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Physician Entrepreneurs and AI Technology: An In-depth Study of Knowledge, Competence, Adoption, and Sustainability in the GCC Region

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ABSTRACT

In recent years, the usage of artificial intelligence (AI) has grown significantly, and its implementation is now widespread across all industries worldwide. In terms of finances, the business sector is aware of the importance of AI in healthcare. Physician entrepreneurship is a familiar idea that has developed over time. Doctors who are also entrepreneurs have broadened their areas of expertise and taken on more primary clinical duties. This study aims to assess the knowledge, competency, adaptability, and sustainability of artificial intelligence (AI) technology among physician entrepreneurs in GCC nations. This study will focus on how AI technology is used in the healthcare industry.A sample of 220 respondents will be used in this study's survey. Out of the 220 participants, 152 males (69.09%) and68 females (30.9%) were included in the study. Based on the results of the structural equation model, competence, adaptability, and sustainability contribute to artificial intelligence and have a significant positive impact. After analyzing the interview responses, it is clear that incorporating AI into a company demands a considerable investment in employees, technology, and software. This study focused on how well physician entrepreneurs understand, use, and maintain artificial intelligence regarding knowledge, competency, adaptability, and sustainability. However, comparative research was conducted only for developed countries with similar or different settings.

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1. Introduction

The application of an entrepreneurial attitude and set of skills to the practice of medicine is referred to as physician entrepreneurship. It entails physicians making use of their clinical experience, medical knowledge, and creative ideas to spot opportunities, develop healthcare solutions, and provide value to the healthcare ecosystem. With the intention of enhancing patient care, tackling healthcare difficulties, and bringing about good change in the sector, physician entrepreneurs may launch firms, create medical innovations, or put into practice cutting-edge healthcare delivery methods(Koelewijn et al., 2014). According to the 2018 Alpen Capital GCC Healthcare Industry Report, healthcare spending in the GCC is expected to increase from US$76.1 billion in 2017 to US$104.6 billion in 2022. The compound annual growth rate (CAGR) for this is 6.6%. These governments are introducing regulatory changes and healthcare reforms to enhance the quality and efficiency of services. Over the past few decades, artificial intelligence (AI) has become more and more popular, and its use in the healthcare sector is expanding globally. It is anticipated that machine learning (ML) and artificial intelligence (AI) will have a significant impact on digital health care for disease diagnosis and treatment. In terms of finances, it seems that the business sector is aware of the importance of AI in healthcare. Physician entrepreneurship is not a brand-new idea; it has developed over time. Physician entrepreneurs have expanded their fields of practice in addition to their primary clinical responsibilities. They are involved in every element of medical innovation, changing how patients are cared for and modernizing outdated healthcare business models in both the private and public sectors. The evaluation of physician entrepreneurs' knowledge, competency, adaptability, and sustainability of artificial intelligence (AI) technology is the main objective of this study.

Literature Review

Physician Entrepreneurs

Numerous doctors have become medical entrepreneurs to address this crucial issue by innovating healthcare delivery. However, only some investigations explore how physician entrepreneurs manage the difficulties of decision-making strategies for their medical enterprises. These investigations focus on generalized similarities or variances (Battle, 2021).

If medical school graduation occurs at age 26, the average age of all physician entrepreneurs would be 46 years old, with clinical practice entrepreneurs' average ages being 42 years old and biotechnology business entrepreneurs' average ages being 50 years old(Greenblatt, 2021).

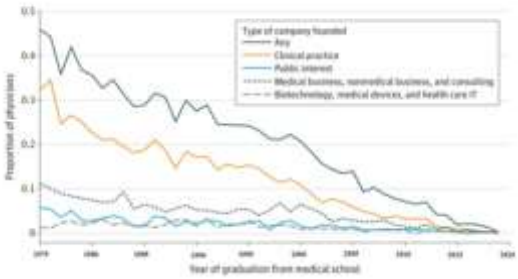


Figure 1. Proportion of Physicians Who Had Ever Founded a Company, by Year of Medical School Graduation(Greenblatt, 2021)

According to the American Academy of Family Physicians Foundation, the healthcare sector would benefit from an increase in physician entrepreneurs. Physician entrepreneurship is a type of enterprise business similar to high-end start-ups. Suppose there is a specific problem in a particular market. In that case, customers are more likely to be attracted to a solution that offers the right value proposition, a distribution channel that can be scaled, and a business model that provides a steady flow of revenue. Furthermore, here lies the value of being a physician-entrepreneur. Physician entrepreneurship is a guiding tool to help highly motivated and dedicated healthcare professionals create sustainable and gainful employment(Sayeed, 2020).

The health sector is currently facing challenges in terms of organization and optimization. Healthcare professionals invest significant time in memorizing illnesses and dosages, mastering delicate movements during deliveries, setting bones, suturing wounds, palpating patients, and performing various surgical procedures (Sayeed, 2020). Practicing physicians try to gradually put in more hours, work more shifts, and take on additional responsibilities to make a little extra money. The medical field is an odd outlier in that it takes so long for the coveted consultant to receive the proper societal value. The population of medical entrepreneurs is a minority inside a minority. We get complacent out of fear because so many difficulties go beyond the surface. According to Sayeed (2020), people often experience fear of the unknown, fear of being inadequate or incompetent, and fear of doing things alone. Although physician entrepreneurship is viewed positively as a form of managed competition, it is uncommon. According to Koelewijn et al., 2014, most physicians choose to work in

hospitals, resulting in only a small number of entrepreneurs operating specialty clinics.

According to a 2021 study by Iqbal et al., physician entrepreneurship has experienced significant changes in recent years. These changes result from shifts in healthcare delivery, advancements in medical technology, and an increasing demand for healthcare providers to play a more active role in shaping healthcare policy and delivery. Historically, medical professionals were mainly trained in clinical treatment delivery and lacked sufficient exposure to business and management principles. However, as healthcare delivery has become more complex, physicians have been asked to assume more management and leadership responsibilities, particularly in cost containment and quality improvement (Mosadeghrad, 2014).

Artificial Intelligence

AI development can be categorized into three periods: the early phase (1956-1980), the industrialization phase (1980-2000), and the explosion phase (2000 onwards). The first phase, from 1956 to 1980, marked the initial significant progress of AI. During this time, AI was primarily used to learn English, solve geometric theorems, and address algebraic application problems. Young and talented scientists like McCarthy and Minsky attended a symposium on using artificial simulated intelligence held in 1956 at Dartmouth University in the United States(Mijwil & Abttan, 2021). Several challenges need to be addressed in the development of AI, such as teaching computers to think like humans, facilitating communication between machines using natural language, enhancing machine intelligence, and the initial implementation of AI. According to legend, AI was born at Dartmouth Top. The second significant era of AI development took place between 1980 and 2000. The Japanese government started developing software for fifth-generation computers and devoted significant funding to advancing AI. The objective was to develop human-machine interaction, translation, and picture recognition tools. Then, in response, a select few industrialized nations in Europe and the US began to commit substantial amounts of money to advancing AI. The current emphasis of AI research is "knowledge processing". (Yuang Lu,2022)

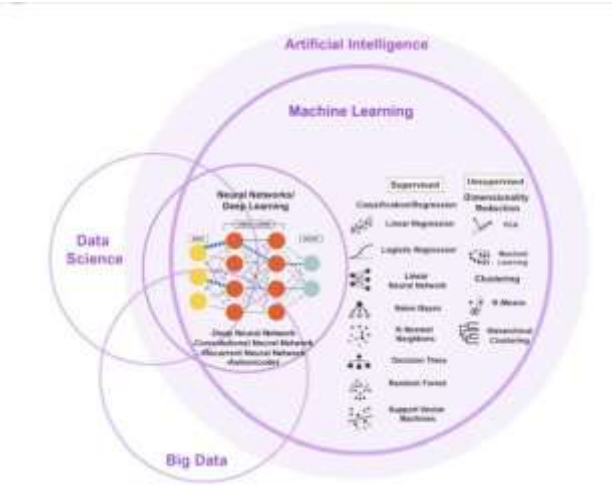


Figure 2. - Venn diagram on the relationship between artificial intellige nce, data science, and big data. Also displayed are common machine learning and deep learning algorithms. Sources : (Aljubran et al., 2022)

Figure 2. shows the Venn diagram of AI. AI includes machine learning, deep learning, and data science. Data science is about data, as its name suggests. It is an interdisciplinary field to gain insights that can guide an organization's decision-making. Vast amounts of data are now readily available, which means increased revenue from data science. Predictive analytics can be used to find data's hidden trends.

Artificial Intelligence in Business Sectors

There are many ways to leverage artificial intelligence (AI) to enhance your business. AI can optimize operations, increase overall revenue, and allow employees to focus on more critical tasks when used effectively. As stated by Chowdhury, AI is being utilized in multiple industries worldwide, such as manufacturing, finance, retail, banking, and public health.

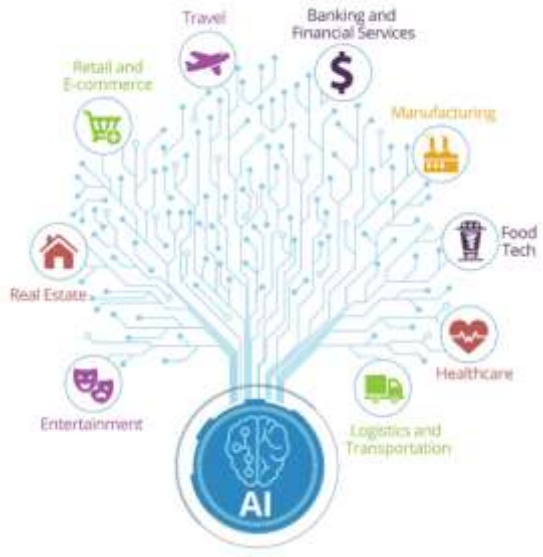


Figure 3. : Artificial Intelligence use cases and applications reforming major industries (Takyar, 2019)

2.4 Artificial Intelligence (AI) Entrepreneurship in GCC countries

By giving entrepreneurs and investors access, artificial intelligence affects the world economy. According to studies, by 2030, AI will have made an economic contribution of roughly 15.7 trillion US dollars to the world. Furthermore, the middle east will receive around 2% or 320 billion US dollars. Governments and companies in the GCC council countries are preparing for the worldwide transition to artificial intelligence and new technologies (Diwakar, 2019).

GCC economies namely Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and UAE have taken massive initiatives for the promotion of AI industry and market. Economic contribution to the GCC countries is likely to exceed 277 billion US dollars by 2030. Remarkably five of the GCC economies were ranked among the world's top 50 economies based on Oxford insight Government readiness index for Artificial Intelligence 2020 report survey(Hanafi et al., 2021a).GCC governments have integrated AI into their national visions and strategic planning processes(Hanafi et al., 2021b).

2.5 Artificial Intelligence (AI) in Public Health Business

Artificial intelligence can be a valuable tool for clinics and hospital departments to enhance the effectiveness of diagnosis and treatment, as well as to simplify administrative procedures and accelerate workflow. By leveraging AI, healthcare systems can realize two significant benefits: improved operational and financial efficiency. When used appropriately, AI can also support early prevention. By optimizing healthcare personnel usage, AI can reduce the time it takes for patients to receive diagnosis and treatment and boost the accuracy of such diagnoses. Artificial intelligence (AI) can be classed as analytical, human-inspired, humanized, or Artificial Narrow Artificial Intelligence (AI), according to the types of intelligence it exhibits, General or Super Intelligence (cognitive, emotional, and social intelligence)(Joiner, 2018).



Figure 4. AI and Robotics (PricewaterhouseCoopers, 2022).

In digital healthcare, artificial intelligence (AI) and machine learning (ML) are becoming increasingly crucial for disease detection and treatment. These technologies are steadily gaining influence in our daily lives. Machine learning aims to enable computers to learn and solve problems in a way similar to the human brain. Deep Learning is a specific type of machine learning that mimics the brain's ability to process data, allowing it to recognize images and objects, understand language, improve precision medicine, enhance diagnoses, and aid decision-making (Iqbal et al., 2021).

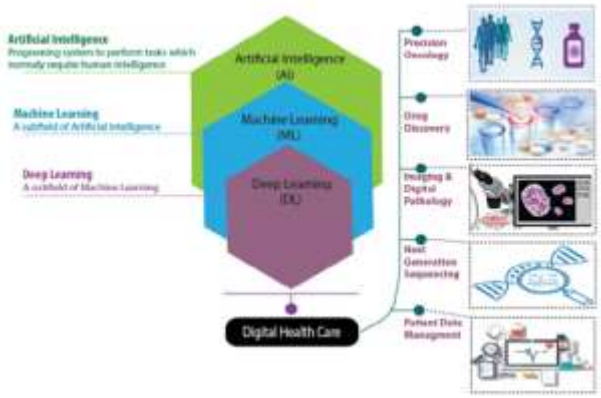


Figure 5. : Applications of AI, ML, and DL in digital health care(Iqbal et al., 2021)

Methodology

Using a structured questionnaire, the data was collected from a selected group of physician entrepreneurs from various disciplines. A Likert scale survey was utilized to measure physician entrepreneur's core perceptions of artificial intelligence as well as constructs like knowledge, competency, adoptability, and sustainability. The difficulties and challenges associated with the duties that AI could return in terms of cost, legal and ethical issues, regulatory, business, storage, cultural, and HR components were also examined using qualitative analysis. The participants in this study were GCC physician entrepreneurs who run a sole proprietorship, partnership, or joint family firm. The current study will utilize a sample of 220 respondents for the survey. The data will be analyzed using the Smart PLS version 4 (Ringle, et al., 2022), 2022) variance-based structural equation modeling (SEM) statistical method, and the relationships between the latent variables will be estimated using PLS-SEM.

3.1 Research Hypotheses

- H1: The knowledge has a significant positive effect on physician entrepreneurs for the

application of artificial intelligence in Health care industries.

- H_2: The competencies possessed by physician entrepreneurs have a positive effect on physician
- entrepreneurs to apply Artificial Intelligence (AI) in their business?
- H3: The adoptability of physician entrepreneurs has a positive effect on physician entrepreneurs towards Artificial Intelligence (AI) technology.
- H4: Internal and external sustainability has a positive effect on physician entrepreneurs in the application of Artificial Intelligence (AI) technology.

Results

Particulars	Frequency (%)
Gender	
Male	152(69.09)
Female	68(30.91)
Marital Status	
Single	42(19.09)
Married	14264.55)
Divorced	32(14.55)
Separated	4(1.82)
Age Group	
Below 30 Years	43(19.55)
31-40 years	64(29.09)
41-50 years	70(31.82)
Above 50 years	43(19.55)
Educational Qualification	
Bachelors	42(19.09)
Masters	105(47.73)
Physicianate	73(33.18)
Years of practice as physician	
0-5 Years	41(18.64)
6-10 Years	58(26.36)
11-20 Years	78(35.45)
> 20 Years	43(19.55)
Years of practice as physician entrepreneurs	
0-5 Years	101(45.91)
6-10 Years	74(33.64)
11-20 Years	27(12.27)
> 20 Years	18(8.18)

Table 1. The demographic characteristics of the participants (N=220).

Table 1. presents the demographic characteristics of the participants, 69.09% (n = 152) were males, and 30.9% (n = 68) were females. Most of the participants come under the 41–50 age group (31.82%, N = 70), and a few participants were above 50 years. Majority of the participants (48%) (N = 105) had a master's degree and having 11–20 years of practice as a physician. The 45.91% (N = 101) of physician entrepreneurs have 0-5 years of experience, while 33.64% (N = 74) have 6-10 years of experience.

4.1 Measurement Scale Analysis

	Items	Loadings	AVE	CR	Rho_A
Knowledge	KW_Q1	0.822	**0.682**	**0.865**	**0.770**
	KW_Q2	0.865			
	KW_Q3	0.788			
	KW_Q4	0.894			
	KW_Q5	0.841			
	KW_Q6	0.868			
	KW_Q7	0.902			
	KW_Q8	0.916			
	KW_Q9	0.921			
Competency	COM_Q1	0.807	**0.703**	**0.922**	**0.908**
	COM_Q2	0.829			
	COM_Q3	0.802			
	COM_Q4	0.870			
	COM_Q5	0.880			
	COM_Q6	0.782			
	COM_Q7	0.853			
	COM_Q8	0.779			
	COM_Q9	0.846			
	COM_Q10	0.770			
Adoptability	ADA_Q1	0.753	**0.697**	**0.920**	**0.901**
	ADA_Q2	0.877			
	ADA_Q3	0.862			
	ADA_Q4	0.844			
	ADA_Q5	0.833			
	ADA_Q6	0.870			
	ADA_Q7	0.892			
	ADA_Q8	0.882			
Sustainability	SUS_1	0.826	**0.639**	**0.914**	**0.891**
	SUS_2	0.850			
	SUS_3	0.751			
	SUS_4	0.830			
	SUS_5	0.819			
	SUS_6	0.710			
	SUS_7	0.899			
	SUS_8	0.886			
	SUS_9	0.826			
	SUS_10	0.850			
	SUS_11	0.751			
	SUS_12	0.830			
	SUS_13	0.819			

Table 2: Item loadings, Average Variance Extracted (AVE), Composite Reliability (CR) and Cronbach Alpha.

The scale reliability of all dimensions, including knowledge, competency, adoptability, and sustainability used in the current study, was evaluated using internal consistency and item-total correlations. All the items' loadings on their constructions are more than 0.7, indicating indicator reliability. The average variance extracted (AVE) estimates range from 0.639 to 0.703, and the composite reliability values range from 0.865 to 0.922(Refer Table 2).

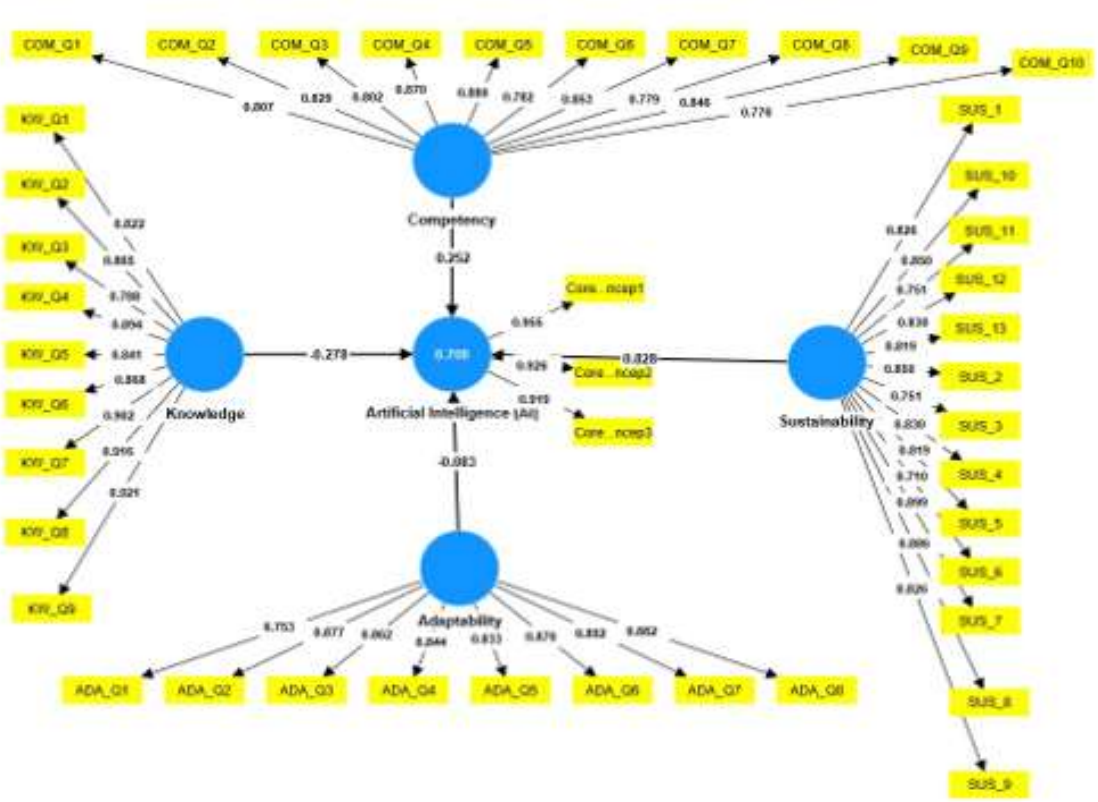


Figure 6 : Path Diagram

Hypothesis	Relationship	Std. Beta	Std. Error	|t-value| ^	Decision	p-value	f^2	q^2	95% CI LL	95% CI UL
H1	Knowledge -> Artificial Intelligence (AI)	-0.079	0.043	1.723	Not Supported	0.085	0.0111	0.0031	0.032	0.373
H2	Competency -> Artificial Intelligence (AI)	0.204	0.088	2.287*	Supported	0.022	0.0333	0.0123	0.071	0.346
H3	Adoptability -> Artificial Intelligence (AI)	0.218	0.071	3.094*	Supported	0.002	0.0425	0.0230	0.180	0.487
H4	Sustainability -> Artificial Intelligence (AI)	0.333	0.078	4.207**	Supported	0.000	0.0998	0.0567	-0.165	0.006

** p<0.01, *p<0.05, ns: Not Significant; R_2 (Artificial Intelligence (AI) 0.459)

Effect Size impact indicator as per Cohen (1988) f_2 values 0.35 (large), 0.15(medium), and 0.02(small)

Q_2 (Artificial Intelligence 0.347).

Predictive Relevance q_2 of predictor exogenous latent variables as per Henseler et al.(2009) , q_2 values 0.35 (large), 0.15 (medium), and 0.02 (small)

Table 3. Direct Relationship for Hypothesis testing

According to the findings of the structural equation model, the construct's competence, adoptability, and sustainability contribute to artificial intelligence and have a significant positive effect. The results indicate in Table 3 that hypothesis H_2: competency contributes to artificial intelligence and has a significant positive effect

(ß =0.204, t = 2.287, p< 0.005); hypothesis H3: adaptability contributes to artificial intelligence and has a significant positive effect (ß =0.218, t = 3.094, p< 0.05); hypothesis H4: sustainability construct contributes to artificial intelligence and has a significant positive effect (ß =0.333, t = 4.207, p< 0.01); and hypothesis H1: knowledge does not contribute to artificial intelligence and has no significant effect (p > 0.05).

Conclusion

The integration of artificial intelligence (AI) into various industries, including healthcare, has ushered in a transformative era. AI's versatility, coupled with its capacity to process vast datasets and adapt to dynamic circumstances, positions it as an indispensable tool for businesses striving to thrive in our fast-evolving digital landscape. From enhancing customer experiences to optimizing operational workflows, AI empowers businesses to make data-driven decisions and engage customers effectively.

Physician-entrepreneurs play a pivotal role in navigating this rapidly changing healthcare landscape. Their involvement extends beyond founding businesses to encompass roles as investors and advisors. The complex healthcare environment demands a diverse skill set, and pursuing an MBA equips physician entrepreneurs with essential business acumen. Through MBA programs, physicians gain proficiency in healthcare administration, finance, marketing, and strategy, enabling them to manage resources effectively, make informed decisions, and foster innovation in healthcare and beyond.

The profound impact of AI on healthcare delivery and outcomes underscores the importance of physicians staying current with AI technology. Physician entrepreneurs who possess a deep understanding of AI can leverage it to enhance patient care, refine diagnostics, streamline administrative processes, and optimize treatment plans. Collaborating effectively with AI professionals ensures the successful integration of these technologies into healthcare practices, empowering physician entrepreneurs to identify new opportunities, deliver value-based care, and develop enduring healthcare solutions.

The recommendations from physician entrepreneur associations emphasize collaboration and the need to stay abreast of global AI trends. Future research should explore the knowledge, competencies, adaptability, and sustainability of AI among physician entrepreneurs in greater depth. Utilizing the structural equation model (SEM) method in subsequent studies can provide more detailed insights and conclusions.

Governmental bodies and authorities in the Middle East, such as the Saudi Authorities for Data and Artificial Intelligence (SDAIA), UAE Minister of States for Artificial Intelligence, Advanced Technology Research Council of UAE, Qatar National Strategy for Artificial Intelligence, Artificial Intelligence Authority of Bahrain, and Artificial Intelligence Authority of Kuwait, are poised to study and enhance the entrepreneurial skills of physician entrepreneurs. This collaboration between clinical expertise and entrepreneurial acumen contributes to economic growth, job creation, and advancements in healthcare, benefiting patients and the broader healthcare ecosystem. This becomes especially crucial as the world grapples with unprecedented public health challenges stemming from disease outbreaks, pandemics, climate change, drought, and conflicts. Physician entrepreneurs hold the potential to shape a resilient and innovative healthcare future, driving positive change on a global scale.

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