THE NEW LEADERSHIP PARADIGM IN DIGITAL HEALTH AND ITS RELATIONS TO HOSPITAL SERVICES

Sidhi Laksono,[1] Ede Surya Darmawan[2*]

[1] Master Program of Hospital Administration, Faculty of Public Health, University of Indonesia, Kampus Baru UI Depok, West Java 16424, Indonesia.
[2] Head of Hospital Administration Study Program, Faculty of Public Health, University of Indonesia, Kampus Baru UI Depok, West Java 16424, Indonesia.

ABSTRACT

The current and future of the healthcare system will face various problems, ranging from digitizing the health system, digital transformation and disruption of the health world or the problem of digital application during the Covid-19 pandemic in Health 4.0 and Community 5.0 and its leadership. The objective of the study is to explore digital information and the role of leadership in healthcare services in the future. This research is a narrative literature review and searched relevant articles from ProQuest and PubMed. Digital health is transforming healthcare delivery around the world to meet the evolving challenges of an aging population with a variety of chronic conditions. Digital transformation and disruptive innovation illustrate a comprehensive reorientation of the industry, including its business model due to the advent of digital technology in the form of digitizing products, services, and processes. Digital health products can be in the form of electronic health (eHealth), cellular health (mHealth), health information technology, teleconsultation (telehealth/telemedicine). All these digital products, if they cannot be applied now and in the future, will cause digital disruption in traditional healthcare services in hospitals. The current world of health also has an impact because of the COVID-19 pandemic, where this situation is a race for Health 4.0 and Society 5.0 (super smart people). Where Health 4.0 will relax and reflect digital health and implement it in Society 5.0. The leadership strategies that can be selected are systems thinking, contextual intelligence, and metacognitive strategies.

Keywords: *digital transformation and disruption, COVID-19 in Health 4.0 and Society 5.0, leadership in hospital*

ABSTRAK

Sistem kesehatan saat ini dan di masa depan akan menghadapi berbagai problematika, mulai dari digitalisasi sistem kesehatan, transformasi digital dan disrupsi dunia kesehatan atau permasalahan aplikasi digital pada masa pandemi Covid-19 di Health 4.0 dan Community 5.0 beserta kepemimpinannya. Tujuan studi ini adalah untuk menggali informasi digital dan peran kepemimpinan dalam layanan kesehatan di masa depan. Studi ini merupakan literatur review dengan mencari artikel yang relevan dari ProQuest dan PubMed. Kesehatan digital mengubah pemberian layanan kesehatan di seluruh dunia untuk memenuhi tantangan yang berkembang dari populasi yang menua dengan berbagai kondisi kronis. Transformasi digital dan inovasi yang mengganggu menggambarkan reorientasi komprehensif industri, termasuk model bisnis tersebut karena munculnya teknologi digital dalam bentuk digitalisasi produk, layanan, dan proses. Produk kesehatan digital dapat berupa kesehatan elektronik (eHealth), kesehatan seluler (mHealth), teknologi informasi kesehatan, teleconsultation (telehealth/telemedicine). Semua produk digital ini, jika tidak dapat diterapkan sekarang dan di masa depan, akan menyebabkan disrupsi digital pada layanan kesehatan tradisional di rumah sakit. Dunia kesehatan saat ini juga terkena imbasnya karena adanya pandemi COVID-19, dimana keadaan ini menjadi perlombaan untuk Health 4.0 dan Society 5.0 (super smart people). Dimana Health 4.0 akan menerapkan dan mengimplementasikannya dalam bentuk kesehatan digital di Society 5.0. Strategi kepemimpinan yang dapat dipilih adalah sistem berpikir, kecerdasan kontekstual, dan strategi metakognitif.

Kata kunci: transformasi dan disrupsi digital, Covid-19 dalam Kesehatan Era 4.0 dan Society 5.0, kepemimpinan di rumah sakit

Ede Surya Darmawan, Hospital Administration Study Program, Faculty of Public Health, University of Indonesia. Address: Jl. Margonda Raya, Pondok Cina, Depok, West Java, 16424. Email: edesurya@ui.ac.id

Introduction

The healthcare system faces major challenges in the form of increasing costs, demand for the provision of care for the elderly population, and other chronic disease problems.[1,2] Digital technology is able to eliminate these major challenges and improving health services; this is called digital health.[3] Digital health has been around for the past twenty years in the form of simple medical and also telehealth informatics, but the development of the literature on this topic has grown rapidly in the last five years.[4] Digital health consists of routine and innovative forms of information and communication technology to fulfill health needs and provide effective health interventions remotely. [5]

Digital health includes the presence of electronic health (eHealth), such as independent and web-based software (electronic health/e-health); smartphone apps (mobile health/mHealth), text messaging application; health information technology; telehealth/telemedicine; electronic medical record (EMR); and the use of developed computational science in big data, genomics, and artificial intelligence. A digitally activated system has the potential to shift the paradigm of health care systems. Adoption of new technology can increase the quality of patient care. This may transform future healthcare models to align primary and secondary services with self-management as the main pillar.[4,6] Currently, there is a digital transformation in health services, where if the hospital cannot apply digital technology to the hospital system, digital disruption will occur.[7] This disruption could interfere and lower the quality of medical services for the patients. Not to mention the current pandemic problem, resulting in a race against generation 4.0 and Society 5.0. Therefore, adaptation to the new era of digital health is an essential thing for medical personnel. Understanding digital health could lead to more innovation and more effective medical services. This article will briefly discuss digital health and digital disruption in-hospital services and how a new style of leadership method is needed in this transformation era to minimalize the disruption.

Methods

This article is a narrative literature review. Two authors independently do the literature searching using search engines such as ProQuest and Pubmed to search for the relevant article by using several keywords such as digital health, digital transformation, digital disruption, the race for COVID-19 in Health 4.0 and Society 5.0 and leadership. The inclusion criteria were relevant literature ranging from 2010-2020 (last ten years) or if it is less than the last ten years can be used according to the relevance of this article. The exclusion criteria were incomplete article, abstract only, inaccessible, proceedings books, and lecture materials. After sorting relevant articles, two

authors independently identified eligible articles. Different opinions between authors were resolved by reassessment and discussion.

Results

Study Selection

Through 2 databases (ProQuest and PubMed), we found 219 relevant articles as a result. After sorting the articles using inclusion and exclusion criteria, there are 64 articles that were included. There were 21 pieces of literature for digital health, 14 literature for digital transformations and digital disruption, 10 kinds of literature for Health 4.0 and Community 5.0, and as many as 19 pieces of literatures for leadership in health services.

Literature about digital health discusses the use of digital technology in health services to monitor and implement management strategies (smartphone applications, web-based software, telemedicine, big data system, and artificial intelligence). Literature about digital transformations and disruptions is focused on how traditional health services adapt and face challenges in the shifting of the health service. Lack of understanding could disrupt the quality of health services. Literature about leadership in health services discusses how future leaders should be able to adapt and break the old concept, so they are able to overcome the disruptions caused by digital transformation in the health field. Literature about Medicine 4.0 and Society 5.0 mainly discusses the introduction of digital technologies to the health system and how the implementation of smart technologies should be supported by a new evolved social model, society 5.0. Here below, we presented the chart for the literature searching strategy from ProQuest and Pubmed.
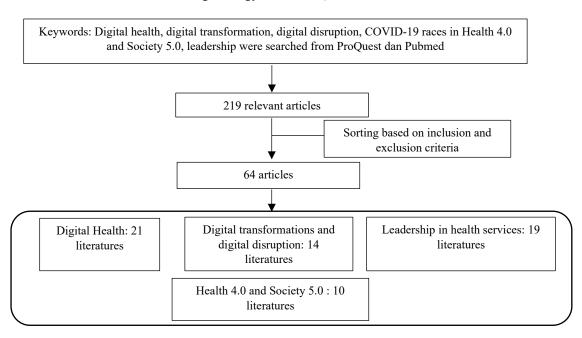
Keywords: Digital health, digital transformation, digital disruption, COVID-19 races in Health 4.0 and Society 5.0, leadership were searched from ProQuest dan Pubmed

219 relevant articles

Sorting based on inclusion and exclusion criteria

64 articles

Digital Health: 21 literatures

Digital transformations and digital disruption: 14 literatures

Leadership in health services: 19 literatures

Health 4.0 and Society 5.0 : 10 literatures

Figure 1. A literature search from ProQuest and Pubmed

Discussion

Digital health, which includes the programs of digital health care, is the combination of digital technology with health, healthcare, life, and for society to make health care delivery more efficient and make a more personalized and precise medicine.[3.6] Digital health is the use of technology of information and communication in the field of medicine and other health professions to manage the disease, health risks, and to improve fitness. Digital health has a broad scope and includes the use of wearable devices, mobile health, telehealth or telemedicine, and health information technology.[7,8]

Digital Health has gained momentum because of the expectation of improving health services, reduce flaws in health care systems, improve service quality, reduce health service costs, and provide more personal health services to patients.[6-8] Digital health (Figure 2) exists in the form of independent and web-based software (electronic health/e-health); smartphone apps (mobile health/mHealth), text messaging application, and wearable devices; health information technology; telehealth or telemedicine; electronic medical record (EMR); and the use of advanced computational science in big data, genomics, and artificial intelligence. [4-6]

Figure 2. Forms of digital health. A. Monitoring blood glucose levels with devices and applications connected to a smartphone. B. Smartwatch that can record patient's blood pressure. C. Recording ECG using a smartphone.[9]

There are several established technologies that support EHealth, such as electronic medical records (EMR), computerized provider order entry (CPOE), ePrescribing, and clinical decision support systems (CDSS). Those technologies are beneficial for the financial aspect and patient data. This has made eHealth the center of many government agendas around the world, [10] with 75% of hospitals in the United States implementing EMR.[11] However, reports on unintended negative consequences are increasing, with physicians using eHealth technology in unexpected ways.[12] In addition, some doctors refuse to use this system.[13]

An "application" is software that can be downloaded to a smart or mobile device, so it could enable certain activities to be performed. The development of health care applications has increased substantially since 2007, driven mainly by the rapid growth of mobile technologies such as smartphones, tablets, and smartwatches.[14,15] Those applications were developed to monitor the sleep patterns, give information for nutrition and diet improvement, record physical activity, perform tests and improve cognitive ability. They were also made to make a diagnosis, analyze health data, or send other clinical data to other health staff for further analysis.[15-18]

In this digitalization era, a new term of "telehealth" has been existed, which includes the concepts "telemedicine" and "telecare" .[19] There is no universal definition for these terms yet. However, telehealth can be understood as the use of electronic information and telecommunications technology to enable remote clinical health care, patients and professionals related to health education, public health, and health administration. Telehealth also includes clinical services provided by telemedicine and non-clinical services in remote areas, including provider training, administrative meetings, and continuing professional development.[19-21]

Telemedicine is also referred to as "providing clinical services to patients in other locations"[20] as shown in Figure 3. Examples include patient consultation via video link with a specialist or general practitioner, remote monitoring and evaluation of a patient's vital signs, remote medical assessment and diagnosis based on digitally transmitted medical data such as imaging, and drug prescription. Telecare refers to the use of technology that enables patients to do a home-based treatment, thereby avoiding the need to enter into hospital settings. The patients maintain their independence in a familiar environment while reducing costs and pressure on the health care system. [19-21]
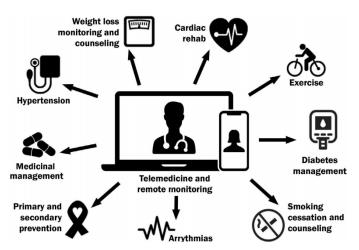
Figure 3. Clinical scenario and remote monitoring that can be used from telemedicine.[21]

Digital transformation is happening in hospitals nowadays, from traditional health services to digital (become paperless). Digital disruption is a condition where a change is facilitated by the rapid introduction of new digital technology and disrupts the usual ways of creating value, social interaction, business, and our thinking.[22] Poor understanding of digital disruption resulted in the failure of more than half of electric medical records (EMR) usage.[23,24] Digital disruption also occurs in hospital settings. It affects the workflow and causes anxiety in hospital staff. Therefore, digital disruption may raise a new challenge in assuring the safety and quality of healthcare services.[24,25]

Digital health can lead to disruption in its ability to support existing healthcare practices. This characteristic inevitably becomes a conflict or incompatibility of digital health in the form of health services with several models, processes, activities, and even community culture.[26] The lack of ability to overcome challenges due to digital change also complicates this phenomenon.[27] Indeed, Digital health provides a new approach to deliver services that is really novel compared to the traditional models based primarily on hospitals and has demonstrated its limitations, especially in chronic disease and aging populations.[28] Every country faces different challenges related to digital disruption in the digital transformation of the healthcare system.

Lack of a systematic and strategic vision on overcoming the complexity of the new reality, need, and expectation of recipients, apart from the process, procedure, practice, and operation that is certain to the healthcare ecosystem, has an important part in the disruption process. Indeed, digital transformation is not only a matter of technology development, strategy, vision, and the new skills for working, collaborating; it is also for experimenting.[29,30] Among the several emerging technologies that are being implemented, only a few that aim for innovation. The influence of vertical measures often becomes the limitation in integrating the complexity that characterizes the

health care sector. Restriction or partition in the entry of digitalization is the enemy of the collaboration, creativity, and innovation that digital health has to offer.

The capability of the health care system to be a part of digital transformation is one of the big questions, especially when it comes to reconfiguring the existing models along with the development of new skills and capabilities related to digitization, which we can call "production capabilities".[31] Existing information and telecommunications technology will cause hospital institutions and health systems to learn new skills and abilities to adapt with unexpected technological changes and also citizens' needs and expectations.[31] Health systems are slow in identifying and understanding the potential, and also the challenge, namely digital health. The decision-making process is more influenced by past experiences and less sensitive to future challenges.[32] Changes to new ecosystems can lead to the breakdown of current health care ecosystems that still use traditional systems, with new types of mediation in the end.[31,32]

Technology can be a potential factor for improving access to the healthcare system.[33] With artificial intelligence (AI) technology, it helps the medical staff to improve diagnostic decisions, treatment outcomes, and reduce medical errors.[34] AI is also able to overcome the challenge in human resource (HR) problems, such as recruitment and selection of potential health workers. However, we must be aware that AI development cannot directly solve all the HR problems for doctors.[34] AI also has its limitation in the entire medical process. AI is lacks of empathy, interpersonal communication, and physical touch that remain important. AI does not replace the importance of personal connection and trust between patients and medical staff. The role of the human doctor is essential. The presence of AI in the medical field is only as a supporting factor. AI also shifts the paradigm of the doctor-patient relationship. When digital health turns the well-known doctor-patient hierarchy into equal partnerships, what happens with the autonomy that has been at the heart of care.[34,35]

The Covid-19 (Coronavirus) pandemic resulting in lockdown, and is changing people's behavior and affecting the medical field with new challenges. Currently, with contactless medical services, the health facility has been affected by proximity risk. Continuous development and innovation in advanced technology such as artificial intelligence has a greater influence on the two new models namely Health 4.0 and Society 5.0.[37]

One area of the application is the health field. The risks of Covid-19 and the management of new health care processes allow health leaders in hospitals to rethink the appropriate health care models. To briefly understand the main innovation cycle in facing this pandemic, it can be seen from the four eras of representation in the world of medicine. Health 1.0, where most of the treatment is based on the underlying disease. Health 2.0 is patient-centered human health care that ranges from basic technology, is results-oriented, and focuses on prevention, with significant benefits for people, suppliers, and companies. Then, Health 3.0 represents a transitional moment

and overcomes the barriers associated with the alteration of the operation mode, through the forced introduction of advanced technology in the work process.[37,38]

The compact concept in this medical era increases the flexibility, through the utilization of "smart materials", transforming the health system where digital models are introduced. Emerging technology is of course, the main pillar of Health 4.0.[38] During this Covid-19 era, the transition period through medicine 4.0. must be supported by various essential aspects such as proper drug procurement, the use of robots as a supporting tool, especially at the Covid-19 referral facilities, which helps from the triage process, examinations to providing patient therapy. The entire system is also important to be supported by the use of a 3D printer, a digital environment to support information communication between patients and doctors, and between clinical departments.[39] The digitization of the manufacturing sector opens up opportunities for "digital design," such as making virtual copies of patient data. This concept is not only able to reduce the possibility of errors occurring but also reducing costs and improving performance and quality for patients.[40] Use of robotic devices and sensors for data scanning, digitization and analysis, design and production using CAD / CAM, and 3D printing, can be done with the minimal human touch.[41,42] New immaterial and digital factories reengineer production systems through the smart network

In the new Health 4.0 scenario, AI plays an important role because it supports flexibility and also affects the quality of service, and more patients are using the one-on-one mode, such as in the medical imaging interpretation using AI-based system in some Covid-19 referral hospitals.[43] Collection and management large dimensions of patient care information introducing an emerging role to all smart technologies like machine learning and AI.[44]

Comprehensive relationships that improve the system need to be done such as increasing computing capabilities and memory storage devices (nanodevices); full concentration on the Internet of Things (IoT) which collects and connects data from various devices; the ability to perform more advanced algorithms as well as predictive capabilities; increase AI functionality for existing products (application processing, interface operations).[45] Technological advances are enhancing hospital functionality, such as the use of robotics and AGV (self-guided vehicles) and autonomous systems to assist hospital waste management processes, maintain safe supply chains, and reduce the risk of Covid-19 contact. Technology also enables patients to take an active part in patient management by collecting data using a mobile device. The use of automated systems for monitoring and collecting information can overcome the current challenges of AI, which include the inadequacy and accuracy of current data. The combination of smart implant systems, such as body sensors and AI chips enables the creation of assistive devices tailored to the patient's needs. Biomedical and health systems became stimulants for Health 4.0 transition. Smart devices enable agents to assess the clinical condition of the patient, based on the data mining process, and select

independently or according to the specialist's indication of the best decision (i.e., pharmacological therapy) and intervene via actuators.[43-45]

The transformation of the health care model should be supported by a new digital native of a super-intelligent society, called Society 5.0. Society 5.0, which is also known as Generation Y, is younger than millennials. Implementation of meaningful human-machine interface (HMI), an "ambient intelligent system" must be applied, where people can relinquish control in the decision-making process, with the confidence of technology usage.[44,45] The realization of HMI must always have access to digital technology because it becomes the important aspect for staying connected. However, this new model will make the patient management and doctor-patient relationship rely more on the machine learning system with minimal to no face-to-face interaction. Hence, the presence of technology and mass data greatly reshaped society. New challenges arise when digital data begins to be combined with other data such as clinical, molecular, and contextual data from large numbers of patients because it will present data that is varied and complex and in large volume. Digitalization of the healthcare system and big data paradigm will affect patients, medical systems, and also healthcare management.[44-46]

From the issue of digital transformation, leadership is needed in overcoming disruption. This leadership process uses four basic forms to support transformation: innovation forms that can empower teams to explore value-creating ideas using digital transformation; establishment of agile systems and hospital business types that rapidly design and deliver information technology implementations; learning forms to support reflective discourses that lead to organizational capacity building, and the form of adoption to decide when and what application to switch to the regular form in order to maintain the competitiveness of the hospital.[35,36]

In this digital environment, technology provides opportunities for current and future leaders to have options in receiving information and communication.[47,48] To adapt to a new, interconnected, and digitally-driven world, leaders need to utilize new abilities and strategies that are foreign to their predecessors.[49] The success of future leaders will be determined by the new paradigm and not by the old traditional leadership concept.[50,51] because the old concept is not fully prepared to deal with the impact of technology on business and social matters. Conversely, research reflects that new leadership strategies are needed, such as systems thinking,[52,53] contextual intelligence,[54,55] and metacognitive strategies.[56,57]

Senge et al.[58] defined system thinkers as "The profound change needed to accelerate progress towards the resolve of society's most difficult problems requires a unique type of leader - a system leader, someone who catalyzes collective leadership." A system leader is one who is able to provide solutions to systematically eliminate the most urgent social problems. The solutions provided do not only solve the problem but are also based on the underlying causes of a problem.[59] System leadership can only be occurred by looking at the entire interconnected system and

network. Contextual intelligence. Plato further explained the concept of leadership, "a true pilot must pay attention to years and seasons and sky and stars and winds, and whatever belongs to his art if he is to truly qualify for that command of a ship." Context becomes essential for leaders to lead in a current complex global environment that relies on network systems.[54,60] Global leadership is supported by the surrounding ecosystem, and contextual intelligence increases the understanding of the relation between leaders and contexts, thus enabling leaders to define the dynamic of their environment.[61]

Metacognitive strategies are important for leaders to conduct effective leadership. This includes understanding someone's idea and the elements and conditions that influence that thinking.[56] Metacognitive skills are key to identify and overcome potential reasoning challenges by promoting strategies for thinking about their thinking. The ability to learn and adapt quickly is becoming increasingly important as the global context becomes increasingly unstable, uncertain, complex, and ambiguous. Metacognition is essential and a constant repetitive learning process for a fast-paced VUCA (Volatility, Uncertainty, Complexity, and Ambiguity) environment.[62]

The limitation of this narrative literature review is that we still use data from abroad, so that its implementation in Indonesia cannot be done yet. In addition, most of the literature was taken in the form of studies and a case from journals, while for research that links digital health, digital transformation, digital disruption, Health 4.0, Society 5.0, and the role of leadership does not yet exist, so this can only be used as a consideration to see the changing conditions in the future (VUCA environment).

This narrative literature review study is expected to be able to help hospital leaders in dealing with the uncertainty of digital disruption in hospitals. Leaders can begin to conduct studies that may be in accordance with existing services in the hospital by including digital health in every health service and program.

It is expected that this narrative literature study can be continued into the form of systematic study and meta-analysis, predictor studies to assess hospital preparation in facing digital disruption through several linear regression variables or multivariate logistic analysis, so we can see the relationship can be implemented in the life of Health 4.0 and Community 5.0.

Conclusion

Implementation of medical services in the current era faces efficacy challenges. Through innovation, the digitalization of the health system becomes the solution to overcome those challenges. However, the shifting of this trend could cause disruption to the whole health system in its early implementation. Good and adaptive leadership is needed. Future health leaders should be innovative, adaptive, and capable of utilizing new strategies. Future leaders should implement leadership strategies in the form of systems thinking, contextual intelligence, and metacognitive

strategies. Therefore, digital health and digital transformation can be implemented into Health 4.0 and become a complete Community 5.0. Digital health in the future can lead to more effective medical services. However, human interaction must remain to exist.

Acknowledgement

We thank all those who have helped in carrying out for the publication of this review

Funding

No outside financial support for the review, authorship, and/or publication of this article

Conflict of Interest

We have no conflict of interest in writing this article.

.

References

1. Steven M McPhail. Multimorbidity in chronic disease: impact on health care resources and costs. Risk Manag Healthc Policy. 2016; 9: 143-156.

2. Maximilian Herrmann, Philip Boehme, Thomas Mondritzki, Jan P Ehlers, Stylianos Kavadias, Hubert Truebel. Digital Transformation and Disruption of the Health Care Sector: Internet-Based Observational Study. J Med Internet Res 2018;20(3):e104.

3. Chen, Connie E.; Harrington, Robert A.; Desai, Sumbul A.; Mahaffey, Kenneth W.; Turakhia, Mintu P. Characteristics of Digital Health Studies Registered in ClinicalTrials.gov. JAMA Internal Medicine. 2019; 179 (6): 838–840.

4. Ahmadvand A, Kavanagh D, Clark M et al. Trends and visibility of "digital health" as a keyword in articles by JMIR publications in the new millennium: bibliographic-bibliometric analysis. J Med Internet Res. 2019; 21: e10477.

5. World Health Organization (2019) WHO Guideline: Recommendations on Digital Interventions for Health System Strengthening: Web Supplement 2: Summary of Findings and GRADE Tables. Geneva: World Health Organization.

6. Bhavnani, Sanjeev P.; Narula, Jagat; Sengupta, Partho P. (7 May 2016). Mobile technology and the digitization of healthcare. European Heart Journal. 2016; 37(18): 1428–38.

7. Rebekah Eden, Andrew Burton-Jones, Ian Scott and Clair Sullivan. Effects of eHealth on hospital practice: synthesis of the current literature. Australian Health Review. 2018; A-D.

8. Woods L, Cummings E, Duff J, Walker K. Partnering in Digital Health Design: Engaging the Multidisciplinary Team in a Needs Analysis. Stud Health Technol Inform. 2018; 252: 176-181.

9. Sanjeev P. Bhavnani. Digital Health: Opportunities and Challenges to Develop the Next-Generation Technology-Enabled Models of Cardiovascular Care. Methodist DeBakey Cardiovasc J. 2020; 16(4): 296-303.

10. Hruby GW, Matsoukas K, Cimino JJ, Weng C. Facilitating biomedical researchers' interrogation of electronic health record data: ideas from outside of biomedical informatics. J Biomed Inform. 2016; 60: 376–84.

11. Gardner RM. Clinical information systems – from yesterday to tomorrow. Yearb Med Inform. 2016; S62–S75.

12. Zheng K, Abraham J, Novak LL, Reynolds TL, Gettinger A. A survey of the literature on unintended consequences associated with health information technology. Yearb Med Inform. 2016; 13–29.

13. Rathert C, Mittler JN, Banerjee S, McDaniel J. Patient-centered communication in the era of electronic health records: what does the evidence say. Patient Educ Couns. 2017; 100: 50–64.

14. Hwang, J. and Christensen, C. M. Disruptive innovation in health care delivery: A framework for business-model innovation. Health Affairs. 2017; 27(5): 1329–1335.

15. Massoomi MR, Handberg EM. Increasing and Evolving Role of Smart Devices in Modern Medicine. Eur Cardiol. 2019;14(3):181-186.

16. Andre Esteva, Katherine Chou, Serena Yeung, Nikhil Naik, Ali Madani, et. al. Deep learning-enabled medical computer vision. Digital Medicine. 2021; 4:5.

17. J. T. Kelly, P. F. Collins, J. McCamley, L. Ball, S. Roberts and K. L. Campbell. Digital disruption of dietetics: are we ready? J Hum Nutr Diet. 2020; 1-7

18. Kimberly Aguillard and Arthur Garson J. Patient Use of Cardiovascular Devices and Apps: Are We Getting Our Money's Worth? Methodist DeBakey Cardiovasc J. 2020; 16 (4): 291-5

19. Monaghesh, E., Hajizadeh, A. The role of telehealth during COVID-19 outbreak: a systematic review based on current evidence. BMC Public Health. 2020; 20: 1193.

20. Federica Segato, Cristina Masella. Telemedicine services: How to make them last over time. Health Policy and Technology. 2017; 6(3): 268-278.

21. Ahmed M. Soliman. Telemedicine in the Cardiovascular World: Ready for the Future? Methodist Debakey Cardiovasc J. 2020; 16(4): 283-90.

22. Riemer KGU, Hamann J. Digital disruption intermediaries. Sydney: University of Sydney; 2015. Available at:

https://ses.library.usyd.edu.au//bitstream/2123/12761/7/ADTL_Digital%20Disr
uptive%20Interme diaries-final.pdf

23. Keasberry J, Scott IA, Sullivan C, Staib A, Ashby R. Going digital: a narrative overview of the clinical and organisational impacts of eHealth technologies in hospital practice. Aust Health Rev 2017. doi:10.1071/AH16233

24. Sullivan C, Staib A, Ayre S, Daly M, Collins R, Draheim M, Ashby R. Pioneering digital disruption: Australia's first integrated digital tertiary hospital. Med J Aust. 2016; 205: 386–9.

25. Barnett ML, Mehrotra A, Jena AB. Adverse inpatient outcomes during the transition to a new electronic health record system: observational study. BMJ. 2016; 354: i3835.

26. Vertakova, Yuliya V; Rudakova, Olga V; Shadrina, Valentina V; Kobersy, Iskandar S; Belova, Irina N Strategy of Disruptive Innovation in Emerging Regional Markets: Factors of Success and Failure. Int J of Economics and Financial Issues. 2016; 6(8S): 1-6

27. Helbing D. The automation of society is next: How to survive the digital revolution. North Charleston, SC: Createspace, 2015:266.

28. World report on ageing and health. Geneva, Switzerland: World Health Organization, 2015.

29. Kane GC, Palmer D, Phillips AN, et al. Is Your Business Ready for a Digital Future? MIT Sloan Management Review. 2015; 56: 37.

30. Ricoul S. Quand l'économie numérique bouleverse l'innovation. Revue Gestion. 2016. Available online: http://lwww.revuegestion.ca/opinions/quand-leconomie-numerique-bouleverse-linnovation/.

31. Ansari, S., Garud, R. & Kumaraswamy, A. The disruptor's dilemma: TiVo and the U.S. television ecosystem. Strategic Management Journal. 2016; 37: 1829-1853

32. Alami H, Gagnon MP, Fortin JP. Digital health and the challenge of health systems transformation. Mhealth. 2017; 3: 31.

33. Tracking universal health coverage: First global monitoring report. WHO and World Bank Group 2015.

34. Mesko B. The role of artificial intelligence in precision medicine. Expert Rev Precis Med Drug Dev. 2017:1–3.

35. Meskó B, Drobni Z, Bényei É, Gergely B, Győrffy Z. Digital health is a cultural transformation of traditional healthcare. mHealth. 2017; 3: 38–8.

36. Mohan Tanniru, Jiban Khuntia and Jack Weiner. Hospital Leadership in Support of Digital Transformation. Pacific Asia Journal of the Association for Information Systems. 2018; 10(3): 1-24

37. McCall B. COVID-19 and artificial intelligence: Protecting healthcare workers and curbing the spread. Lancet Digit Health. 2020; 2: 166–167.

38. Wolf B., Scholze C. Medicine 4.0. Curr Dir Biomed Eng. 2017; 3: 183–186.

39. Javaid M., Haleem A., Vaishya R., Bahl S., Suman R., Vaish A. Industry 4.0 technologies and their applications in fighting COVID-19 pandemic. Diabetes Metab Syndr Clin Res Rev. 2020; 14: 419–422.

40. Guoguang Rong G., Mendez A., Bou Assi E., Zhao B., Sawan M. Artificial Intelligence in Healthcare: Review and Prediction Case Studies. Engineering. 2020; 6: 291–301.

41. Mangano F., Gandolfi A., Luongo G., Logozzo S. Intraoral scanners in dentistry: A review of the current literature. BMC Oral Health. 2017; 17: 149.

42. Ioppolo G., Cucurachi S., Salomone R., Saija G., Ciraolo L. Industrial Ecology and Environmental Lean Management: Lights and Shadows. Sustainability. 2014; 6: 6362–6376.

43. Zhang Wei C., Ziyong L., Junjie L., Chengbo L., Changsha L., Yuelong F., Changyong L., Yang L., Pei W., Yi H. 3D printing of ceramics: A review. J. Eur Ceram Soc. 2018; 39: 661–687.

44. Lewis S.J., Gandomkar Z., Brenner P.C. Artificial Intelligence in medical imaging practice: Looking to the future. J. Med Radiat. Sci. 2019; 66: 292–295.

45. Vaishya R., Javaid M., Khan I.H., Haleem A. Artificial Intelligence (AI) applications for COVID-19 pandemic. Diabetes Metab Syndr Clin Res Rev. 2020; 14: 337–339.

46. Medaglia R., Sun T.Q. Mapping the challenges of Artificial Intelligence in the public sector: Evidence from public healthcare. Gov Inf Q. 2019; 36: 368–383.

47. Bradley, J., Loucks, J., Macaulay, J., Noronha, A., & Wade, M. (2015). Digital vortex, Retrieved from Global Center for Digital Business Transformation website: http://global-center-digital-businesstransformation.imd.org/globalassets/digital_vortex_full-reportv2.pdf

48. Brodie, V. (2017, March). Agile public relations: Engaging stakeholders in a time of digital disruption. Paper presented at the International Organization of Social Sciences and Behavioral Research, New Orleans, LA. Abstract retrieved from https://www.researchgate.net/publication/318796346_Agile_Public_Relations_Engaging_stakeholders_in_a_time_of_digital_disruption

49. Petrie, N. (2011). Future trends in leadership development. Center for Creative Leadership (CCL). Retrieved from http://www.isacs.org/uploads/file/article CCL white paper Petrie vertical development.pdf

50. Bolden, R. Distributed leadership in organizations: A review of theory and research. International Journal of Management Reviews. 2011; 13(3): 251–269

51. Elkington, R., van der Steege, M., Glick-Smith, J., & Breen, J. M. (2017). Visionary leadership in a turbulent world: Thriving in the new VUCA context. Boston, MA: Emerald.

52. Ramosaj, D. S. B., & Berisha, G. (2014). Systems theory and systems approach to leadership. ILIRIA International Review. 2014; 4(1): 59.

53. Rios, M., Herremans, I., Wallace, J., Althouse, N., Lansdale, D., & Preusser, M. Strengthening sustainability leadership competencies through university internships. International Journal of Sustainability in Higher Education. 2018; 19(4): 739–753.

54. Khanna, T. A case for contextual intelligence. Management International Review. 2015; 55(2): 181–190.

55. Kutz, M., & Bamford-Wade, A. Understanding contextual intelligence: A critical competency for today's leaders. Emergence: Complexity and Organization. 2013; 15(3): 55–80.

56. Black, H., Soto, L., & Spurlin, S. Thinking about leadership: Metacognitive ability and leader developmental readiness. New Directions for Student Leadership, 2016; 149: 85–95.

57. Chua, R. Y. J., Morris, M. W., & Mor, S. Collaborating across cultures: Cultural metacognition and affect-based trust in creative collaboration. Organizational Behavior and Human Decision Processes. 2012; 118(2): 116–131.

58. Senge, P., Hamilton, H., & Kania, J. (2015). The dawn of system leadership. Stanford Social Innovation Review. 2015; 13(1): 26–33.

59. Sure, G. Creating the innovation ecosystem for renewable energy via social entrepreneurship: Insights from India. Technological Forecasting and Social Change. 2017; 121: 184–195.

60. Masciulli, J. Global public leadership in a technological era. Bulletin of Science, Technology & Society. 2011; 31(2): 71–80.

61. Zakeer Ahmed Khan, Allah Nawaz, Irfanullah Khan, Dera Ismail Khan. Leadership Theories and Styles: A Literature Review. Journal of Resources Development and Management 2016; 16:1-7

62. Thomas C. Reeves and Patricia M. Reeves. Educational Technology Research in a VUCA World. Educational Technology. Educational Technology. 2015; 55(2): 26-30.