

# Digital transformation in healthcare

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**Abstract-** Many health systems around the world are increasingly facing challenges when it comes to providing comprehensive care and treatment options, for example, due to ongoing demographic changes and aging societies<sup>1</sup>, leading to more patients and increasing age-related health problems<sup>2</sup>. These issues are often paired with structural and spatial disparities, especially in rural locations, resulting in an unfair distribution of medical facilities and practitioners, as well as barriers to access to care. At the same time, the exodus of general practitioners and specialists, as well as the absence of heirs to continue their practice, can be observed in many rural regions.<sup>3</sup> Reasons include, for example, a lack of attractiveness among young graduates to assert themselves in such fields or an inferior work-life balance due to high demand per capita.

**Index Terms-** health care management, organizational culture, technology application

## I. INTRODUCTION

The application of technology in care delivery processes can change the relationship between practitioners and patients, calling for new forms of cooperation based on mutual trust. Furthermore, for the efficient and satisfactory application of technologies in healthcare, users are increasingly obliged to

develop higher levels of technological efficiency as well as health literacy.

Further, the trend towards the establishment of specialized clinics in urban and more central regions can be overcome, potentially disadvantaging remote areas by taking away much-needed expertise. These challenges put increasing pressure on practitioners, who are obliged to adapt and cope with higher workloads. To this end, the application of digital technologies and telemedicine solutions in healthcare has proven to be an appropriate measure to deal with the threat of insufficient supply and shortage of care, thus functioning as a catalyst for change through technological progress. The adoption of digital approaches in nursing has led to a multitude of use cases that seek to modify medical routines to make them not only more robust and efficient, but also outcome-oriented and therefore satisfactory. Technologies, for example, appear in the form of video communications and consultation systems, mobile health solutions (mHealth), such as sensory equipment worn on the body, units of measurement,<sup>4</sup> mobile applications<sup>5</sup>, visual guidance systems<sup>6</sup>, as well as orthoses and smart implants.<sup>7</sup> These technological advances have enabled multiple digitally supported treatment scenarios, such as remote consultations with general practitioners, remote therapeutic examination and treatment, spatially independent measurement of patient data and subsequent transfer to the clinic, online appointment, digital prescription,

<sup>1</sup> Davis, S. and Bartlett, H. (2008), "Healthy ageing in rural Australia: Issues and challenges: Rural healthy ageing", *Australasian Journal on Ageing*, Vol. 27 No. 2, pp. 56–60.

<sup>2</sup> Demiris, G. and Hensel, B.K. (2008), "Technologies for an aging society: a systematic review of 'smart home' applications", *Yearbook of Medical Informatics*, Vol. 17 No. 01, pp. 33–40.

<sup>3</sup> Adarkwah, C.C., Schwaffertz, A., Labenz, J., Becker, A. and Hirsch, O. (2019), "Hausärzte (GPs) for Medical education in Siegen-Wittgenstein (HaMedSi) - Assessment of the occupational perspectives of General Practitioners in a rural area", *MMW Fortschr Med*, Vol. 161 No. S6, pp. 9–14.

<sup>4</sup> Aggarwal, D., Zhang, W., Hoang, T., Ploderer, B., Vetere, F. and Bradford, M. (2017), "SoPhy: A Wearable Technology for Lower Limb Assessment in Video Consultations of Physiotherapy", *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems*, ACM Press, Denver, Colorado, pp. 3916–3928.

<sup>5</sup> Barry, M., Doherty, K., Marcano Belisario, J., Car, J., Morrison, C. and Doherty, G. (2017), "mHealth for Maternal Mental Health: Everyday Wisdom in Ethical Design", *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems*, ACM Press, Denver, USA, pp. 2708–2756.

<sup>6</sup> Tang, R., Yang, X.-D., Bateman, S., Jorge, J. and Tang, A. (2015), "Physio@Home: Exploring Visual Guidance and Feedback Techniques for Physiotherapy Exercises", *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems*, ACM Press, Seoul, Republic of Korea, pp. 4123–4132.

<sup>7</sup> Ledet, E.H., Liddle, B., Kradinova, K. and Harper, S. (2018), "Smart implants in orthopedic surgery, improving patient outcomes: a review", *Innovation and Entrepreneurship in Health*, Vol. Volume 5, pp. 41–51.

online disease information and symptoms and telemonitoring of at-risk patients.<sup>8</sup>

## II. MODERN TECHNOLOGY APPROACH TO HEALTHCARE CULTURE

As addition to influencing treatments and therapeutic procedures, digital technologies also affect the people who use them, as well as their routines, habits and attitudes. As research has shown, the application of technology in care delivery processes can change the relationship between practitioners and patients, calling for new forms of cooperation based on mutual trust. Furthermore, for the efficient and satisfactory application of technologies in healthcare, users are increasingly obliged to develop higher levels of technological efficiency as well as health literacy. On the contrary, traditional care does not require consumers to actively contribute to treatment, the use of supportive digital technologies therefore requires new forms of engagement, with associated skills.<sup>9</sup>

Furthermore, patients need to develop their health literacy, which allows them to see their health problems and whether digital solutions are appropriate for solving them. These advances may eventually lead to new spending behaviors. There is a need to integrate the perspectives of more stakeholders in the design and application of technology, as a result, to take into account different expectations, attitudes, needs and reservations when it comes to the use of digital technology in healthcare. To this end, multiple approaches have been developed and used, which take an ethical and inclusive stance; they seek to integrate different stakeholder perspectives on the use of digital technologies in care when it comes to the development, testing and application of new systems. The research identified that the design of such technological solutions should be in line with the perceptions of their users in order for these technologies to be more acceptable, desirable and satisfactory for use. In light of the currently low rate of IT adoption in healthcare,<sup>10</sup> such efforts represent a major scientific task. Several approaches, such as “Responsible Innovation”<sup>11</sup> and “Value-Sensitive Design”), now enable holistic and deliberative design and development of stakeholder-oriented digital technologies in healthcare.<sup>12</sup>

## III. ARTIFICIAL INTELLIGENCE (AI) AND HEALTH CARE

Health care in the United States, which has historically focused on encounter-based care and treatment of diseases as they arise, rather than preventing them, is now undergoing a major transformation toward a more health-based approach to population health. This transformation occurs through a series of changes in the refund. Among these changes are multiple eras of managed care and population management research per capita and increases in value-based care and prevention, both of which attempt to manage the patient's overall health beyond treatment.<sup>13</sup> Despite this, health care costs in the United States continue to rise without adequate gains in key health outcomes compared to many similar countries. To assess where and how artificial intelligence (AI) can provide opportunities for improvement, it is important to understand the current context of health care and the drivers of change. AI is likely to promote automation and provide a synthesis of context-relevant information and recommendations (through a variety of tools and in many settings) to patients, “families” (friends and unpaid caregivers), and the clinical team. Artificial intelligence developers and stakeholders should prioritize the ethical collection and use of data and support the visualization of data and information using artificial intelligence.<sup>14</sup> Technological innovation and financing are guided by business criteria such as profit, efficiency and return on investment. It is important to explore how this will affect the development, evaluation and implementation of AI health. This reality is further challenged by the views of the US public and government on health and health care, which oscillate between health care as a social good and health care as an economic product. These considerations are likely to lead to some clear use cases in healthcare business operations: AI tools can be used to reduce costs and achieve efficiency by prioritizing the focus of human work on more complex tasks; to identify the workflow of the optimization strategy; to reduce medical waste (failure to provide care, failure to coordinate care, over-treatment or low-value care, failure to set prices, fraud and abuse, and administrative complexity); and to automate highly repetitive business and workflow processes using reliably recorded structured data.<sup>15</sup>

When applying these tools, it is crucial that you are thoughtful, fair and inclusive to avoid unwanted events and unintended consequences. This requires ensuring that artificial

<sup>8</sup> Aamodt, I.T., Lycholip, E., Celutkiene, J., Strömberg, A., Atar, D., Falk, R.S., von Lueder, T., *et al.* (2019), “Health Care Professionals’ Perceptions of Home Telemonitoring in Heart Failure Care: Cross-Sectional Survey”, *Journal of Medical Internet Research*, Vol. 21 No. 2, p. e10362.

<sup>9</sup> Hojat, M., Louis, D.Z., Maxwell, K., Markham, F., Wender, R. and Gonnella, J.S. (2010), “Patient perceptions of physician empathy, satisfaction with physician, interpersonal trust, and compliance”, *International Journal of Medical Education*, Vol. 1, pp. 83–87.

<sup>10</sup> Karsh, B.-T., Weinger, M.B., Abbott, P.A. and Wears, R.L. (2010), “Health information technology: fallacies and sober realities”, *Journal of the American Medical Informatics Association*, Vol. 17 No. 6, pp. 617–623.

<sup>11</sup> Owen, R., Stilgoe, J., Macnaghten, P., Gorman, M., Fisher, E. and Guston, D. (2013), “A framework for responsible

innovation”, in Owen, R., Bessant, J. and Heintz, M. (Eds.), *Responsible Innovation: Managing the Responsible Emergence of Science and Innovation in Society*, John Wiley & Sons, pp. 27–50.

<sup>12</sup> Friedman, B., Kahn Jr, P.H., Borning, A. and Huldgtren, A. (2013), “Value sensitive design and information systems”, *Early Engagement and New Technologies: Opening up the Laboratory*, Springer, Dordrecht, pp. 55–95.

<sup>13</sup> Kissam, S. M., H. Beil, C. Cousart, L. M. Greenwald, and J. T. Lloyd. (2019). States encouraging value-based payment: Lessons from CMS’s state innovation models initiative. *The Milbank Quarterly* 97(2):506– 542.

<sup>14</sup> Israni, S. T., and A. Verghese. 2019. Humanizing artificial intelligence. *JAMA* 321(1):29–30.

<sup>15</sup> Bauchner, H. and P. B. Fontanarosa. (2019). Waste in the US Health Care System. *JAMA* 322(15): 1463- 1464.

intelligence tools are aligned with user preferences and the end goals of these technologies, and that the tools do not exacerbate further historical inequalities in approach and outcomes. Driven by a shift to compensation and incentives for higher health management to increase personalization, innovation in AI technologies is likely to improve patient health outcomes through applications, workflows, interventions, and support for distributed health care delivery outside the traditional system, a meeting-based paradigm. The challenges of data accuracy and privacy protection will depend on whether AI technologies are regulated as a medical device or classified as an entertainment application. These consumer-facing tools are likely to support fundamental changes in the interactions between healthcare professionals and patients and their carers. Tools such as single-electrode ECG monitoring or continuous blood glucose monitors will transform the way health data is generated and used. They offer an opportunity to incorporate social determinants of health (SDoH) to identify patient populations for targeted interventions to improve outcomes and reduce health care utilization.<sup>16</sup> Since SDoH interventions are labor intensive, their scalability is poor. AI can reduce the cost of using SDoH data and provide effective means to prioritize scarce clinical resources to impact SDoH.<sup>17</sup>

The well-intentioned introduction of electronic health records and the incentives of the HITECH Law have contributed to the transformation of doctors into data entry officers, worsening of physician burnout and reducing patient satisfaction. To ensure that AI health care tools do not exacerbate this burden, a fundamental issue is the potential impact of AI on the patient-provider relationship. This could include further degradation of empathic interactions, as well as a mismatch between existing and required skills in the workforce. Throughout this publication, we emphasize the power of artificial intelligence to increase, not replace, human intelligence, because desirable attributes of people who choose to care for others include, in addition to scientific knowledge, the ability to love, empathize, care and care, be generous, be courageous in advocating for others, do no harm and work for the greater good and advocate for justice.

How can AI help clinicians nurture and protect these qualities? This type of challenge is rarely discussed or discussed at conferences on artificial intelligence and medicine, perhaps because it is considered messy and difficult to define. But if the goal is for AI to mimic the best qualities of human intelligence, it is precisely the territory that cannot be avoided. The American health care system can learn important lessons from the aviation industry, whose history includes many examples of automation that deals with small challenges, but also occasionally creates extraordinary catastrophes. The crash of an Air France plane from Rio to Paris in 2009 showed the potential "unintentional consequence of designing airplanes that anyone can fly: anyone

can accept you." In addition to degrading the basic skills of people who were once competent pilots, fourth-generation jets have enabled people who probably never had those skills to begin with and should not have been in the cockpit. As a result, the mental composition of the airline pilots has changed. More recently, disasters with the Boeing 737 Max caused by software problems offer another caution: complaints from competent pilots about next-generation aircraft have not been sufficiently addressed. Finally, just because technology allows a particular solution to be applied, it may still not be appropriate to do so. Recently, a doctor in California used a robot with a video link screen to tell a patient that he was going to die. After the disaster on social media and public relations, the hospital apologized, saying: "We do not support or encourage the use of technology to replace personal interactions between our patients and their care teams - we understand how important this is for all concerned, and we regret not fulfilling family expectations."<sup>18</sup> Techno-chauvinism in artificial intelligence will only further complicate the already complex and overburdened health system. In short, health care is a complex field that includes genetics, physiology, pharmacology, biology, and other related sciences with social, human, and cultural experience in health management. Health care is both a science and an art and calls into question the idea that simple and elegant formulas will be able to explain significant parts of health care delivery and outcomes.<sup>19</sup>

#### IV. CONCLUSION

In the modern health care system, many different decision makers communicate to care for patients and manage operations. The term health care describes a range of activities that may include, but are not limited to, any of the following: drug delivery / treatment, psychological assessment, physical examination of the patient, services provided by related health disciplines. This review mainly focuses on hospitals. Relevant research on health decision making is rare. Just as in the public sector as a whole, health care management has often drawn inspiration from the manufacturing industry, where the concepts of standardization and mass production are often central, and the customer is reduced to a passive recipient role. In which the customer is a passive recipient who receives a product at the end of the chain in the form of a "medicine" or "repair". In the late 1980s, Berwick developed the transfer of industrial quality management ideas into a healthcare context. In the decades that followed, different quality models from industry were introduced in different healthcare facilities. In general, change management in health care follows the same principles as change management in other types of organizations. The main difference is hierarchical structures that

<sup>16</sup> Lee, J., and C. Korba. (2017). Social Determinants of Health: How are Hospitals and Health Systems Investing in and Addressing Social Needs? *Deloitte Center for Health Solutions*. <https://www2.deloitte.com/content/dam/Deloitte/us/Documents/life-sciences-health-care/us-lshc-addressing-social-determinants-of-health.pdf>. (Pristupljeno: 21.02.2022).

<sup>17</sup> Basu, S., and R. Narayanaswamy. (2019). A Prediction Model for Uncontrolled Type 2 Diabetes Mellitus Incorporating Area-

level Social Determinants of Health. *Medical Care* 57(8):592–600.

<sup>18</sup> BBC News. (2019). *Man told he's going to die by doctor on video-link robot*. March 9. <https://www.bbc.com/news/world-us-canada-47510038>. (Pristupljeno: 22.02.2022).

<sup>19</sup> Toon, P. (2012). Health care is both a science and an art. *British Journal of General Practice* 62(601):434.

are more pronounced in health care than in other organizations. This can make communication difficult because hierarchical levels and professional privileges must be kept in mind. Management should improve the quality of services and care by understanding the requirements of patients with constant interaction with them and providing efficient health services through innovations in service management. Management should train its staff to properly communicate with patients and understand their problems and to address them in a timely manner to satisfy their clients. This, in turn, results in organizational improvement and helps health systems make a profit because clients trust them and spread positive feedback through word of mouth, which is one way of spreading information. This makes health systems sustain and flourish in the global market for a long time.

In addition, health management should collect feedback from patients after treatment and change the strategy accordingly

to satisfy users. Healthcare managers must be creative thinkers to be innovators, in order to improve the organization. As well as the opportunity to appoint innovative employees for the development of the organization, because it is important to have an innovative climate with innovative staff. The culture of an organization depends on innovative staff and the manager should establish a culture of innovation by having flexibility and providing assistance and feedback to staff as well as collaborating with them.

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