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Chapter 1: Understanding the digital transformation landscape in modern healthcare systems

1.1. Introduction to Digital Transformation

Digital transformation (DT) is a compelling function of organizations' sustainable reinvention and reorganization in the face of rapid disruptive changes and crises in the business ecosystem, as demand and supply chains are increasingly conditional not only from the company's abilities and capabilities but also from the connected ecosystem. Digital transformation can be understood in many ways, such as digitalization, industry convergence, full-scale digitalization, digital maturity development, or governing economic hackerism. Just passing digitalization is not enough; however, companies need to develop the skills and abilities to fully leverage the potentials of technologies to increasingly support the socio-ecological goals of society (Chen et al., 2017; Esteva et al., 2017; Jiang et al., 2017).

Fig 1.1: Digital Transformation Landscape in Modern Healthcare Systems

Change processes should not be understood as the irrevocable development of an organization along a linear route from less digital competence to full maturity; however, DT is changing the business landscape as well as the organization landscape, and often it is disregarding path dependency. In addition, digital transformation does not take place in an artificial closed space but in an environment where both threats and help can be found and where the stakeholders must be taken into consideration. Scientists and practitioners are addressing very different but overlapping questions. They cover a wide variety of sectors but although the healthcare sector is one of the spearheading industries in exploring the potentials of digital transformation, there are still slightly more practical questions addressed (Rajpurkar et al., 2017; Topol, 2019).

1.2. Historical Context of Healthcare Technology

Today, every aspect of healthcare delivery, training, and academic administration relies heavily on some aspect of one or more information technologies. The EMR systematically collects and organizes clinical information in a searchable format that has allowed for unprecedented insights into disease, population health, quality of care, and economics. Digital technology has enabled the development of cutting-edge imaging techniques that have changed the nature of diagnosis and treatment across multiple clinical disciplines. It informs and supports every aspect of the practice of telemedicine, from urgent assessment to multi-input consultation to the long-term management of chronic conditions. Devices that are shipped into our homes are increasingly collecting data on our health or the health of our loved ones, providing insights that were unavailable to us only a few years ago. And recent advances in machine learning technology are leading to capabilities that go far beyond the expert systems and rule-based clinical pathways we have experienced to date.

How did we get here? The simple answer is that healthcare technology is an outgrowth and extension of technology employed in other domains. The industry is, however, relatively unique in its organization and regulation. Its importance as a driver of our economy in its multiple roles as a payer for goods and services, an employer, and a source of innovation in research and novel treatment and diagnostic modalities have all driven levels of investment and scrutiny. Technology that has pioneered healthcare - the stethoscope, the scintillation camera, the MRI, the oxygenator - delivered the same identifiable differentials we attribute to technology in other domains. They were adopted for their cost-effectiveness in delivering better quality at a lower price. And yet, for the most part, healthcare technology has been led and guided not by market forces but by philanthropists and the government - thinly-disguised corrections to market inadequacies that have always permeated the conduct of illness and health.

1.3. Key Drivers of Digital Transformation in Healthcare

Digital transformation in the healthcare system is a topic of increasing significance for both the academic approach and the processes and transformations of the healthcare system itself. Digital transformation is the consequence of the combined adoption and convergence of all types of digital technologies by organizations and networks of organizations. The understanding of these drivers, of the processes and systems they might emphasize, and of the interrelations among them might enable health policymakers, healthcare professionals, and managers, but also academics, to set the right conditions for a successful and effective digital transformation process, that would address the weaknesses and the gaps, while better exploiting the potentials offered by the digital technologies.

Fig 1.2: Key Drivers of Digital Transformation

A range of reasons for initiating a digital transformation has been previously identified, citing the desire and need to improve services provision, to gain stakeholder value, to improve business performance, and to face or drive the competition. The pressure to transform, and to some extent, the desire to exploit digital technologies, stems from existing business drivers and from the very nature of organizations. There is pressure top-down, and this relates to the concept that there are external forces driving

organizations toward digital transformation, and will continue driving them, sometimes with increasing pressure, until they submit and undergo the transformation.

1.4. Impact of Telemedicine on Patient Care

Telemedicine has encouraged self-diagnosing, has made quality care available in previously underserved areas, has improved health monitoring, has improved communication with patients, has made access to second-opinions more convenient, has resulted in easier prescription renewal and directed care of chronic diseases, and has been key in treating patients during pandemic conditions when face-to-face visits were not possible. These benefits are profound.

Telemedicine has enabled self-diagnosing. Some of the first telemedicine applications were the use of websites and smartphone applications for self-diagnosing. The templates relied upon by clinicians in face-to-face visits for building their own diagnoses can be automated, allowing patients to fill in the template and, with some filtering based on their demographics, get useful guidance on what the probable diagnosis is. This capability is especially useful for behavioral health diagnosis in order to rule out serious conditions that would pose safety issues if the patient was in crisis and had not been guided towards receiving immediate treatment.

Telemedicine has improved quality care for previously underserved areas both geographically and for certain specialties like mental health. Synchronous voice and video communications allow for face-to-face visits between a patient and their physician or psychologist on demand. Telemedicine has improved health outcomes for those with diabetes and congestive heart failure. Many have used telemedicine to receive experience-based recommendations for care of their chronic conditions.

1.5. Role of Electronic Health Records (EHR)

EHR is an integral part of the digital transformation in the healthcare delivery system, digitally collecting and managing health-integrated data to improve value-based care delivery. It hosts real time clinical, operational, and financial data generated across patient encounters or episodes of care. EHR has transformed the way in which the entire healthcare eco-system exchanges the health data, thanks to the interconnectivity of all healthcare stakeholders. However, we are only at the early stages of unlocking the full potential of EHR to enable the next phase of the digital transformation, exploring how EHR can be utilized as a digital backbone to empower care delivery organizations to successfully drive their digital transformation initiatives.

Currently, EHR are used in merely facilitating transactions – e.g., storing, retrieving, and exchanging data among healthcare stakeholders to ensure that the transactions occur as planned, to track their completion, and to ensure data integrity. In addition, EHR is being used in tracking performance – e.g., risk stratification, calculating episode cost, track healthcare revenue cycle among stakeholders, determine feasibility of value-based contracts with payers, measure performance against predetermined benchmarks. However, going ahead, multi-dimensional use of EHR will become imperative to meeting the digital transformation objectives. Data generated in originally disparate bespoke systems will flow through the EHR system, which will be used to integrate healthcare data at enterprise-level, building bridges with the assets that drive the data and integrating bottom-up and upstream process flows, and connecting all the dots that link clinical, operational, and financial requirements. EHR can serve as a hub to integrate payers, patients, and clinician-focused digital technologies, turning value-based healthcare delivery into an omnichannel connecting patients and providers enabling seamless real-time personalized remote care anytime, anywhere.

1.6. Data Analytics in Healthcare Decision Making

Healthcare decision making is the essential part of modern healthcare systems, where effective and timely decisions guarantee a timely relief of critical medical conditions. Such decisions have a huge impact on patients, their caregivers, healthcare professionals, and the healthcare organization. Moreover, suboptimal and delayed decisions increase the risks of medical errors and undermine patient safety. Thereby, healthcare decision making has been a prime focus area of researchers, decision support system developers and healthcare professionals. Traditionally, decisions in healthcare systems have been based on the experience and judgment of managers and healthcare professionals. However, recent years have noted a proliferation of electronically generated healthcare data in the form of Electronic Health Records and web enablement of healthcare systems through integrated databases, patient portals, consult scheduling systems, etc. With the advent of such big data, decision making in healthcare systems has shifted towards data-driven intelligence. The data-driven approach has not only enhanced the scope of analysis and its underlying facts but has also enabled evidence-based decision making.

Data analytics is the broad term that encompasses the entire spectrum of quantification, modeling, simulation, visualization, algorithms, and data warehousing. The tremendous growth and development of data analytics has made it a scientific and research-driven topic in almost all fields of academia and application or achievement, be it business, logistics, marketing, sports, social networks, sociology, sciences, or healthcare. Healthcare analytics has come to be known by several different self-explanatory names, namely Healthcare Business Intelligence, Healthcare Data Warehouse, Healthcare

Predictive and Prescriptive Analytics. These names denote different aspects of how data, especially historical and current data, related to patients, patterns, clinical procedures, treatment and discharge, administrative policies, and actions, is collected, stored, and mined to execute timely and effective healthcare decisions.

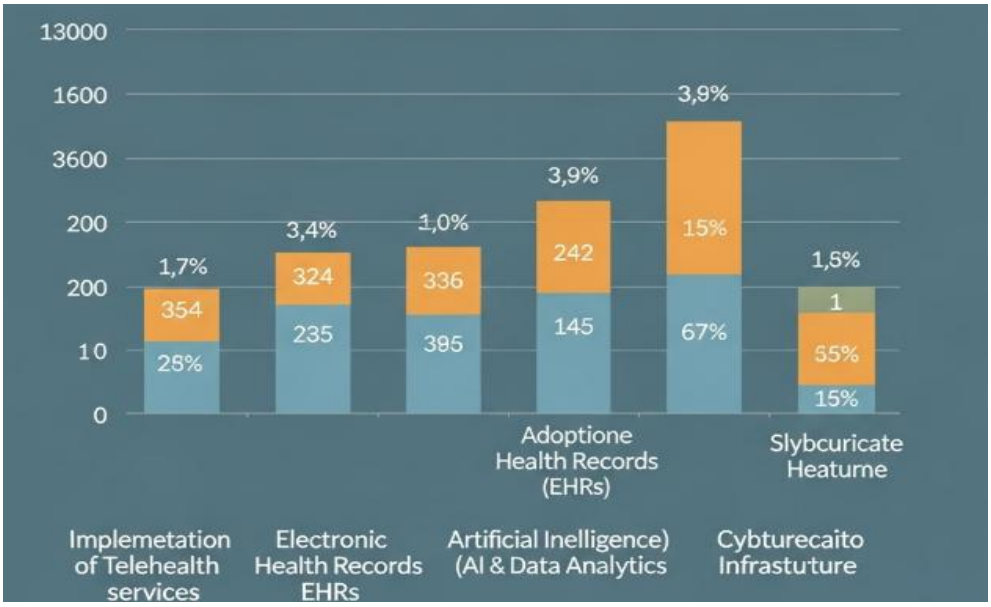

Fig : Digital Transformation Landscape in Modern Healthcare Systems

1.7. Conclusion

The need for digital transformation in modern healthcare systems is a widely recognized phenomenon, but a well-structured plan has yet to be developed. Defining a transformation roadmap that minimizes negative impact on healthcare systems while benefiting from increased resource utilization is a challenging task, especially for large, interconnected, complex, adaptive systems such as those in the domain of modern healthcare. Many researchers from a variety of domains study specific aspects of healthcare transformations, but there is a lack of a top-down, high-models that take into account all healthcare stakeholders when analyzing the implications of digitalization on the broader healthcare landscape.

In this paper, we explored the implications of increased adoption of interconnected IT systems on the areas of activity of the four key healthcare stakeholders: patients, healthcare providers, healthcare insurers, and state authorities. Furthermore, we produced a series of high-level models mapping healthcare stakeholders' interactions, the potential obstacles to digital transformation, the potential pathways for obviating inter-stakeholder constraints and friction, and the resulting dimensions of digital

transformation. By doing so, we not only provided a comprehensive exploration and model of healthcare digital transformations but also an actionable, visually compelling guide for healthcare long-term planners, as well as executive decision-makers across the private-public health service industry spectrum, in order to assist them in the formulation of their digitalization journey in the 21st century.

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