
Digital Transformation in Healthcare Management in Saudi Arabia

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Abstract:

Digital transformation in healthcare management in Saudi Arabia is rapidly reshaping the landscape of medical services, enhancing efficiency and patient care. The Saudi government has prioritized digital health initiatives as part of its Vision 2030 plan, aiming to improve healthcare access and quality through innovative technologies. This transformation encompasses the implementation of electronic health records (EHRs), telemedicine, and mobile health applications that facilitate real-time patient data access and communication between healthcare providers. By embracing these technologies, Saudi Arabia is not only streamlining administrative processes but also enabling better decision-making through data analytics, ultimately leading to improved patient outcomes. Moreover, the rise of artificial intelligence (AI), machine learning, and cloud computing in healthcare management is fostering a more proactive approach to patient care in the country. Hospitals and clinics are increasingly utilizing AI for predictive analytics, which assists in forecasting patient inflow and optimizing resource allocation. The integration of digital health solutions is also crucial in addressing the challenges posed by a growing population and the demand for quality healthcare services. As Saudi Arabia continues its journey toward a digitalized healthcare system, collaboration among government entities, private sectors, and health professionals will be vital to leverage technology effectively and ensure sustainable improvements in healthcare delivery.

Keywords: Digital Transformation, Healthcare Management, Saudi Arabia, Vision 2030, Electronic Health Records (EHRs), Telemedicine, Mobile Health Applications, AI in Healthcare, Predictive Analytics, Patient Care, Data Analytics, Resource Allocation.

Introduction:

The digital transformation of healthcare is a fundamental shift that is reshaping the landscape of medical services across the globe. In Saudi Arabia, a nation characterized by its rapid economic advancements and technological adoption, the healthcare sector is undergoing substantial reforms aimed at improving the quality of care, optimizing operational efficiencies, and enhancing patient

outcomes. Digital transformation in healthcare management refers to the integration of digital technologies into all aspects of healthcare delivery and administration, fundamentally altering how health services are designed, delivered, and experienced. This introductory section explores the impetus behind this transformation in Saudi Arabia, evaluating its implications, challenges, and future directions [1].

Saudi Arabia's healthcare system has faced numerous challenges, including a burgeoning population, increasing prevalence of chronic diseases, and the rising cost of healthcare services. Traditionally, the system has been characterized by a high demand for healthcare services, often leading to inflated wait times and a strain on resources. Recognizing these issues, the Saudi government has taken significant steps to overhaul the healthcare sector, focusing on promoting sustainable models of care that leverage both technology and innovation. The Vision 2030 initiative encapsulates this transformation, aiming to develop a robust healthcare system that caters to the needs of its citizens while enhancing the overall health landscape of the Kingdom [2].

Several factors are driving the shift towards digital transformation in the Saudi healthcare management sector. First and foremost is the increasing penetration of digital technologies among the Saudi population. With a high percentage of internet and smartphone use, Saudi citizens have come to expect more from their healthcare systems, including easier access to services and improved patient-provider interactions. Consequently, the adoption of telehealth, electronic health records (EHRs), and mHealth applications is gaining momentum as these technologies facilitate seamless communication, enhance data management, and promote patient engagement [3].

Government policy is another vital driver of this transformation. As part of its commitment to the Vision 2030 agenda, the Saudi government has invested significantly in healthcare IT infrastructure, promoting interoperability among disparate health information systems. Programs aimed at fostering digital literacy among healthcare professionals are also being implemented to ensure that end-users are equipped to utilize these technologies effectively. Additionally, the COVID-19 pandemic has accelerated the need for digital solutions, with healthcare providers increasingly turning to virtual consultations and remote monitoring to continue delivering care amidst public health emergencies [4].

The implications of digital transformation in healthcare management in Saudi Arabia are profound. By incorporating advanced technologies such as artificial intelligence (AI), machine learning, and big data analytics, healthcare providers can enhance decision-making processes, streamline

operations, and improve patient outcomes. For instance, predictive analytics can anticipate patient needs and enable more personalized care plans, while AI-powered tools can assist in diagnosing and treating diseases, effectively reducing errors and improving accuracy [5].

Moreover, patient-centric care is becoming a reality as digital health tools empower individuals to take control of their own health. Patients can access their medical histories, schedule appointments, and even communicate with healthcare providers through mobile applications. This shift not only enhances patient satisfaction but also fosters a culture of accountability and self-management, which is vital for chronic disease management and preventative care [6].

Despite the numerous benefits associated with digital transformation, several challenges must be addressed to realize its full potential in Saudi healthcare management. Chief among these are concerns surrounding data privacy and security. As healthcare organizations adopt digital solutions, the volume of sensitive patient data stored electronically increases, raising the stakes for data breaches and cyberattacks. Consequently, regulatory frameworks must be established to protect patient privacy while fostering an environment conducive to innovation [7].

Additionally, the integration of diverse technologies and systems poses a significant barrier to successful implementation. Many healthcare facilities, particularly those in rural areas, may lack the necessary infrastructure or expertise to adopt advanced technologies effectively. Thus, targeted efforts are needed to build capacity, ensuring that all providers have access to the tools they require to contribute to the digital ecosystem [8].

Looking ahead, the pathway to successful digital transformation in Saudi healthcare management relies on collaboration among various stakeholders, including government agencies, healthcare providers, technology companies, and patients. By fostering public-private partnerships, the Kingdom can leverage resources and expertise, driving innovation while enhancing service delivery [9].

Furthermore, continuous education and training for healthcare professionals will be paramount in ensuring that staff are equipped to navigate and fully exploit the benefits of digital technologies. A culture of adaptability, where healthcare providers are

encouraged to embrace change, will facilitate a smooth transition into this new digital landscape [10].

Overview of Saudi Arabia's Healthcare Landscape:

Saudi Arabia is a nation that has experienced substantial changes over the past few decades, particularly in the realm of healthcare. With a rapidly growing population, urbanization, and a drive towards modernization, the healthcare landscape in Saudi Arabia offers a unique case study of how a nation balances tradition and modernity in providing healthcare services to its citizens. The Kingdom's commitment to improving healthcare delivery, enhancing quality, and adopting innovative practices reflects its broader vision for national development as articulated in the Kingdom's Vision 2030 initiative [11].

Saudi Arabia's healthcare system is a combination of public and private organizations aimed at providing comprehensive healthcare services to its population. The Ministry of Health (MoH) is the principal government body responsible for the planning, provision, and regulation of healthcare services. The MoH oversees a network of hospitals, primary healthcare centers, and specialized institutions that deliver a vast array of medical services. With an extensive coverage model, the public healthcare sector caters to approximately 70% of the population, offering services that are predominantly free at the point of care [12].

The private healthcare sector, although smaller than the public counterpart, has seen significant growth and investment over recent years. Private hospitals and clinics often provide quicker access to care, additional specialties, and a degree of comfort that appeals to various segments of the population. The diversification of healthcare services in Saudi Arabia has encouraged competitive pricing and improved service delivery across both sectors [13].

The healthcare system in Saudi Arabia has undergone transformative changes since the establishment of the modern state in 1932. Initially, healthcare facilities were sparse, and medical services were rudimentary. However, the discovery of oil in the 1950s propelled economic development, enabling significant investments in healthcare infrastructure. By the 1960s and 1970s, the government initiated sweeping reforms laying the groundwork for a more organized healthcare system,

including the establishment of hospitals and training programs for healthcare professionals [14].

Throughout the 1990s and 2000s, the government continued to enhance healthcare quality by establishing specialized hospitals, developing primary healthcare centers, and promoting health education among the populace. These efforts were complemented by a growing recognition of the importance of evidence-based practice and an emphasis on research and healthcare innovation [15].

Despite the significant advances in healthcare infrastructure and service delivery, Saudi Arabia's healthcare system faces several challenges. One of the most pressing issues is the increasing burden of non-communicable diseases (NCDs), including cardiovascular diseases, diabetes, and obesity. These illnesses are now recognized as major public health concerns, necessitating urgent action to promote preventive measures, lifestyle modifications, and early detection strategies [16].

Furthermore, the rapid population growth and urbanization have strained existing healthcare resources, leading to overcrowded hospitals and long waiting times for patients. The distribution of healthcare facilities tends to be uneven, with urban areas better serviced compared to rural regions. This disparity highlights the need for a more balanced approach to healthcare distribution and access [17].

Another significant challenge is the need for skilled healthcare professionals. While the Kingdom has made great strides in training local healthcare workers, there remains a dependence on expatriate professionals to fill the gap. This reliance raises concerns regarding the sustainability and long-term stability of the healthcare workforce [18].

Saudi Arabia's healthcare sector is increasingly embracing technology as a means of improving service delivery and patient outcomes. Digital health initiatives, such as telemedicine, electronic health records, and health information systems, have gained traction as ways to enhance patient care and streamline operations. The COVID-19 pandemic further accelerated the adoption of telehealth services, enabling patients to receive consultations and follow-up care from the comfort of their homes [19].

Additionally, the government has invested in health data analytics to improve public health surveillance

and inform policymaking. Programs aimed at enhancing preventive care and chronic disease management have also incorporated technological solutions and community engagement strategies [19].

The application of artificial intelligence (AI) and machine learning in diagnostics and treatment planning represents another frontier for the healthcare system. Saudi Arabia has launched initiatives to explore AI-driven technologies, aimed at optimizing resource allocation and personalizing patient care [19].

Looking forward, Saudi Arabia's Vision 2030 initiative plays a pivotal role in shaping the future of its healthcare landscape. The Vision outlines strategic objectives to enhance healthcare quality, improve accessibility, and diversify the healthcare economy. Key components include promoting healthy lifestyles, integrating health services, and advancing the use of innovative solutions across the healthcare continuum [20].

As part of this framework, public-private partnerships (PPPs) are expected to play a crucial role in enhancing healthcare resources and expanding service offerings. By fostering collaboration between governmental bodies and private entities, the Kingdom can mobilize additional resources and expertise, ultimately leading to a more resilient healthcare system.

Moreover, there is a growing emphasis on health research and development to address local health challenges and contribute to the global body of medical knowledge. Investments in biotechnology, pharmaceuticals, and medical technology are anticipated to stimulate economic growth while contributing to local capacity building in the healthcare sector [20].

Government Initiatives and Policies Supporting Digital Health:

In recent years, digital health has emerged as a transformative force in the healthcare landscape, leveraging technology to enhance patient care, improve health outcomes, and increase operational efficiencies. As countries grapple with the challenges of burgeoning healthcare costs, an aging population, and the demand for quality care, governments worldwide have recognized the significance of digital health. Consequently, various initiatives and policies have been formulated to

bolster this sector, ultimately aiming to create a more sustainable, equitable, and efficient healthcare system [21].

Digital health encompasses a wide array of technologies, including telemedicine, mobile health apps, electronic health records, wearable technology, and health information exchanges. The evolution of digital health policy was propelled by the rapid advancement of technology and the growing recognition of its potential to address long-standing healthcare issues. In many countries, initial government action focused on encouraging the adoption of electronic health records (EHRs), which facilitated the digitalization of patient information and improved accessibility for healthcare providers [22].

Over the past few years, the COVID-19 pandemic catalyzed a paradigm shift towards digital health. Social distancing measures and the need to minimize virus transmission accelerated the adoption of telehealth services. Governments quickly mobilized to establish emergency policies that provided funding and regulatory adjustments to facilitate the surge in digital health. These emergency measures laid the groundwork for more permanent changes in healthcare delivery.

Many governments have implemented funding initiatives to promote the development and integration of digital health technologies. For instance, the United States introduced the Medicare Acute Hospital Care At Home program, which allows hospitals to provide care at home for eligible patients. This not only helps to reduce healthcare costs but also improves patient satisfaction and outcomes [23].

In Europe, the EU's Digital Health Action Plan emphasizes financing mechanisms to support digital health initiatives, promoting investment in innovative technologies that enhance the efficiency of healthcare systems. Various grants and subsidies are made available to startups and established companies working on digital health solutions [23].

The rapid growth of digital health technologies has prompted governments to develop regulatory frameworks to ensure the safety, effectiveness, and security of digital health applications. In the United States, the Food and Drug Administration (FDA) has established guidelines for the approval and monitoring of digital health technologies, including software as a medical device (SaMD) [23].

In contrast, the European Union has introduced the Medical Device Regulation (MDR) and the In Vitro Diagnostic Regulation (IVDR), which govern the use of digital health tools and ensure that they meet stringent safety and efficacy standards. These regulations aim to protect patients while fostering innovation in the digital health sector [24].

As digital health relies heavily on the collection and analysis of personal health data, data privacy and security have emerged as paramount concerns. Governments have enacted legislation, such as the Health Insurance Portability and Accountability Act (HIPAA) in the United States and the General Data Protection Regulation (GDPR) in the European Union, to protect patient data. These regulations stipulate the ethical use of health information, require informed consent for data sharing, and hold organizations accountable for breaches [25].

Recognizing the potential of telehealth to expand access to care, numerous governments have adopted policies to integrate it into mainstream healthcare. Australia, for example, launched the Medicare Benefits Schedule Telehealth Service, which enables patients to access consultations with healthcare professionals remotely. This initiative has been particularly beneficial for rural and remote communities, where access to healthcare services may be limited [26].

In the U.S., the Centers for Medicare & Medicaid Services (CMS) expanded telehealth coverage during the pandemic, allowing for reimbursement of virtual visits, which significantly increased the use of telehealth services. These policies reflect a commitment to making healthcare more accessible and convenient for patients [27].

The efficiency of digital health technologies is significantly enhanced by interoperability—the ability of different systems to communicate and exchange data seamlessly. Governments have recognized the importance of standardized protocols and frameworks to facilitate interoperability across healthcare systems. The U.S. has initiated the Interoperability and Patient Access final rule which aims to provide patients with access to their health records while enabling seamless data exchange between providers [28].

In Europe, the European Health Data Space initiative seeks to create a secure infrastructure that allows health data to be shared across borders, fostering collaboration among member states while

ensuring the protection of patient privacy. These initiatives underscore the importance of coordinated efforts in enhancing the digital health ecosystem [29].

Despite significant advancements in government initiatives and policies supporting digital health, challenges remain. Implementation gaps across different regions can lead to disparities in access and health outcomes. Some areas may lack the necessary infrastructure or resources to fully adopt digital health solutions. Additionally, resistance from healthcare professionals, driven by concerns about job displacement or technology usability, necessitates comprehensive training and change management strategies [29].

Moreover, as digital health technologies evolve, ethical considerations related to data usage, consent, and algorithmic bias must be addressed. Policymakers will need to ensure that frameworks are in place to safeguard individual rights while promoting innovation. Stakeholder engagement, including inputs from healthcare professionals, patients, and technology developers, will be critical in shaping effective policies [30].

Technological Innovations in Healthcare Management:

In recent years, the healthcare sector has experienced dramatic transformations propelled by technological innovations. The integration of advanced technologies into healthcare management has reshaped the landscape of patient care, streamlined operations, and improved overall health outcomes [31].

One of the most significant technological advancements in healthcare management is the adoption of electronic health records (EHRs). EHRs are digital versions of patients' paper charts and contain comprehensive medical histories, treatment plans, medication lists, and diagnostic information. The transition from paper-based records to digital systems has facilitated better patient care by enhancing information accessibility, improving the accuracy of patient data, and enabling seamless sharing of information among healthcare providers [32].

EHRs offer multiple benefits, including real-time access to patient information, which can lead to quicker diagnosis and treatment. Moreover, they support evidence-based decision-making by

allowing healthcare professionals to stay updated on practices and interventions. However, challenges remain, including issues related to privacy, data security, and the need for standardized systems to ensure interoperability among different healthcare providers [33].

In the wake of global changes such as the COVID-19 pandemic, telemedicine has emerged as a pivotal innovation in healthcare management. Telemedicine involves the use of telecommunications technology to provide medical care remotely, allowing patients to consult healthcare professionals without needing to visit a clinic or hospital physically. This approach has made healthcare more accessible to patients, particularly in rural or underserved areas [34].

The benefits of telemedicine include increased convenience, reduced waiting times, and the ability to receive timely interventions without the risk of exposure to infectious diseases in crowded healthcare settings. Additionally, telehealth platforms often facilitate continuous monitoring for chronic conditions, empowering patients to take an active role in their healthcare. However, the effectiveness of telemedicine relies on robust internet connectivity and raises concerns about the digital divide, particularly affecting vulnerable populations who may lack access to the required technology [35].

Artificial intelligence has begun to revolutionize healthcare management by offering predictive analytics, decision support systems, and automating routine tasks. With its capability to analyze vast amounts of data, AI technologies can identify patterns and trends that may not be immediately apparent to human clinicians. For instance, AI algorithms can analyze imaging studies to assist in early disease detection, potentially improving patient outcomes [36].

Additionally, AI-driven chatbots and virtual health assistants are enhancing patient engagement by providing accessible health information and supporting patients in managing their health conditions. However, the implementation of AI in healthcare management poses ethical concerns regarding data privacy, the necessity for transparency in algorithmic decision-making, and potential biases in training data that could lead to unequal treatment outcomes [37].

The proliferation of digital records and health data has led to the use of big data analytics in healthcare

management. By leveraging vast datasets, healthcare organizations can derive insights that inform decision-making and improve operations. Big data analytics can assist in population health management, identifying health trends and enabling preventive interventions by analyzing demographic information, social determinants of health, and treatment effectiveness [38].

Moreover, predictive analytics can facilitate resource allocation, helping healthcare administrators to forecast patient admissions and optimize staffing levels. Despite its transformative potential, the use of big data analytics raises challenges, including the need for data standardization, integration across platforms, and compliance with regulations such as the Health Insurance Portability and Accountability Act (HIPAA) that safeguard patient privacy [39].

Blockchain technology offers a promising solution for enhancing healthcare data security and interoperability. Blockchain is a decentralized ledger system that ensures the integrity and transparency of transaction records, making it an attractive tool for storing sensitive patient information. This technology can facilitate secure sharing of health data among providers while maintaining patient control over access rights [39].

By reducing the risk of data breaches and enabling audit trails for the modification of records, blockchain can enhance trust in healthcare transactions. However, challenges exist in terms of implementation costs, scalability, and the need for widespread adoption among healthcare stakeholders to achieve the full benefits of blockchain [39].

The Internet of Things (IoT) in healthcare refers to the network of interconnected devices that collect and share health-related data, significantly enhancing monitoring and management capabilities. Wearable devices, such as fitness trackers and smartwatches, enable patients to monitor their health metrics in real time, promoting proactive health management and allowing healthcare providers to tailor treatments based on continuous data streams [40].

IoT applications extend to remote patient monitoring, where devices can provide timely alerts about patient conditions, enabling interventions before complications arise. However, the reliance on IoT networks raises concerns about data security,

device reliability, and the integration of IoT data into traditional healthcare workflows [40].

Challenges and Barriers to Digital Transformation:

In an increasingly digital world, organizations across various sectors are compelled to embrace the concept of digital transformation, which involves integrating digital technologies into all areas of a business. This transformation is not merely about adopting new technologies; it requires a significant shift in processes, culture, and organizational mindset. However, as organizations embark on this journey, they often encounter numerous challenges and barriers that hinder their progress. Understanding these obstacles is critical for stakeholders aiming to initiate and sustain successful digital transformation initiatives [41].

One of the most pervasive barriers to digital transformation is the resistance to change within organizational culture. Many employees may be accustomed to traditional methods of working and may view the implementation of digital tools and processes as unnecessary disruption rather than innovation. This resistance often stems from fear of the unknown, job insecurity, or a lack of digital literacy. Organizations must recognize that digital transformation is as much about changing attitudes and mindsets as it is about technology. Fostering a culture that embraces change, continuous learning, and adaptability is essential for overcoming resistance. Initiatives can include comprehensive training programs, open communication about the benefits of digital tools, and involving employees in the transformation process to build ownership and acceptance [42].

A poorly defined strategy for digital transformation can lead to confusion, misalignment, and wasted resources. Organizations must establish a clear vision that outlines specific goals, desired outcomes, and the road map for achieving digital transformation. This strategy should align with the overall business objectives and consider the unique needs and capabilities of the organization. Without a structured approach, investments in technology may not yield the expected results, and efforts may become fragmented. Stakeholders must engage in thorough planning, including assessing current capabilities, conducting market analyses, and focusing on areas that promise significant value addition [43].

Digital transformation often requires significant technological upgrades and investments, including infrastructure, software applications, and cybersecurity measures. Many organizations, especially those in traditional industries, may lack the necessary technological foundations to support transformative initiatives. Legacy systems can be particularly problematic, as they are often incompatible with modern digital solutions and can hinder the integration of new technologies. Addressing these technological gaps typically involves substantial costs, time, and resources. Organizations may need to prioritize their investments by taking a phased approach, gradually upgrading systems, or integrating cloud-based solutions to enhance flexibility and scalability [43].

As organizations increasingly rely on data for decision-making and operational efficiency, concerns about data privacy and security have come to the forefront. Cybersecurity threats are on the rise, with organizations facing significant risks of data breaches that could compromise sensitive customer and corporate information. Moreover, stringent regulations such as the General Data Protection Regulation (GDPR) in Europe and similar laws in various jurisdictions impose strict guidelines on data handling, creating additional complexity for businesses. Organizations must prioritize robust cybersecurity measures and data governance frameworks as part of their digital transformation strategies to gain customer trust and compliance with regulatory requirements [44].

The transition to a digital-first approach requires a diverse range of skills, including technical expertise, data analytics, and change management capabilities. Unfortunately, there is a significant talent shortage in the technology sector, compounded by a skills gap among existing employees. Many organizations struggle to attract and retain professionals with the necessary digital competencies to drive transformation initiatives. This shortfall not only hinders the implementation of new technologies but also adversely affects innovation and strategic growth. Organizations need to invest in training and development programs that equip their workforce with the required skills. Additionally, collaborating with educational institutions and leveraging upskilling initiatives can help bridge the talent gap [44].

Digital transformation often involves multiple departments working collaboratively to realize

overarching objectives. However, interdepartmental silos are common in organizations, leading to fragmented efforts and a lack of cohesive direction. When departments operate in isolation, it can result in miscommunication, duplication of efforts, and a disjointed approach to digital initiatives. Breaking down these silos requires fostering a collaborative mindset and aligning cross-functional teams towards shared goals. Implementing tools that facilitate communication and information sharing between departments can also enhance collaboration, ensuring that digital transformation efforts are synergized across the organization [44].

Determining the ROI of digital transformation initiatives can be challenging. Many organizations find it difficult to quantify the benefits of digital investments, especially in the short term. While improvements in efficiency, customer experience, and innovation may result from digital transformation, translating these benefits into concrete financial metrics is often complex. Organizations need to establish clear metrics for success at the outset and adopt methodologies that enable them to track progress against their digital transformation goals. By setting key performance indicators (KPIs) and incorporating benchmarking against industry standards, organizations can better assess the efficacy of their digital strategies and make necessary adjustments [45].

The Role of Artificial Intelligence and Data Analytics:

In the 21st century, two technological advancements have increasingly dominated discussions within both academic and professional spheres: Artificial Intelligence (AI) and Data Analytics. Together, these innovations play a pivotal role in transforming industries, enhancing operational efficiency, and driving informed decision-making. As organizations strive for competitiveness in an era marked by rapid digitalization, understanding the intricacies of AI and data analytics becomes crucial [45].

Artificial Intelligence encompasses a range of technologies that allow machines to simulate human-like cognitive functions, such as learning, reasoning, problem-solving, perception, and language understanding. At its core, AI aims to create systems capable of performing tasks that traditionally require human intelligence. Dynamics within the realm of AI can be broadly categorized into two types: Narrow AI and General AI. Narrow AI, also known as Weak AI, refers to systems

designed to handle specific tasks, such as facial recognition or language translation. In contrast, General AI, or Strong AI, represents a theoretical construct where machines possess the capability to understand and reason at a human level across a wide array of subjects [46].

Recent advancements in machine learning, a subset of AI, have greatly amplified its capabilities. Machine learning algorithms enable systems to learn from data inputs, identify patterns, and make predictions without explicit programming for every scenario. Deep learning, a further evolution, mimics the human brain's architecture through artificial neural networks, leading to breakthroughs in image and speech recognition, autonomous vehicles, and personalized recommendations [46].

The Evolution of Data Analytics

Data Analytics is the science of examining raw data to draw conclusions, uncover patterns, and identify insights that drive decision-making. The advent of big data, characterized by vast volumes, velocity, and variety of data, has revolutionized how organizations approach analytics. Techniques in data analytics can be categorized into descriptive, diagnostic, predictive, and prescriptive analytics [47].

1. **Descriptive Analytics:** This involves summarizing historical data to understand what has happened in the past. Businesses utilize descriptive analytics for reporting and monitoring performance metrics, providing foundational knowledge for further analysis.
2. **Diagnostic Analytics:** While descriptive analytics tells what occurred, diagnostic analytics focuses on understanding why it happened. It employs methods such as data mining and statistical analysis to uncover causal relationships [47].
3. **Predictive Analytics:** By leveraging statistical algorithms and machine learning techniques, predictive analytics forecasts future outcomes based on historical data. This is widely applied in industries ranging from finance—where risk modeling is essential—to healthcare, where patient outcomes can be predicted.
4. **Prescriptive Analytics:** The most advanced form of analytics, prescriptive

analytics goes beyond prediction to suggest actionable recommendations. Utilizing simulation and optimization techniques, it aids in decision-making, allowing organizations to strategize optimally [47].

The Intersection of AI and Data Analytics

The convergence of AI and data analytics is creating a new paradigm in the technological landscape. AI enhances data analytics by automating complex data processing tasks, offering deep insights at unprecedented speeds. In turn, data analytics provides the foundation upon which AI systems operate—without vast amounts of high-quality data, the effectiveness of AI diminishes significantly [48].

For instance, in the realm of customer service, chatbots powered by AI can analyze customer inquiries in real-time while referencing historical data to provide tailored responses. This symbiotic relationship means organizations can expedite responses, enhance customer interactions, and develop a comprehensive understanding of consumer preferences [48].

Moreover, businesses are increasingly facing the challenge of data silos as organizations generate immense volumes of data across various platforms. AI-driven analytics tools shine in this aspect, as they can integrate and analyze data from disparate sources, providing a holistic view that enhances decision-making processes [49].

Applications Across Industries

The applications of AI and data analytics span numerous industries, each experiencing distinct transformations [50].

1. **Healthcare:** AI algorithms analyze patient data to identify at-risk individuals, optimizing resource allocation. Predictive analytics can forecast disease outbreaks by analyzing historical health data, geography, and socio-economic factors [50].
2. **Finance:** Financial institutions harness AI-driven analytics to identify fraudulent transactions, assess credit risks, and personalize financial products. Robotic process automation (RPA) enhances operational efficiency by automating repetitive tasks like data entry.

3. **Retail:** Retailers employ machine learning algorithms for inventory management, sales forecasting, and personalized marketing strategies, thereby enhancing customer engagement and optimizing shelf space.
4. **Manufacturing:** AI and data analytics are pivotal in predictive maintenance, where machines predict failures based on historical data and machine performance metrics, minimizing downtime and maximizing productivity [50].

Ethical Considerations

Despite the promising potential of AI and data analytics, ethical considerations loom large, particularly regarding privacy, bias, and accountability. As organizations increasingly rely on data-driven decisions, they must navigate the thin line between beneficial insights and invasive surveillance. The data used must be representative and not perpetuate existing biases that could lead to discriminatory outcomes [51].

Furthermore, transparency in AI algorithms is paramount. Stakeholders should understand how decisions are made by AI systems, ensuring that accountability rests with human oversight rather than opaque automated processes. As regulations regarding data privacy, such as the General Data Protection Regulation (GDPR) in Europe, evolve, organizations must remain diligent in adhering to ethical standards while leveraging technological advancements [52].

Impact of Telemedicine on Patient Care and Accessibility:

In recent years, the healthcare landscape has experienced a transformative shift with the rapid integration of telemedicine—a healthcare delivery model that utilizes technology to provide clinical services remotely. Telemedicine is not merely a supplementary approach but a revolutionary paradigm that has redefined patient care and accessibility. Its impact is profound, touching upon various dimensions of healthcare, including patient engagement, healthcare costs, treatment efficiency, and access to care for underserved populations [53].

At the heart of telemedicine is the goal to improve patient care by leveraging technology to extend the reach of healthcare services. One of the most significant advantages of telemedicine is its ability

to facilitate timely consultations. Patients no longer have to endure long waits for in-person visits, a barrier that often exacerbates health concerns. Through telehealth platforms, patients can connect with healthcare providers from the comfort of their homes, ensuring that they receive prompt attention. This immediacy can be crucial for chronic disease management, where regular monitoring and timely interventions are essential for optimal health outcomes [53].

Additionally, telemedicine enhances the quality of patient care by providing doctors access to a broader range of specialists and resources. No longer confined by geographic limitations, healthcare providers can consult with specialists across the globe, enriching their diagnostic capabilities and ensuring that patients receive evidence-based care tailored to their unique circumstances. This collaborative approach fosters a comprehensive healthcare environment that is holistic and centered around patient needs [54].

Moreover, telemedicine enhances patient engagement and education. Many telehealth platforms incorporate educational resources, enabling patients to access health information that aids in understanding their conditions. Interactive sessions can empower patients to take an active role in their healthcare management, aligning with the concept of shared decision-making. The more informed patients are, the better equipped they become to manage their health, follow treatment regimens, and achieve better outcomes [55].

One of the most profound impacts of telemedicine is its ability to increase accessibility to healthcare services, especially for populations traditionally marginalized or underserved. For individuals living in rural or remote areas, access to healthcare providers has often been limited due to geographic constraints. Telemedicine bridges this gap by removing the need for long-distance travel to obtain medical care. Patients can engage with healthcare providers from their homes, significantly reducing travel time, associated costs, and the burden on local healthcare facilities [56].

Furthermore, telemedicine plays a vital role in improving access for individuals with disabilities or mobility challenges. For these individuals, attending in-person appointments can be fraught with difficulties, including transportation issues and physical accessibility of healthcare facilities. Telehealth eliminates many of these barriers,

allowing patients to receive care without the additional stresses associated with in-person visits [57].

The COVID-19 pandemic further underscored the importance of telemedicine in ensuring continued access to care. Faced with lockdowns and social distancing measures, healthcare facilities turned to digital solutions to maintain their services. Patients could connect with their providers remotely, ensuring that necessary care continued while minimizing the risks associated with in-person visits during the pandemic. This crisis accelerated the adoption of telemedicine and highlighted its potential to be an essential component of the healthcare system even after the immediate crisis had subsided [58].

From an economic perspective, telemedicine can contribute to reduced healthcare costs for both patients and providers. Virtual consultations generally cost less than traditional in-person visits, which may involve overhead expenses for the healthcare facility and transportation costs for patients. This aspect can make healthcare more affordable, particularly for individuals who may struggle with healthcare expenses [58].

Moreover, telemedicine can lead to more efficient use of healthcare resources. By conducting follow-up appointments and routine check-ups virtually, providers can optimize their schedules and reduce patient wait times. Healthcare systems may also alleviate the strain on emergency services and urgent care facilities, allowing them to focus on acute cases rather than non-urgent visits that could be managed remotely [59].

Despite its advantages, the integration of telemedicine into mainstream healthcare is not without challenges. Issues regarding technological literacy among both patients and providers can hinder effective implementation. While younger, tech-savvy generations may adapt quickly to telemedicine, older adults or those with limited access to technology may struggle to utilize these services. Ensuring that all populations can benefit from telemedicine requires ongoing efforts to address the digital divide [60].

Privacy and security concerns also accompany the digitalization of healthcare. With the increased use of telehealth platforms, sensitive patient information is transmitted over the internet, making it susceptible to potential breaches. Therefore,

stringent security measures and regulations are paramount to safeguarding patient data and maintaining trust in telemedicine as a reliable form of care [61].

Moreover, reimbursement policies lagging behind technological advancements can pose a barrier to telemedicine's full potential. In many jurisdictions, reimbursement rates for telehealth visits remain lower than those for in-person consultations, potentially disincentivizing providers from adopting telemedicine practices. Policymakers must address this disparity to encourage broader adoption and facilitate equitable access to virtual healthcare services [62].

Future Trends and Recommendations for Healthcare Digitalization:

The healthcare landscape is on the cusp of a significant transformation, shaped by technological advancements and a shift toward digital solutions. As society continues to navigate the complexities of healthcare, the digitalization of health services emerges as both a priority and a necessity [63].

Healthcare digitalization refers to the integration of digital technologies into all aspects of health services. This includes electronic health records (EHRs), telemedicine, mobile health applications, artificial intelligence, and data analytics, among others. The overarching goal of healthcare digitalization is to enhance patient care, streamline operations, improve outcomes, and create a more patient-centric health system [64].

Key Trends Shaping the Future of Healthcare Digitalization

1. **Telehealth Expansion:** The COVID-19 pandemic accelerated the adoption of telemedicine as a viable means of delivering healthcare services. Future trends indicate that telehealth will continue to evolve, incorporating virtual reality (VR) and augmented reality (AR) to enhance the remote experience for both healthcare providers and patients. As regulatory frameworks adapt to support this modality, patients will demand flexibility [65].
2. **Artificial Intelligence and Machine Learning:** AI and machine learning are poised to revolutionize the healthcare landscape. With the ability to analyze vast volumes of data quickly and accurately, AI can assist in diagnostics, personalize treatment plans, predict patient outcomes, and optimize hospital operations. Future developments will see a greater emphasis on ethical AI practices, ensuring transparency and equity in AI-powered healthcare solutions [65].
3. **Wearable Technology and Remote Monitoring:** The growth of wearable devices, such as fitness trackers and smartwatches, is transforming how patients engage with their health. These devices enable continuous monitoring of vital signs and health metrics, facilitating proactive care. Future innovations will focus on enhancing data privacy and security while integrating seamlessly with EHRs and telehealth platforms [66].
4. **Interoperability and Data Exchange:** One of the persistent challenges in healthcare digitalization is ensuring that various digital systems communicate effectively. Future trends suggest a strong focus on developing interoperable systems that allow for seamless data exchange between different healthcare providers and IT solutions. This could enhance patient care coordination and facilitate more informed decision-making [67].
5. **Blockchain Technology:** The adoption of blockchain in healthcare can significantly enhance data security and integrity. Blockchain technology provides a decentralized framework for storing health records, ensuring that patient information is tamper-proof and easily accessible when needed. As concerns over data breaches mount, the use of blockchain is likely to gain momentum in the coming years [68].
6. **Patient Engagement and Personalization:** A notable trend in healthcare digitalization is the shift toward more patient-centric models. Future digital health solutions will increasingly focus on engaging patients in their own care through personalized health applications, gamification, and community-building initiatives. These approaches not only

foster adherence to treatment plans but also empower patients to take control of their health [69].

7. **Social Determinants of Health (SDOH):** Recognizing that health outcomes are influenced by various social factors, future digital health initiatives will increasingly address social determinants of health. Integrating social services into health IT platforms can provide a comprehensive approach to patient care, identifying and addressing disparities in health equity [96].

Recommendations for Stakeholders

As stakeholders in the healthcare ecosystem navigate the digital transformation, several recommendations can be made to ensure the successful implementation of healthcare digitalization:

1. **Invest in Training and Education:** Continuous education and training for healthcare professionals are vital to maximize the benefits of digital tools. Stakeholders should invest in training programs that enhance technological literacy and ensure staff are comfortable utilizing new digital solutions [70].
2. **Prioritize Data Security and Privacy:** With the increase in data exchange and reliance on digital solutions, patient privacy and security must be prioritized. Organizations should adopt robust data protection protocols, comply with regulatory standards, and foster a culture of privacy [70].
3. **Foster Collaboration Across Sectors:** To achieve true interoperability, collaboration among healthcare providers, technology vendors, and regulatory bodies is essential. Stakeholders should advocate for shared standards and frameworks that enable seamless communication and information exchange [71].
4. **Engage Patients and Communities:** Patient engagement should be a central focus in the design and implementation of digital health tools. Involving patients in the development process helps tailor solutions to their needs and equips them to play an active role in their healthcare [72].

5. **Monitor and Evaluate Impact:** It is crucial for stakeholders to continuously evaluate the effectiveness and impact of digital health initiatives. Implementing measurement and feedback mechanisms can help identify areas for improvement and ensure that digital solutions meet their intended goals [72].
6. **Emphasize Ethical Considerations:** Stakeholders must prioritize ethical considerations in the adoption of AI and other technologies in healthcare. This includes addressing potential bias in algorithms, ensuring equitable access to digital health resources, and maintaining transparency in technological applications [73].
7. **Promote Health Literacy:** Efforts should be made to improve health literacy among patients, as a better-informed patient population is essential for the success of digital health initiatives. This can involve providing resources, translations, and support to ensure all patients can navigate digital solutions effectively [74].

Conclusion:

In conclusion, the digital transformation of healthcare management in Saudi Arabia represents a pivotal shift towards enhancing the efficiency, accessibility, and quality of healthcare services. Through the strategic implementation of technologies such as electronic health records, telemedicine, and artificial intelligence, Saudi Arabia is not only addressing the immediate healthcare challenges posed by a growing population but also fostering a more proactive and data-driven approach to patient care. The commitment of the Saudi government to the Vision 2030 initiative underscores the importance of these advancements and their potential to revolutionize healthcare delivery.

However, to fully realize the benefits of digital healthcare transformation, ongoing collaboration between government entities, private sector innovators, and healthcare professionals is essential. Addressing challenges such as data privacy, infrastructure limitations, and resistance to change will be crucial to ensuring successful implementation and sustainability. As Saudi Arabia continues to navigate this digital evolution, it has the

opportunity to set a benchmark for healthcare transformation in the region, ultimately leading to improved health outcomes for its population and a more robust healthcare system aligned with global best practices.

References:

1. Gopal G., Suter-Crazzolara C., Toldo L., Eberhardt W. Digital transformation in healthcare—Architectures of present and future information technologies. *Clin. Chem. Lab. Med. CCLM*. 2019;57:328–335. doi: 10.1515/cclm-2018-0658.
2. Boonstra A., Versluis A., Vos J.F.J. Implementing electronic health records in hospitals: A systematic literature review. *BMC Health Serv. Res.* 2014;14:370. doi: 10.1186/1472-6963-14-370.
3. Eden R., Burton-Jones A., Scott I., Staib A., Sullivan C. Effects of eHealth on hospital practice: Synthesis of the current literature. *Aust. Health Rev.* 2018;42:568–578. doi: 10.1071/AH17255.
4. Attila S.Z., Miklos S., Tamas P., Viktoria S., Tamas J. Global and national overview of the digital health ecosystem. *Inf. Tarsad.* 2021;21:47–66. doi: 10.22503/inftars.XXI.2021.3.3.
5. Sanyal C., Stolee P., Juzwishin D., Husereau D. Economic evaluations of eHealth technologies: A systematic review. *PLoS ONE*. 2018;13:e0198112. doi: 10.1371/journal.pone.0198112.
6. Eden R., Burton-Jones A., Grant J., Collins R., Staib A., Sullivan C. Digitising an Australian university hospital: Qualitative analysis of staff-reported impacts. *Aust. Health Rev.* 2019;44:677–689. doi: 10.1071/AH18218.
7. Nazir S., Ali Y., Ullah N., García-Magariño I. Internet of Things for Healthcare Using Effects of Mobile Computing: A Systematic Literature Review. *Wirel. Commun. Mob. Comput.* 2019;2019:5931315. doi: 10.1155/2019/5931315.
8. Hu Y., Bai G. A Systematic Literature Review of Cloud Computing in Ehealth. *Health Inform. Int. J.* 2014;3:11–20. doi: 10.5121/hij.2014.3402.
9. Kampmeijer R., Pavlova M., Tambor M., Golinowska S., Groot W. The use of e-health and m-health tools in health promotion and primary prevention among older adults: A systematic literature review. *BMC Health Serv. Res.* 2016;16:290. doi: 10.1186/s12913-016-1522-3.
10. Iyawa G.E., Herselman M., Botha A. Digital health innovation ecosystems: From systematic literature review to conceptual framework. *Procedia Comput. Sci.* 2016;100:244–252. doi: 10.1016/j.procs.2016.09.149.
11. Kolasa K., Kozinski G. How to Value Digital Health Interventions? A Systematic Literature Review. *Int. J. Environ. Res. Public Health.* 2020;17:2119. doi: 10.3390/ijerph17062119.
12. Wilson L., Kim A., Szeto D. The Evidence for the Economic Value of Ehealth in the United States Today: A Systematic Review. *J. Int. Soc. Telemed. eHealth.* 2016;4:e21.
13. Gagnon M.-P., Ngangue P., Payne-Gagnon J., Desmartis M. m-Health adoption by healthcare professionals: A systematic review. *J. Am. Med. Inform. Assoc.* 2016;23:212–220. doi: 10.1093/jamia/ocv052.
14. Gjellebæk C., Svensson A., Bjørkquist C., Fladeby N., Grundén K. Management challenges for future digitalization of healthcare services. *Futures.* 2020;124:102636. doi: 10.1016/j.futures.2020.102636.
15. Pagliari C., Sloan D., Gregor P., Sullivan F., Detmer D., Kahan J.P., Oortwijn W., MacGillivray S. What Is eHealth (4): A Scoping Exercise to Map the Field. *J. Med. Internet Res.* 2005;7:e9. doi: 10.2196/jmir.7.1.e9.
16. Hosseinzadeh M., Ahmed O.H., Ehsani A., Ahmed A.M., Hama H.K., Vo B. The impact of knowledge on e-health: A systematic literature review of the advanced systems. *Kybernetes.* 2021;50:1506–1520. doi: 10.1108/K-12-2019-0803.
17. Marques I.C., Ferreira J.J. Digital transformation in the area of health: Systematic review of 45 years of evolution. *Health Technol.* 2020;10:575–586. doi: 10.1007/s12553-019-00402-8.
18. Kraus S., Schiavone F., Pluzhnikova A., Invernizzi A.C. Digital transformation in healthcare: Analyzing the current state-of-research. *J. Bus. Res.* 2021;123:557–567. doi: 10.1016/j.jbusres.2020.10.030.
19. Agarwal R., Gao G., DesRoches C., Jha A.K. Research commentary—The digital transformation of healthcare: Current status and the road ahead. *Inf. Syst. Res.*

- 2010;21:796–809. doi: 10.1287/isre.1100.0327.
20. Webster J., Watson R.T. Analyzing the past to prepare for the future: Writing a literature review. *MIS Q.* 2002;5:xiii–xxiii.
21. Kesavadev J., Krishnan G., Mohan V. Digital health and diabetes: Experience from India. *Ther. Adv. Endocrinol. Metab.*
22. Mobasheri MH, King D, Johnston M, Gautama S, Purkayastha S, Darzi A. The ownership and clinical use of smartphones by doctors and nurses in the UK: A multicenter survey study. *BMJ Innov* 2015 October 9.
23. Bhavnani SP, Narula J, Sengupta PP. Mobile technology and the digitization of healthcare. *Eur Heart J* 2016. May;37(18):1428-1438.
24. International Labour Organization (ILO). World employment social outlook: the changing nature of jobs. Geneva: International Labour Organization; 2015.
25. DePasse JW, Chen CE, Sawyer A, Jethwani K, Sim I. Academic Medical Centers as digital health catalysts. *Healthc (Amst)* 2014. Sep;2(3):173-176.
26. Widmer RJ, Collins NM, Collins CS, West CP, Lerman LO, Lerman A. Digital health interventions for the prevention of cardiovascular disease: a systematic review and meta-analysis. *Mayo Clin Proc* 2015. Apr;90(4):469-480.
27. Altuwaijri MM. Electronic-health in Saudi Arabia. Just around the corner? *Saudi Med J* 2008. Feb;29(2):171-178.
28. Storey D, Steadman T, Davis C. Is the gig economy a fleeting fad, or an enduring legacy? 2016.
29. Graham M, Hjorth I, Lehdonvirta V. Digital labour and development: impacts of global digital labour platforms and the gig economy on worker livelihoods. *Transfer (Bruss)* 2017. May;23(2):135-162.
30. Mukherjee SY. This startup is bringing the gig economy to health care with virtual doctor visits. *Fortune Brainstorm Health Daily.* 2017 Nov 15.
31. Kohn LT. Academic health centers: leading change in the 21st century. Institute of Medicine (US) Committee on the Roles of Academic Health Centers in the 21st Century. Washington DC: National Academies Press; 2004.
32. Brohan M. Hospitals broaden their use of digital healthcare. 2016 July 18.
33. Khalifa M. Barriers to health information systems and electronic medical records implementation: A field study of Saudi Arabian Hospitals. *Procedia Comput Sci* 2013;2013(21):335-342.
34. Valberg LS, Gonyea MA, Sinclair DG, Wade J. Planning the future academic medical centre. *CMAJ* 1994. Dec;151(11):1581-1587.
35. Digital health. Food and drug administration. 2016.
36. Toner M, Tompkins RG. Invention, innovation, entrepreneurship in academic medical centers. *Surgery* 2008. Feb;143(2):168-171.
37. Myhealthtalent.com. How virtual medicine affects physician recruitment. 2017 Mar 28.
38. Gregg HA. A preview of Parkland's new digital hospital. 2014 Sep 03.
39. National Transforming Program 2020. Ministry of health initiatives. 2017.
40. Rock health. Digital health funding: A year in review. 2013.
41. Cliff B. Using technology to enhance patient-centered care. *J Healthc Manag* 2012. Sep-Oct;57(5):301-303.
42. Al-Muhanna FA. The future of academic medical centers in Saudi Arabia: difficulties encountered in a teaching hospital. *J Family Community Med* 1999. Jul;6(2):23-28.
43. Zanutto O. Digital transformation of care for older people. *Int. J. Care Caring.* 2021;5:535–541.
44. Burmann A., Tischler M., Faßbach M., Schneitler S., Meister S. The Role of Physicians in Digitalizing Health Care Provision: Web-Based Survey Study. *JMIR Med. Inform.* 2021;9:e31527.
45. Gauthier P., Cardot J.-M. Health care digitalization, the straightest pathway to personalization. *Farmacia.* 2021;69:238–245.
46. Roth C.B., Papassotiropoulos A., Brühl A.B., Lang U.E., Huber C.G. Psychiatry in the Digital Age: A Blessing or a Curse? *Int. J. Environ. Res. Public Health.* 2021;18:8302.
47. Ali N.A., NawazTahir H., Jabeen R. Digitalisation provisions for controlling depression in developing countries: Short review. *J. Pak. Med. Assoc.* 2021;71:127–129.
48. Schmidt-Kaehler S., Dadaczynski K., Gille S., Okan O., Schellinger A., Weigand M., Schaeffer D. Health Literacy: Germany in the Digital Race to Catch Up Introduction of Technological Innovations is not

- Sufficient. *Gesundheitswesen Bundesverb. Ärzte Öffentlichen Gesundheitsdienstes Ger.* 2021;83:327–332.
49. Alterazi H.A. Towards Reaping the Promotions of Big Data in Healthcare Services. *Int. Trans. J. Eng. Manag. Appl. Sci. Technol.* 2021;12.
 50. Dang T.H., Nguyen T.A., Hoang Van M., Santin O., Tran O.M.T., Schofield P. Patient-Centered Care: Transforming the Health Care System in Vietnam With Support of Digital Health Technology. *J. Med. Internet Res.* 2021;23:e24601.
 51. Naumann L., Babitsch B., Hübner U.H. eHealth policy processes from the stakeholders' viewpoint: A qualitative comparison between Austria, Switzerland and Germany. *Health Policy Technol.* 2021;10:100505.
 52. Hoch P., Arets J. Video Consultation as a Model for the Acceptance of Digital Services in the Healthcare Sector. *Beweg. Gesundh.* 2021;37:151–156.
 53. Beaulieu M., Bentahar O. Digitalization of the healthcare supply chain: A roadmap to generate benefits and effectively support healthcare delivery. *Technol. Forecast. Soc. Chang.* 2021;167:120717.
 54. Bartosiewicz A., Burzyńska J., Januszewicz P. Polish Nurses' Attitude to e-Health Solutions and Self-Assessment of Their IT Competence. *J. Clin. Med.* 2021;10:4799.
 55. Bogumil-Uçan S., Klenk T. Varieties of health care digitalization: Comparing advocacy coalitions in Austria and Germany. *Rev. Policy Res.* 2021;38:478–503.
 56. Lu W.-C., Tsai I.C., Wang K.-C., Tang T.-A., Li K.-C., Ke Y.-C., Chen P.-T. Innovation Resistance and Resource Allocation Strategy of Medical Information Digitalization. *Sustainability.* 2021;13:7888.
 57. Mussener U. Digital encounters: Human interactions in mHealth behavior change interventions. *Digit Health.* 2021;7:20552076211029776.
 58. Saetra H.S., Fosch-Villaronga E. Healthcare Digitalisation and the Changing Nature of Work and Society. *Healthcare.* 2021;9:1007.
 59. Alimbaev A., Bitenova B., Bayandin M. Information and Communication Technologies in the Healthcare System of the Republic of Kazakhstan: Economic Efficiency and Development Prospects. *Montenegrin J. Econ.* 2021;17:145–156.
 60. Dick H., Doth S., Ernst C., Fischer S., Holderried M. Current developments on digitalization Analysis of quality and economics in healthcare. *Urologe.* 2021;60:1141–1149.
 61. Zoltan V., Borbala V., Tamas P., Judit L. Smart & Safe—Digitalisation strategy from a patient safety perspective. *Orv. Hetil.* 2021;162:1876–1884.
 62. Alt R., Zimmermann H.-D. The digital transformation of healthcare—An interview with Werner Dorfmeister. *Electron. Mark.* 2021;31:895–899.
 63. Zhao Y., Canales J.I. Never the twain shall meet? Knowledge strategies for digitalization in healthcare. *Technol. Forecast. Soc. Chang.* 2021;170:120923.
 64. World Health Organization (WHO). Non Communicable Diseases (NCD) Country Profiles-2014; 2014.
 65. Kuek SC, Paradi-Guilford C, Fayomi T, Imaizumi S, Ipeirotis P, Pina P, et al. The global opportunity in online outsourcing. Washington: The World Bank; 2015.
 66. Al Zahrani S. Health information system for Saudi Arabia – An Overview and guidelines. ICITNS 2003 International conference on information technology and natural sciences; 19-21 October 2003; Amman, Jordan.
 67. Ortiz E, Clancy CM, AHRQ Use of information technology to improve the quality of health care in the United States. *Health Serv Res* 2003. Apr;38(2):xi-xxii.
 68. Safavi K, Altuwaijri M. Patients want a heavy dose of digital. 2016.
 69. Shaprio LA, Angelo M. Teaching hospitals are the best place to test health innovation. *Har Bus Rev* 2014 Nov 21.
 70. de Grood C, Raissi A, Kwon Y, Santana MJ. Adoption of e-health technology by physicians: a scoping review. *J Multidiscip Healthc* 2016. Aug;9:335-344.
 71. Al-Abri R, Al-Balushi M, Kolehthekkat A, Bhargava D, Al-Alwi A, Al-Bahlani H, et al. The accuracy of IOS device-based uHear as a screening tool for hearing loss: A Preliminary study from the Middle East. *Oman Med J* 2016. Mar;31(2):142-145.
 72. ITU. ICT facts and figures 2016. Geneva: International Telecommunications Union. 2016.
 73. Jacobson S. A new world of care. The Dallas Morning News. 2015 Aug 14.

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74. Kumar S, Nilsen WJ, Abernethy A, Atienza A, Patrick K, Pavel M, et al. Mobile health technology evaluation: the mHealth evidence workshop. *Am J Prev Med* 2013. Aug;45(2):228-236.