Chapter 16
Future Entrepreneurship in Digital Health

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Background

Medicine and entrepreneurship may have gone hand-in-hand since the earliest humans. For thousands of years, medicine has been practiced in many different ways: from very primitive interventions, like a skull trepanation, basic abscess drainage, hemorrhage control, etc., to the present implementation of very sophisticated diagnostic and interventional technologies, such as scar-less surgery, genomics and precision health, robotics, and artificial intelligence among many others. Throughout this progression, physicians have, in general, been entrepreneurs by default. Good or bad, we have been performing the trade called "medicine" by offering our services for something else, such as goods, other services, benefits, money, and in many cases just personal satisfaction. Sadly, during all these years, the core business model of medicine has remained greatly unchanged and quite antiquated. Usually and mostly in clinical practice, a physician can only serve a given patient at a time using a B2C (business-to-consumer) model or, more aptly, a P2P (physician-to-patient) model. This reflects the foundation of the doctor–patient relationship and what most people may think about when describing the practice of medicine. Unfortunately, this model is not scalable and is extremely limited, especially when having a limited number of care providers and an unlimited number of patients, and results in a very inadequate throughput and poor access to care. Certainly, preventive medicine conducted through public health strategies can reach much wider populations; however, such an approach represents high-risk investment and a long-term plan, with considerable uncertainty regarding the return on investment. As a matter of fact, and sadly, most government health budgets only allocate very little to prevention. As it has become evident in other chapters of this book, Digital Health has disrupted the way most people practice and receive

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healthcare and it truly empowers all stakeholders to potentially gain universal access to care in most if not all specialties.

The Perfect Storm in Healthcare for Entrepreneurship

Lately, due to multiple diverse factors that include, but are not limited to extremely busy clinical practices, increasingly more complex and older patients, intricate medico-legal issues, reduced pay, and universal implementation of electronic medical records, among many others; there is great dissatisfaction among clinicians and for many there is no incentive to remain in clinical practice. Additionally, attrition from medical school remains a challenge, along with concerns of poor quality of life among potential candidates debating to pursue a medical education or, alternately, some other less challenging careers with more attractive lifestyles. In many other cases, medical students may go through years of medical school with a plan to follow non-clinical pathways by joining a corporate workforce or becoming full-time entrepreneurs as soon as they graduate, if they ever do.

By now, this situation has been identified by a few medical schools and medical associations and has led to organized efforts to implement the concept of entrepreneurship in healthcare as part of the medical curriculum, vision, or core values. Hopefully, in the not so distant future, instead of being the exception this paradigm may be the rule in healthcare across the world. Much like the mass adoption of digital health technologies by younger generations, entrepreneurship in digital health will be inherent to a new generation of clinical workforce of digital natives that if anything, they may question why entrepreneurship and digital health were not fully embraced many years before.

For many, entrepreneurial traits may be natural while for many others such traits would have to be cultivated and nourished throughout their medical education. For this, all medical school curricula should soon include not only basic science and clinical skills, but also and just as importantly, innovation and business courses, providing physicians-in-training a solid foundation in innovation, design thinking, entrepreneurship, marketing, financial forecasting, creation of business plans, pitching, investing, among others. The present profile of a successful physician being risk averse to maintain optimal clinical outcomes will evolve into one more acutely sensitive physician who would gauge optimal risk and opportunity when it comes to innovating and creating novel value propositions in entrepreneurial ventures in healthcare.

Without a doubt, physician-entrepreneurs will be involved not only as consultants or investors of business ventures but, most importantly, as founders of numerous different healthcare startups. Our competitive advantage in medicine, together with sound business acumen, will make the physician-entrepreneur a key to success for these healthcare businesses. Indeed, there is no one better than healthcare providers to empathize with patients and to identify voids in this complex market. We are certainly the right stakeholders to ideate, innovate, and implement new concepts

and processes through startups in healthcare. Additionally, it is likely that successful physician-entrepreneurs will also venture outside healthcare, leveraging their leadership and business skills in non-medical startups.

The Future Patient-Physician Interaction, Patient-Experience, and New Medical Professions

Soon to be common are innovative business models that implement basic and advanced information and communication technologies along with advanced neural networks or engines of machine learning. A great portion of the patient–physician interaction will be automated and it will rely purely on digital health platforms. Patients will meet with physicians following well-curated differential diagnoses and respective potential treatments proposed by artificial intelligence (AI) platforms. Diagnostic specialties, such as radiology, pathology, dermatology, etc., would be the first to follow these procedures and, soon after, they may be followed by others where automated intervention would take place such as interventional radiology, surgical specialties, etc.

Innovative insurance and revenue models will engage patients and physicians into shaping better lifestyles and promoting a better state of wellness and disease prevention, in contrast to traditional models that support the treatment of disease but do not invest much on prevention. Fee-for-service models clearly incentivize physicians to treat more rather than to be investing in education and prevention. Such models will be the exception rather than the rule.

Regulation will have a paramount role on allowing the creation of innovative revenue models that would promote universal access to care through digital health platforms including telemedicine, genomics, precision medicine, robotics, brain-computer interfaces, etc. For example, genomics will change enormously the practice of medicine, including present insurance practices. In the not so distant future, all births, and even pregnancies *in utero*, will require extensive genomic coding to assess accurately the newborn's health forecast and propose personalized preventive and healthcare life plans. Thus, children would be spared from hereditary diseases before they are even born. Some professions will flourish, such as Geneticists, Artificial Intelligence Medical Informatics, etc., and some new medical super specialists will be created such as Genomic Planners, Genomic Curators, Genomic Editors, Tissue Engineers, Healthcare Designers, Brain Computer Interface Specialists, etc. Regulation within ethical boundaries should promote such an innovative and entrepreneurial spirit.

Probably since the inception of the concept of AI, there has been a general paranoia that AI may replace most professions, including medicine. In healthcare, with no doubt, physicians who do not embrace digital health technologies and AI may soon be replaced by those who do. This transition will be generational and geographic. Digital native generations of patients and medical providers will lead the

way as well as small, visionary countries. Places like the United Arab Emirates have already incorporated Ministers of Artificial Intelligence, Happiness, Future, etc. into their government cabinets, which will allow them to innovate at a much bigger scale by implementing such technologies. Other places, like Singapore or Kuwait, may do the same as they attempt to obtain genomic profiles of all their population. On the contrary and ironically, for larger countries, where most innovating technologies are being created every day like in the United States, their implementation strategies will be laggards in this race due to regulation, litigation, a risk-averse culture in healthcare, etc.

In the near future, the profile of the successful physician-entrepreneur will depict someone who navigates flawlessly through all digital health technologies previously described. On the other hand, not understanding them and not embracing them will take us away from business, as we would be replaced by others who actually do. In addition, the patient–physician interaction will be so different from what it has been until now. From before its inception, extensive, yet simple genomic planning will take place. Through genomics and AI, each of us will have personalized "life portfolios." Minimal viable genomic profiles will be pursued and healthcare providers will become medical curators of such profiles. Digital health literacy will become a must, being even as important as medical knowledge itself. Regular physical checkups would be obtained based on biometrics, wearables, implantables, other smart clothing, sweat analyzers, brain computer interfaces, etc., at any time, 24 h a day, 7 days a week, on demand and remotely through telemedicine. Similar to taking a car in for servicing, AI and genomic platforms will scan and screen patients using medical bots at home to identify any problems, suggest treatments, and if possible, such platforms would take automated action based on those suggestions. Many existing digital health technologies will become quintessential, including bio-3D printing, implantable bio-neuronal circuits, use of soft exoskeletons, among many others. Many diseases will then be curable, some others treatable, and some may not exist anymore.

Markets will evolve as well as the health of large corporations is evaluated up or down depending on AI-based "health indexes" of corporate members. Indeed, the sum of those AI/genomics health checks, which would change day by day, sometimes for the better, sometimes for the worse, could affect a company's value and, hence, its share price. Chief Medical Officers will truly become accountable for the health of their corporations not only for keeping them physically healthy, but also and more importantly, for keeping them financially sound. Everyone would be expected to be healthy and disease would be the exception rather than the rule.

Final Thoughts

A fully re-imagined healthcare delivery system based extensively on digital health, with novel revenue models, entrepreneurially trained physicians across the world, and empowered e-patients with nearly universal connectivity, will inevitably result

in extensive regulation changes that allow care providers and physicians from all over the world to engage with each other, regardless of location. Telemedicine, therefore, will be the rule and physical encounters would be limited to interventional procedures (i.e., surgery, obstetrics, etc.), where even automated procedures will be the norm. Genomics and artificial intelligence networks will work together not only to predict and diagnose disease but also to propose the best precision treatments, which may be manufactured through genomic curation, bio 3D printing, etc. Successful physician entrepreneurs will be those who embrace digital health.

Bibliography

1. Rivas H. Creating a case for digital health. In: Digital health, scaling healthcare around the world, vol. 2018: Springer. p. 1–13.
2. Higgins L. Mamas, don't let your babies grow up to be doctors. Forbes. 2017. https://www.forbes.com/sites/realspin/2017/01/06/mamas-dont-let-your-babies-grow-up-to-be-doctors/#10f120941990.
3. Beck M. How telemedicine is transforming health care. WSJ. 2016. https://www.wsj.com/articles/how-telemedicine-is-transforming-health-care-1466993402.
4. Cabitza F, Rasoini R, Gensini GF. Unintended consequences of machine learning in medicine. JAMA. 2017;318(6):517–8; Publisher: American Medical Association; PMID: 28727867.
5. Fogel A, Kvedar JC. Artificial intelligence powers digital medicine. NPJ Digital Medicine. 2018;5
6. Stanford University. One hundred year study on artificial intelligence. Online. 2015. https://ai100.stanford.edu/.
7. Esteva A, et al. Dermatologist-level classification of skin cancer with deep neural networks. Nature. 2017;542:115–8.
8. LeCun Y, Bengio Y, Hinton G. Deep learning. Nature. 2015;521:436–44.
9. Pearl L, Fogel A. New physicians will need business school skills. NEJM Catalyst. 2017.
10. Pearl L. Engaging physicians in telehealth. NEJM Catalyst. 2017.
11. Gouda P, Steinhubl S. How digital health will deliver precision medicine. In: Digital health, scaling healthcare around the world: Springer; 2018. p. 189–96.
12. Zajicek H, Meyers A. Digital health entrepreneurship. In: Digital health, scaling healthcare around the world: Springer; 2018. p. 271–87.
13. Mesko B. The guide to the future of medicine: Webicina Kft; 2014.
14. The Topol Review, Preparing the healthcare workforce to deliver the digital future. Health Education England, NHS. 2018. https://www.hee.nhs.uk/sites/default/files/documents/Topol%20Review%20interim%20report_0.pdf.