenges, limitations, and drawbacks. Digital technologies are known to have both direct and indirect health consequences. Direct effects can occur through, for instance, the propagation of health misinformation. Indirect effects on some determinants of health can also occur, including socioeconomic, commercial, and environmental factors. For instance, people's exposure to marketing or political messaging may be influenced. Children and adolescents born and raised in this digital era are likely to experience extremes of digital access. Young people who are fond of online surfing all day may be vulnerable to online harm. Individuals living in remote rural areas may remain digitally excluded, thus affecting their access to education and health information. Digital access and the quality of that access are key determinants of health.

In this section, we discuss crucial current challenges that need to be overcome to ensure that digital health systems meet the guiding principle of being *for everyone, everywhere,* and every time.

1. **Societal Problems**

   The delivery of affordable, simple-to-operate health solutions to the elderly using new digital technologies is often adopted and accepted very slowly by this special population (Cordeiro, 2021). This reluctance is premised on a lack of user acceptance based on uncertainties surrounding digital health policies and legislation and a suspected lack of accountability within the entrepreneurial sector. The entrepreneurial sector is equally challenged by the intricate multinational pattern of the digital health market and the need to operate within the limitations of varied health systems. Poor knowledge of digital technology and healthcare systems, culminating in digital health illiteracy among the general populace, particularly among elderly individuals, is a key societal factor.

   To overcome this challenge, healthcare professionals and the general populace need to be upskilled via far-reaching educational initiatives (Lennon et al., 2017). The suitability of existing and newly introduced digital health solutions should be adequately and appropriately assessed from the viewpoints of all stakeholders (both patient and clinician end-users) (Flott et al., 2016). Hopefully, this stakeholder inclusiveness would encourage wider adoption and adaptation of the next generation digital technologies, consequently leading to improved healthcare solutions for users (Alcaraz et al., 2017; Robbins & Dunn, 2019).

   COVID-19 has revolutionized digital health and is a major propellant for adapting and updating healthcare delivery systems (Keesara et al., 2020). There are concerns that gravitating from traditional face-to-face consultation toward remote, digital health care could widen the already existing socioeconomic gaps between those who can access and use such services and those who cannot (Gasser et al., 2020; Ramsetty & Adams, 2020). Despite the vital roles played by social media in improving information dissemination to social and family groups during lockdowns, it has also been abused to spread health misinformation across various groups and societies (Laato et al., 2020; Pennycook et al., 2020). Cooperation between the general community and government should help counter this abuse of digital technology (Pennycook et al., 2020). There are also concerns about data ownership and other ethical issues surrounding the data collected with digital technology (Fahey & Hino, 2020; Ramsetty & Adams, 2020).

2. **Ethical Issues**

   Many concerns have been raised about the rapidly increasing digitization of health care and the widespread use of mobile and internet-related devices for data collection. A major concern is the many unresolved ethical issues. One wonders about the exact role of consumer technology companies, such as Amazon, Apple, Google, Facebook, and Samsung, in digital health (Nedelkoska & Glenda, 2018). These companies now offer solutions for gathering, archiving and examining health data without regard to an individual's privacy, data protection and informed consent (Mirchev, 2019; Schmietow & Marckmann, 2019; Sharon, 2016). The essence of healthcare data is now different as more private user-generated data are being obtained, especially those data gathered from social media and wearable

devices, than usual. In addition, ethical concerns about data ownership are another challenge that has not been addressed (Kostkova et al., 2016; Mirchev, 2019). The rapid proliferation of digital apps and technologies for consumer use has obliterated the boundaries between medical and nonmedical devices, thus raising ethical challenges that are related to regulating such devices and technologies (Cortez, 2018; Schmietow & Marckmann, 2019). This situation is worsened by the spate of advanced and increased healthcare solutions globally (Cortez, 2018; Ruotsalainen, 2017).

3. **Enhancing Linked Health Solutions**

An essential goal of digital health is to aid smooth data flow between patients, health professionals and medical devices (Vayena et al., 2018). Enhancing this link permits faster and prompt sharing of information between doctors and patients within the principles of digital health (Pattichis & Panayides, 2019). Linked health solutions were pivotal in the COVID-19 response during the pandemic (Radanliev et al., 2020). Notwithstanding, enhanced linked health solutions are challenged with uncertainty with regard to safety and security.

As healthcare services expand beyond traditional clinical-based patient care to personalized and preventative digital health approaches, our concepts of patient safety will inevitably change (Agboola et al., 2016; Mathews et al., 2019). As digital technology in health advances swiftly, safety concerns will grow larger. This is because evidence-based research emphasizing the health benefits of the newest technologies is lacking. Another challenge is that studies were unable to demonstrate the effectiveness of newer approaches and technologies (Mathews et al., 2019).

The use of internet devices in linked health solutions suggests greater support for everywhere, every time, and everybody solutions along with real-time self-care or self-monitoring (Patrick et al., 2016). Nevertheless, the security and privacy of data transferred from the collection point to remote servers have not been addressed (Yang et al., 2017). Although the practices of informed consent and privacy by design are being used in digital health, patients still lack the understanding of how their data are being processed and by whom (O'Connor et al., 2017). A new trend in digital health and health research is the way patients are treated as mere data sources rather than being engaged and treated as stakeholders (de Wit et al., 2019).

4. **Artificial Intelligence**

Artificial intelligence (AI) can utilize data from digital health systems to enhance diagnosis, choose treatments, and prognosticate clinical outcomes. The existence of AI solutions in digital health reinforces the challenges surrounding safety, justification, and fairness (Panch et al., 2019). AI systems are perceived to have higher safety standards than humans (Winfield, 2019), suggesting that AI is less prone to errors. In addition, the risk of AI-based systems to human life has not been well established, and standards for the verification and validation of these systems are currently lacking. Evidence of some promising solutions associated with AI models was based on limited real-world data. For instance, a systematic review of deep learning solutions in medical images revealed that

a few studies on this subject had sufficient quality for clinical implementation (Liu et al., 2019).

The General Data Protection Regulation (GDPR) recently introduced in the European Union permits both doctors and patients the right to know how a particular AI decision was achieved (Voigt & Von dem Bussche, 2017). This act will enhance trust and transparency in AI systems as well as increase the stakeholders' knowledge and understanding of the internal operations of the systems, thus enhancing the overall accuracy and generalizability of the technology (Adadi & Berrada, 2018). It is hoped that the next generation of AI technologies that will be deployed for clinical use will be transparent, understandable, explainable, and just.

Most results of AI operations are achieved using "black-box" techniques. The operations involve data feeding into the systems, which in turn generate a predictive output without providing any information or inference about how the predicted values are generated. This issue is more pronounced as the presence of deep learning systems in digital health increases (Cummins et al., 2018). It is worth noting that deep learning models are studied with internal connections measured in millions (Han, Pool, Tran, & Dally, 2015).

5. **The Potential of Genomics in Precision Medicine**

Due to the rising costs of health care, funding mass population screening for diseases that most patients will never develop and prescribing expensive drugs that may have no clinical benefits for an individual patient is now out of place. Improving precision medicine offers a solution, where we can tailor a patient's therapy using their unique genomic and physiological characteristics. Technological advances are now incorporated into genetic studies to personalize the diagnosis and treatment of some specific diseases, such as cancer and rare diseases. Unfortunately, genetic information is not yet integrated into routine medical care (Muse et al., 2018; Rehm, 2017). Genomics information has the potential to be considerably useful in data-driven, personalized care (Tarkkala et al., 2019). To achieve this feat, relevant genetic risk scores need to be developed for broader clinical knowledge and greater understanding of the interpretation of genetic variants (Muse et al., 2018). A major factor needed to understand this information is the ability to interpret the genetic variants identified during testing. There are many millions of these variants, and no standard definition is available for all of them (Rehm, 2017; The, 1000 Genomes Project Consortium, 2015). Facilitating data and computational resource sharing are important means identified to close this knowledge gap (Rehm, 2017). Data sharing is associated with ethical concerns, which have already been discussed earlier.

The literature is replete with evidence of how genomic polymorphisms affect the absorption and metabolism of most drugs. Despite the great promise offered by pharmacogenetic testing, its clinical applicability is convincingly demonstrated in only a few instances. Among the failures of digital health in precision medicine is the use of CYP2C19 testing to tailor the use of selective serotonin reuptake inhibitors (SSRIs) in patients with depression. Theoretically, identifying patients with particular

variants of CYP2C19 may be able to predict what dose of SSRI the patient should receive based on the metabolizing strength of their CYP2C19 variant. This led to mass retail availability of testing for CYP2C19 variants, with several tests even receiving FDA clearance. This is despite the recommendation of the Evaluation of Genomic Applications in Practice and Prevention (EGAPP) Working Group that CYP2C19 testing should not be used routinely based on a lack of evidence to support its use (EGAPP Working Group, 2007).

On the other hand, CYP450 variants have provided some potentially valuable insights in other clinical settings, such as determining which patients will respond to clopidogrel, an antiplatelet agent used in acute coronary syndrome (ACS) (Hulot et al., 2006). Despite being a promising approach to individualizing clopidogrel dosing, the American Heart Association (AHA), in 2007, did not recommend routine testing due to a lack of evidence that using this technology could lead to improved clinical outcomes, which poses the largest challenge to the early implementation of this class of technology (Lanham et al., 2010). Over the past few years, more evidence is available in support of a prognostic value of CYP2C19 genotyping with clopidogrel dosing and outcomes of ACS patients (Mega et al., 2010; Sibbing et al., 2009). Digital technology-driven easy-to-use point-of-care CYP2C19 assays, such as the Spartan RX (Spartan Bioscience, Inc.; Ontario, Canada) and VERIGENE (Luminex Corporation; Austin, TX) assays, identify common loss-of-function (CYP2C19*2 and *3) and gain-of-function (CYP2C19*17) alleles with good reproducibility and high levels of inter-assay agreement (Erlinge et al., 2014; Roberts et al., 2012).

Several large-scale and well-designed randomized clinical trials that aimed to answer the question of whether tailoring antiplatelet therapy based on CYP2C19 genotyping would provide any benefit, for instance, the TAILOR-PCI and POPular Genetics trials, are ongoing (Sibbing et al., 2017). The therapeutic strategies evaluated in such trials may further guide precision dosing of clopidogrel in the treatment of patients with ACS.

5 Conclusion

Overall, digital technology has immensely transformed health care. This transformation is unquantifiable and expected to continue into the future. Following the COVID-19 pandemic, the transformation has increased by leap and bound, and many have come to stay. Digital health solutions would likely play a vital role in fighting the pandemic and potential future ones by enabling fundamental shifts in medical care, both during the pandemic and in the aftermath. Drones, artificial intelligence, machine learning, deep learning, blockchain, healthcare mobile apps and devices, wearables, and many other such advancements will change the future of health care globally. Therefore, long healthcare industries and healthcare professionals are open-minded and create the required infrastructure and interlinked systems, and there is no limit to how far digital technology can go in health care.

Despite the gains from digital innovation in health care, they did not come without challenges, which are likely to be more with future advancements in digital technology and health. Virtually all technological tools in health care are associated with at least a challenge, limitation or drawback. Notable areas of problems are related to societal problems, ethical issues, connected health solutions, artificial intelligence, and genomics in precision medicine. The challenges are still very much at the forefront of digital health research, which is aimed at proffering lasting solutions.

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