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Systematic Literature Review on Opportunities for Digital Innovation in the Healthcare Sector

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Background and Purpose: The concept of digital innovation has garnered significant attention recently and has the potential to revolutionise industries. With the recent advancements in healthcare and the emergence of new digital technologies, this manuscript reports the results of a systematic literature review (SLR) aimed at identifying the opportunities that digital innovation can afford the healthcare sector. These opportunities could guide policymakers and healthcare practitioners in making informed decisions regarding the implementation of digital innovation in healthcare.
Methods: This study conducted a systematic literature review (SLR) that involved defining the purpose of the literature review, establishing inclusion and exclusion criteria, identifying data sources and search strategies, screening and determining eligibility, and making inclusion/exclusion decisions. This study also included quality assessment criteria to evaluate the selected publications. 1478 research papers were analysed using descriptive statistics and thematic analysis to identify themes from the papers included in the SLR.
Results: The findings presented nine themes related to opportunities for digital innovation in healthcare. The following themes were discussed: precision/personalised medicine/healthcare, interoperability, privacy, and security, improved decision-making process, real-time/remote monitoring, enabling new processes/services/products, training/education, knowledge acquisition/sharing, and other themes that could not be categorised. These themes include cost, effectiveness, and time management.
Conclusions: This study utilised thematic analysis to examine the themes that emerged from the findings. These themes centred around the opportunities for digital innovation in healthcare. Awareness about each opportunity for digital innovation in healthcare is discussed. This study discussed the limitations of this SLR and future research opportunities for policymakers and healthcare practitioners wanting to implement digital innovation in healthcare.

Keywords: Digital Innovation Opportunities, Healthcare, Systematic Literature Review

1 Introduction

With the emergence and advancement of technology, the concept of digital innovation has garnered significant attention in both research and practice [1]. The healthcare sector has faced pressure from various stakeholders, including healthcare providers, non-governmental organisations, physicians, medical practitioners, academics, regulators, policymakers, and patients to improve the quality of healthcare service delivery [2] [3]. There is a pressing need to enhance the quality of healthcare services considering the numerous challenges confronting the global health system. The challenges include access to affordable healthcare, a decline in living standards, an increase in the prevalence of life-threatening conditions, and a rise in the incidences of deteriorating health conditions [4] [5]. There is a growing need to explore the potential of digital innovation to transform and enhance the healthcare sector [4] [6]. According to Jha and Bose [6], digital innovation is the new wave of organisational, technical, and cognitive innovation practices that follow the digitalisation of physical artefacts. According to Lyytinen et al. [7], digital innovation is the creation of new combinations of digital and physical components to produce new products. According to Khan and Tariq [8], digital innovation is an idea, practice or object that is considered new and embodied in and enabled by digital technology. Considering the various definitions of digital innovation [6] [7] [8], this

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study adopts the definitions [7] [8] and refers to digital innovation as the combination of digital inventions, products, processes, and service innovations, as well as new ideas, their adoption, and diffusion which are facilitated by digital technology.

Some potential benefits of digital innovation in healthcare, such as easy access to complex data, cost savings, improved patient experience, and real-time monitoring, have not been adequately demonstrated in the implementation of new generations of digital innovations [4] [9]. The recent advancements in digital technologies, such as cloud computing, artificial intelligence, 3D printing, 5G Technologies, Internet of Things (IoT), Internet of Medical Things (IoMT), blockchain, and big data, present opportunities for digital innovations in healthcare [10] [11]. These technologies have the potential to transform and revolutionise how medical practitioners, policymakers, and patients manage healthcare services, processes, and products [12].

The nature of healthcare services requires interactions among various stakeholders at different levels of the organisation, all working towards a shared goal of improving patient well-being [12] [13]. Furthermore, challenges such as designing digital innovations for healthcare, conceptualising healthcare innovation products, standardising devices, and integrating with new technologies have led healthcare stakeholders to explore potential opportunities for digital innovation [14]. The lack of distinction between healthcare practices and knowledge has hindered the identification of potential opportunities for digital innovation implementation in healthcare [2] [15]. Healthcare practitioners and policymakers are realising the need to transform healthcare practices and promote advanced services that can respond to the needs of society and patients [16] [2] [11].

This manuscript presents the results of a study aimed to synthesise the different opportunities for digital innovation in healthcare that could guide policymakers and healthcare practitioners in making informed decisions about implementing digital innovations to enhance the quality of healthcare service delivery. The remaining sections of the manuscript are as follows: the materials and methods are outlined in section 2, followed by the results of the analysis in section 3. The discussion of results is presented in section 4, followed by the concluding remarks and future research in section 5.

2 Materials and methods

This study aims to synthesise and present a list of opportunities for digital innovation in healthcare. To achieve this, research articles were retrieved from the following database sources based on their quality and rating as high-impact research journals and conference papers: IEEE Xplore, PubMed, ScienceDirect, and SpringerLink. To ensure that only the relevant papers were retrieved, keywords were combined with the Boolean operators ‘OR’ and ‘AND’ and the wildcard ‘*’ (Digital innovation* AND Opportunities AND Healthcare ‘OR’ Health Innovation* AND Healthcare innovation opportunities). The inclusion and exclusion criteria used in this review were summarised in Table 1:

Table 1: Inclusion and Exclusion criteria

Inclusion criteria	Exclusion criteria
Studies that were published in English.	Sources that were not peer-reviewed.
Studies that were published between 2010 and 2022.	Sources whose reported outcomes did not focus on the opportunities for digital innovation.
Peer-reviewed studies (journals, conference proceedings, and book chapters).	Sources that were not aligned with this SLR's main purpose.
Studies that were aligned with this SLR’s main purpose.	Duplicate studies were excluded.

The systematic literature review was conducted between August and September 2022. A total of 1478 publications were retrieved from the four database sources. An additional 475 publications were retrieved from other sources, namely Scopus, Google Scholar, Web of Science, JSTOR, and ProQuest Central. After

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removing 712 duplicate publications, a total of 1171 publications were excluded based on the exclusion criteria set in this study. A total of 70 publications were screened, and at the end of the selection process, 43 publications were subjected to quality assessment questions. The quality assessment questions used in this study were as follows:

- Quality Assessment (QA)1: Does the research include a description of opportunities for digital innovation?
- QA2: Does the research explore themes/concepts relating to digital innovation?
- QA3: Does the research adequately document digital innovation opportunities in healthcare?

A publication was assigned a score of 1 if it met the QA criterion fully, 0.5 if it met the QA criterion partially, and zero if it did not meet the QA criterion at all. A publication had a maximum score of three if it met all three QA criteria. Only publications that partially or fully met the descriptions of the questions were considered. From 43 publications subjected to the QA questions, 12 sources were excluded, and 31 research papers were considered for final inclusion in this SLR. Figure 1 illustrates the source selection process.

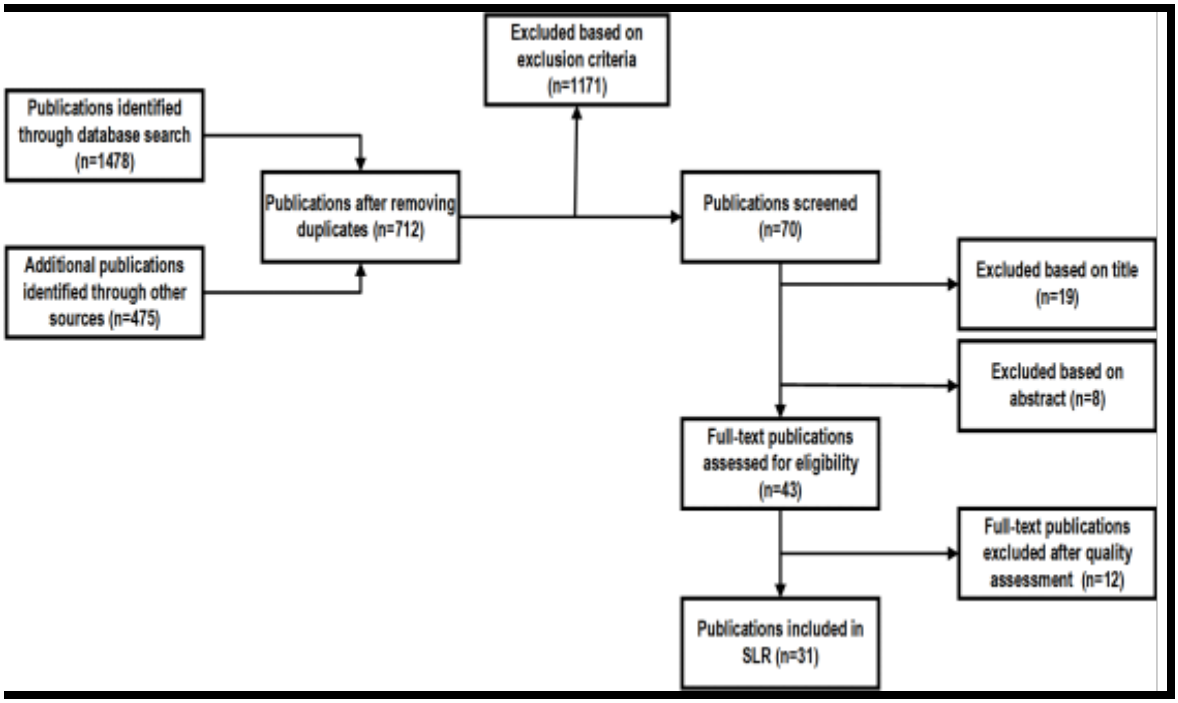

Figure 1: Source selection process

3 Results

The results were analysed based on the distribution of publications per database source, the year of publication, and the research methods employed. Descriptive statistics were used to summarise data on the distribution of publications. In this research, a thematic analysis was conducted to group the themes and concepts that emerged from the publications presented in Appendix Table 1. Thematic analysis is concerned with classifying and representing themes and patterns that relate to data [17]. According to Creswell and Clark [17], a thematic analysis is an active process that involves reading a set of data in which the researcher's subjectivity is at the centre of making sense of the data.

In this analysis, themes related to opportunities for digital innovation in healthcare were identified throughout all these publications. These concepts were grouped following the main themes that emerged, then reviewed, and later defined. The decision to select the thematic analysis was informed by the ability of the technique to allow the researchers to detect and identify concepts of digital innovation opportunities

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in healthcare. The choice of the technique was also informed by the opportunity afforded to researchers to understand the current practices of those involved in the use and implementation of digital innovation in healthcare and their ability to summarise data and make the necessary comparison between various publications.

3.1 Distribution per database sources

The analysis of the research papers according to their distribution per database sources is presented in Table 2:

Table 2: Distribution of publications per database source

Database sources	The number of publications	% of publications
IEEE	9	29%
PubMed NCBI	8	26%
ScienceDirect	7	23%
Springer	2	6%
(Others=Scopus, Google Scholar, Web of Science, DOAJ, JSTOR, and ProQuest Central)	5	16%
TOTAL	31	100%

The analysis of the publications per database sources revealed that 29% of publications came from the IEEE database source, followed by 26% of publications from the PubMed NCBI database source, followed by 23% of publications from the ScienceDirect database source. 16% of publications came from other sources combined and these included Scopus, Google Scholar, Web of Science, DOAJ, JSTOR, and ProQuest Central. The analysis further revealed that 6% of the publications included in this SLR came from the Springer database source. All the publications included in this SLR met the inclusion criteria set in this study. The contributions from these publications provided researchers with a lens to identify the opportunities for digital innovation in healthcare, which were further aligned with this SLR's objectives.

3.2 Distribution of publications by year

The analysis of the research papers according to their year of publication is presented in Table 3:

Table 3: Distribution of publications by years

Year	The number of publications (%)	Citations
2014	2 (6%)	[18] [19]
2015	1 (3%)	[20]

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2016	1 (3%)	[21]
2017	2 (6%)	[1] [22]
2018	2 (6%)	[3] [23]
2019	5 (16%)	[24] [25] [26] [27] [28]
2020	5 (16%)	[29] [30] [31] [32] [33]
2021	9 (29%)	[12] [14] [34] [35] [36] [37] [38] [39] [40]
2022	4 (13%)	[41] [42] [43] [44]
TOTAL	31 (100%)	

The analysis of the research papers according to the year of publications revealed that two publications were published in 2014, this was followed by one publication in 2015 and the other in 2016. Two publications were published in 2017, followed by two publications in 2018. The analysis also indicated five publications were published in 2019, followed by five publications in 2020. From 2019 to 2021, the number of publications addressing the opportunities for digital innovation increased. The analysis of the publications per year further showed that there was a dip between 2021 to 2022.

3.3 Distribution of publications by research methodology

The findings of the publications presented two research methodologies, namely, studies that followed qualitative research and studies that followed the quantitative research method. The findings also included publications that did not indicate any research method. The distribution of publications by research methodology is summarised in Table 4.

Table 4: Distribution of publications by research methodology

Research method	**The number of publications**	**Citations**
Qualitative	16	[1] [43] [3] [20] [18] [25] [14] [37] [29] [28] [24] [33] [36] [22] [42] [23]
Quantitative	4	[44] [21] [19] [31]
Unspecified	11	[34] [35] [32] [38] [12] [26] [39] [1] [40] [41] [30]

Thematic analysis was used to gather themes and concepts that emerged from the findings. The themes and concepts that emerged from the findings revolved around opportunities for digital innovation in healthcare and are presented in Appendix Table 1.

4 Discussion of Results

The analysis enabled the researchers to identify the opportunities for digital innovation in healthcare and provide a detailed description of these opportunities for digital innovation in healthcare as found in

Appendix Table 1. After conducting the thematic analysis, similar themes were grouped, and nine themes related to the opportunities for digital innovation in healthcare were identified.

4.1 Precision/personalised medicine/healthcare

The emergence of large-scale health information system initiatives using data from various sources has led to the development of precision or personalised medicine. This approach uses patient data and profiles, along with other analytics, to provide tailored products or services [45]. The approach is considered an advanced analytical technique, as it uses deep learning models to advance precision medicine due to its ability to process large amounts of diverse data with greater accuracy [45].

With the advancements in healthcare, precision medicine is now capable of making use of digital innovations to revolutionise the future of healthcare. This is achieved by facilitating the usage of patients' genetics to select, diagnose, and provide personalised treatments for their conditions [23] [26] [37]. One notable advancement that was previously unattainable is the ability to verify healthcare prediction models or systems, which has been made possible by digital innovation in healthcare [20] [29] [32] [35] [37] [43]. Digital innovation has enabled healthcare practitioners to receive assistance in interpreting and verifying complex medical data analytics. This ensures that transparency and decision-making are not prone to errors or doubts [3] [35] [37].

There are opportunities to detect symptoms early and collect data through digital innovations in healthcare. This can be aided by the analysis of community health situations, including previous pandemic analytics [20] [29] [35] [37]. Through personalised medicine enabled by digital innovation, tailored healthcare services offer an opportunity for improved standards of living and increased productivity [42] [43]. Some digital technologies driving personalised medicine are 5G Technologies, AI, Cloud Computing, the Internet of Things (IoT), and the Internet of Medical Things (IoMT) [3] [25] [26] [42] [43].

4.2 Interoperability

Interoperability plays a crucial role when two or more platforms need to exchange health information. It ensures that the information is received and translated into a format that can be understood by the receiving system or device [46]. With various overlapping functionalities in healthcare for exchanging patients' data, interoperability is necessary to harmonise healthcare solutions and facilitate communication to provide the necessary outputs [46]. Digital health technologies are examples that are said to promote interoperability in healthcare [24] [33] [40] [46]. One benefit of digital innovation is the potential for improved interoperability at the system level [24] [40].

With the advancements in digital innovation facilitated by healthcare technologies, interoperability occurs when essential requirements are met to enable the reliability and availability of health devices, and technical compatibility between various infrastructure and healthcare technology standards [24] [40]. There is an opportunity to align patients' data across organisational infrastructures to enable standards upon which further healthcare processes, services, and products can be built [22] [24] [40]. Another layer of contribution brought by digital innovation is the opportunity for aggregating medical data facilitated by digital health technologies [32]. Interoperability plays a crucial role in ensuring that different systems can communicate with each other seamlessly. Therefore, there is an opportunity to aggregate data from various digital technologies [32].

4.3 Privacy and security

With the increased connectivity of health information systems, the privacy and security of medical data and applications used to deliver services to patients have become critical components of the healthcare infrastructure [3] [20] [34] [44]. With the new advances in digital technologies, such as blockchain, big data, and the Internet of Things (IoT), so is the high level of sophistication brought about by these digital technologies to revolutionise how risks and threats posed to the healthcare infrastructure could be minimised [20] [26] [31] [34] [44]. Medical practitioners should consider the potential benefits of digital innovation facilitated by blockchain technology in providing an increased level of trust for managing

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medical infrastructures [34] [44]. The immutability of the ledger can be utilised to prevent tampering with medical data during transactions [20] [26] [44].

Digital innovation has presented an opportunity to reconsider the transparency of medical data, facilitated by digital technologies such as blockchain. This technology allows for the incorporation of a consensus method to verify medical records and transactions, which can address patients' relationships using distributed ledger technology [34] [44]. Digital innovation brings new opportunities for privacy and security, such as improving data quality, ensuring compliance, and enabling verification in healthcare [31] [42] [43]. These opportunities are driven by digital technologies such as artificial intelligence (AI), blockchain, and digital health technologies.

4.4 Improved decision-making process

The opportunities for digital innovation have expanded and now can improve decision-making efficiency in healthcare by utilising patient data and other data analytics [29]. Digital technologies such as artificial intelligence (AI), big data, digital health technologies and contactless services present new forms of digitalisation based on the massive use of data for knowledge extraction [29] [36]. These new forms of digitalisation enable the convergence of different areas of expertise to make better decisions and share information among various healthcare entities [25] [29] [36].

With the advent of digital innovation in healthcare, there is a convergence of diverse areas of expertise, resulting in more collaborative and distributed forms of cooperation among various stakeholders. This facilitates the sharing of information and enables better decision-making [25]. These forms of cooperation now involve closer involvement between stakeholders, the convergence of health processes, and improved coordination and communication among various healthcare entities [21] [25] [33] [36] [41]. The other aspect of this contribution to improving the decision-making process is the ability to measure the success of healthcare products and services [33]. According to Hein et al. [33], the success of healthcare services, products, and processes is not solely measured by their monetary value, but also by the collective responsibility and collaboration to solve problems and make informed decisions to execute plans for patient care.

4.5 Real-time / Remote monitoring

As patients increasingly demand quality healthcare services regardless of their location, there are opportunities to provide effective on-time medical support remotely [36] [43]. The advent of digital technologies such as 5G Technologies, AI, the Internet of Things (IoT), cloud computing, and digital health has created opportunities for medical practitioners to provide accurate interpretation of clinical tests remotely and analyse medical data in real-time [29] [36]. These digital technologies have further made it possible to provide accurate interpretations of clinical tests that align with appropriate treatments [21] [29] [36] [39].

There is also an opportunity for remote monitoring to manage patients' data by utilising medical data from various sources. This data can be further analysed using a query to profile cases of patients who were previously tested [20] [35]. Furthermore, digital technologies enable mobility and scalability even when medical data is stored in stationary infrastructure [14] [20] [27] [41].

4.6 Enabling new processes, services, and products

This study emphasises the importance of digital innovation and highlights the potential for creating new patient-oriented services, processes, and products for both patients and healthcare entities [3] [43]. One important consideration to note is the potential for enhancing healthcare operational procedures that extend beyond the confines of the healthcare industry [3] [25]. Improved operational procedures in healthcare are being driven by digital technologies such as blockchain, big data, the Internet of Medical Things (IoMT), cloud computing, and digital health technologies [3] [12] [25] [43].

The use of big data and AI in healthcare is believed to drive digital innovation and improve health processes. Healthcare practitioners can leverage health outputs, advanced health analytics tools, and

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insights to develop successful strategies that aim for better outcomes and improved patient experiences at lower costs [3] [12]. Furthermore, the advent of digital innovation, including 5G Technologies, IoT, cloud computing, and big data, presents new opportunities to enhance data processing capabilities. These technologies enable the collection, aggregation, cleaning, and updating of medical data, which can inform strategic decisions regarding medical treatments, interventions, and procedures [12] [14].

According to Mackey et al. [26] and Javaid et al.[41],digital innovation facilitated by technologies such as blockchain, IoT, IoMT, contactless services, and digital health technologies creates an opportunity to integrate and automate healthcare processes. Digital health technologies, such as 5G Technologies, IoT, IoMT, and cloud computing, have opened new doors for healthcare practitioners to closely examine the services, processes, and products that could be improved to ensure their sustainability more efficiently [33] [25] [43]. Moreover, the implementation of digital health technologies has enabled digital innovation, which is expected to introduce new capabilities for redesigning healthcare business models and optimising healthcare resources to meet patients' expectations. This in turn will help healthcare entities capture the necessary value for long-term sustainability and improve patients' well-being [27] [33] [34] [41] [44].

4.7 Training/Education

The advent of digital health technologies, big data, and contactless services has facilitated digital innovation, providing opportunities to acquire the knowledge and training necessary to drive new healthcare services, processes, and products [8] [27] [43]. With the advances in digital innovation, it has become crucial to train and educate healthcare professionals [27]. According to Kucharska [8] and Saraswat et al. [43], there is a growing need to train and educate healthcare professionals to ensure they have a shared understanding of the team's approach to managing new services, processes, and products for the well-being of patients. This includes developing shared knowledge, skills, and attitudes.

4.8 Knowledge Acquisition/Sharing

Knowledge is a process of exchanging information, expertise, and feedback to create new ideas and knowledge [27] [43] [45]. Knowledge has become critical in healthcare for effectively achieving common goals and making important decisions [27] [43] [45]. To take advantage of the opportunities presented by digital innovation, facilitated by digital health technologies and contactless services, knowledge acquisition and sharing in healthcare is crucial [8] [43]. Healthcare managers and decision-makers must equip stakeholders with the necessary tools to ensure that decisions made in healthcare are well understood and supported [8] [43]. Furthermore, the advancement of digital technology in healthcare, including digital health technologies and contactless services, necessitates the acquisition of new knowledge. This opens up new opportunities to facilitate and create innovative ways of sharing and storing knowledge [43].

4.9 Additional themes

In this analysis, some themes that could not be grouped were discussed individually. Digital innovation has brought several contributions to the healthcare industry, including the opportunity for stakeholders to become more cost-savvy by eliminating high-risk fraud and duplication of services or processes where applicable, by using blockchain technology [21] [44]. One of the features of blockchain technology, such as a decentralised medical database system, is said to play a critical role in eliminating high-risk fraud and duplication of services and processes in healthcare [1] [21] [28] [30] [44]. Digital health technologies have brought about various contributions, including increased flexibility for medical practitioners to organise their time more effectively and manage tasks more intelligently. This has resulted in reduced time spent analysing patients' data and making necessary recommendations and clinical decisions [29] [41].

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5 Conclusion and future research

Identifying the appropriate digital innovations facilitated by digital health technology and aligning them with the need to improve the quality of healthcare services is not without challenges. This study identified nine themes related to opportunities for digital innovation in healthcare. These opportunities provide insights into the advancements in digital innovation that healthcare practitioners and policymakers can consider to improve the quality of healthcare services.

The findings of this study offer a valuable classification system for understanding the potential opportunities for digital innovation in healthcare. Choosing the most appropriate digital innovation for a specific healthcare setting can be a complex decision. However, the themes identified in this study provide a starting point for policymakers and healthcare practitioners looking to improve the quality of healthcare services. The detailed exploration of each theme related to digital innovation opportunities enables healthcare and policymakers to choose the most appropriate digital innovations facilitated by digital technology to implement in healthcare.

This SLR also highlights potential areas for future research. While exploring themes related to the opportunities for digital innovation in healthcare, this study identified limitations in conducting this SLR. This SLR was conducted from August to September 2022, and this study recommends that future research extend the search period to further explore opportunities for digital innovation in healthcare. This SLR identified four database sources: IEEE Xplore, PubMed, ScienceDirect, and Spring Link. Additionally, Google Scholar, Web of Science, JSTOR, and ProQuest Central were also considered for identifying relevant publications. However, it is important to note that the limitation of this SLR lies in the fact that the identification process was limited to these sources, potentially excluding valuable insights from other sources related to digital innovation opportunities in healthcare. Furthermore, the exclusion criteria used in this SLR may have limited the exploration of additional opportunities for digital innovation.

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Statement on conflicts of interest

No conflict of interest

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Appendixes :
Appendix Table 1: A summary of opportunities for digital innovation in healthcare

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A summary of opportunities for digital innovation in healthcare			
Themes	Grouping of concepts	Description and application in healthcare	Citations
Precision/ personalised medicine/ healthcare	Precision medicine	The opportunity that digital innovation brings in reinventing the future of healthcare by facilitating the use of patients' genetics, environment, and lifestyle to select, diagnose, or provide treatment that best works for them.	[23] [26] [37]
	Increased openness toward approaches to personalise treatments and development of supportive digital health solutions	The opportunity that digital innovation brings in addressing the high complexity of treatment and approaches to medications as well as the uniqueness of patients' characteristics to meet their health needs.	[33]
	Improved adherence to medications with a narrow therapeutic window	The opportunity that digital innovation provides healthcare practitioners in enforcing adherence behaviour in treatment while narrowing the therapeutic window which could expose patients to other possible disease-related consequences and adverse effects.	[33]
	Better coordination between various healthcare entities	The opportunity that digital innovation provides health practitioners to better understand the communities that they are serving and develop interventions and outreach efforts to improve access to care.	[21]
	Early symptom detection and data creation	The opportunity that digital innovation provides in the early detection of symptoms and data creation to aid in the analysis of community health situations including pandemics.	[20] [35] [37]
	Verifiability of healthcare prediction models/systems	The opportunity that digital innovation provides in interpreting and verifying complex medical data analytics to ensure that transparency and decision-making are not prone to any errors and doubts.	[14] [20] [27] [29]
	Remote monitoring of health and wellness data	The opportunity provided by digital innovation to facilitate real-time delivery of wellness and medical data. Some applications of digital technologies in healthcare enabled improved connectivity and data access in remote areas.	[41]
	Remote robotic surgery	The opportunity for digital innovation to enable remote delivery in areas without fixed infrastructure and requiring mobility. The application of digital innovation in healthcare provides improved latency, reliability of data, and security coverage.	[27] [41] [43]
	Increased productivity and standard of living in a society	The opportunity for digital innovation to improve the lives of patients by increasing the efficiency of healthcare outputs. This will further allow patients to receive faster service in the same amount of time.	[38]

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	Interactive and tailored health care service(s)	The opportunity presented by digital innovation is to provide healthcare practitioners with educational healthcare resources that are tailored to a patient's specific treatment or procedure needs.	[20]
	Smarter medication	The opportunity for digital innovation lies in introducing real-time medication management and linking it to a health monitoring system. The application of digital technologies in healthcare can facilitate improved connectivity and data coverage in remote areas, further enhancing access to health services.	[27]
	Optimisation for the use of medicines	The opportunity presented by digital innovation to facilitate the safe and effective use of medicine from a patient-centred perspective is crucial in ensuring that medical interventions, treatment, and procedures result in the best possible outcomes.	[33]
	Reduction in unplanned visits and hospitalisation	The opportunity that digital innovation offers to detect health issues early and address them with precision. This opportunity further reduces unplanned hospitalisations from patients.	[29]
	Increased patient well-being and health	The use of digital health technologies presents an opportunity for patients to meet their medical needs in a most engaging and user-centric way while saving costs.	[3] [18] [21]
	Reduction of medical errors	The opportunity provided by digital innovation to improve upon failures resulting from communication issues and limitations in accessing patients' records.	[42]
	Patient-centric identity	The opportunity presented by digital innovation is to empower patients with the right to consent to and choose how their data is used in exchange for health services or even compensation.	[26] [41]
	Improved healthcare operational procedures	The opportunity for digital innovation to expand beyond the boundaries of healthcare while improving clinical health practices.	[3] [25] [43]
Interoperability	Improved system-level interoperability	The opportunity presented by digital innovation facilitates alignment across organisational activities to provide the foundation upon which healthcare processes can built.	[22] [24] [40]
	Medical information sharing	The opportunity presented by digital innovation to facilitate the sharing of medical information in the most efficient manner possible.	
	Medical data aggregation	The opportunity that digital innovation provides to aggregate data from digital technologies can help manage the health of patients by observing treatment impacts and conducting remote evaluations. It can also provide alerts when certain medical conditions need to be addressed.	[47]
	Increased trust	The opportunity for digital innovation to enhance trust and safety in handling medical data is significant. The	

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		immutability of ledgers in blockchain technology can be utilised as an example to prevent tampering with medical data. This means that medical data transmitted during a transaction can remain unaltered and untampered with, making any unauthorised alteration of the data impossible.	[20] [26] [34] [44]
	Transparency	The potential for digital innovation to improve patient relationships by utilising distributed ledger technology that includes a consensus mechanism to verify medical records and transactions.	[34] [44]
Privacy and Security	Access control for data owners	The opportunity for digital innovation to facilitate data access through blockchain technology, allows data owners to grant, alter, and revoke permissions for accessing data. This may provide various levels or degrees of security access.	[18] [21] [26] [34]
	Accessing data quality and certifying data source	The potential impact of digital innovation on the creation, access, and transmission of critical health data to ensure the reliability of medical information.	[3] [18] [31] [34]
	Increased medical data security	The opportunity that digital innovation brings to safeguard medical data and facilitate compliance among healthcare organisations and stakeholders who use medical data.	[42]
	Data privacy and compliance	The opportunity provided by digital innovation to ensure that medical data and records are only accessible to the health practitioners who require them during critical situations. This also entails that medical data and health records are identified and classified according to specific criteria and that they can only be shared with authorised healthcare professionals.	[19] [20] [26] [43]
	Increased data protection and regulation	The opportunity presented by digital innovation is the seamless facilitation of strategies and processes to secure and protect medical data.	[39]
Improved decision-making process	Closer involvement in the decision-making process	The opportunity for digital innovation to involve patients in expressing their opinions about different treatment methods, sharing information, and accepting healthcare instructions or recommendations.	[29]
	Increased cooperation between more heterogeneous contributors	The opportunity presented by digital innovation is the convergence of various areas of expertise, resulting in more distributed forms of cooperation in healthcare.	[25]
	Improved convergence of health processes and outcomes due to more flexibility	The opportunity that digital innovation provides is the use of digital health technologies to enable more open design spaces, faster cycle times, instant releases and updates of medical data, and universal design patterns.	[25] [29] [33]

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	Improved new forms of measuring success	Digital innovation presents an opportunity to measure the value of healthcare digital offerings, overcoming the limitations of monetary-based measurements.	[21] [25]
	Improved collaboration and communication among various stakeholders	Digital innovation in healthcare provides an opportunity for practitioners to assume complementary roles, work collaboratively, share responsibilities for problem-solving, and make decisions to conduct plans for patient care.	[21] [25] [36] [41]
	Better coordination between various healthcare entities	The opportunity that digital innovation provides for health practitioners to better understand the communities they serve. This further helps in developing interventions and outreach efforts to enhance access to healthcare.	[21]
Real-time/remote monitoring	Real-time patient monitoring	The opportunity for health practitioners to utilise digital innovation to predict, analyse, and evaluate medical data in real-time. This service offers precise interpretation or conversion of medical data to ensure it is aligned with the appropriate treatment and decision-making processes.	[21] [28] [29] [36] [39] [43]
	Condition Tracking	The management of pandemics can benefit greatly from digital innovation, which allows for the use of standardised medical data and the collection of data from various sources. This data can later be queried to create profiles of patients who have been tested.	[35] [20]
	Remote monitoring of health and wellness data	The opportunity for digital innovation in healthcare is immense, as it can facilitate the real-time delivery of wellness and medical data. Some applications of digital technologies in healthcare allow for increased mobility and scalability.	[14] [20] [27] [41]
	Medical asset tracking and management	The opportunity for digital innovation to facilitate the automation of supply management and increase effectiveness. The application of digital innovation in healthcare includes increased connectivity, improved location accuracy using drones, and expanded connectivity and data access for outdoor procedures.	[27] [41]
	Remote robotic surgery	The opportunity for digital innovation to enable remote delivery in areas without fixed infrastructure and requiring mobility. The application of digital innovation in healthcare provides improved speed, reliability of data, and enhanced security.	[27] [41]
	Improved healthcare operational procedures	The opportunity for digital innovation to expand beyond the boundaries of healthcare while improving clinical health practices is significant.	[3] [25] [43]
	Maintain the patient's	The opportunity provided by digital innovation allows for patients' medical information to be utilised across	[3] [25]

	functional capacity and health	organisational and regional boundaries, where applicable.	
	Increase in medical data processing capacity	The opportunity presented by digital innovation to facilitate the collection, aggregation, cleaning, and updating of medical data is invaluable in informing strategic decisions related to medical treatments, interventions, and procedures.	[12] [14]
Enabling new processes, services, and products	Improved health processes	Digital innovation provides health practitioners with the opportunity to utilise health outputs, advanced health analytics tools, and insights to develop successful strategies that consistently aim for better outcomes, improved patient experience, and reduced costs.	[12]
	Creation of new business models and value propositions	The opportunity that digital innovation brings to healthcare is the ability to employ digital technologies to redesign healthcare business models that benefit healthcare organisations.	[12] [25] [28]
	Enabling outsourcing and offshoring of medical tasks and services	The opportunity for digital innovation in healthcare includes the ability to collaborate with third-party organisations that specialise in specific areas of digital health technology to perform particular functions or tasks. These digital health technology needs could be outsourced to another country.	[12]
	Automation of healthcare processes	The opportunity that digital innovation brings is to facilitate the modernisation of healthcare processes, making them more dynamic and responsive. This can improve patient satisfaction and the overall patient experience in a variety of ways.	[26]
	Integration of electronic health records across health and care providers	The potential of digital innovation to provide a more consistent and comprehensive approach to healthcare, including care and support, requires prioritising the delivery of health services through a cohesive set of methods, funding, administrative, organisational, and clinical levels that foster connectivity, alignment, and collaboration among various healthcare entities.	[26]
	Optimisation for the use of medicines	The opportunity presented by digital innovation to facilitate the safe and effective use of medicine from a patient-centred perspective is crucial in ensuring that medical interventions, treatments, and procedures yield the best possible outcomes.	[33]
	Decentralisation	As opposed to centralised access, where medical data storage is fragmented, digital innovation can decentralise access and increase transparency with affordable processing power by utilising blockchain technology in healthcare. This can make healthcare systems more robust and effective.	[34] [41] [44]
	Improved service structures that ensure long-term sustainability and patient-centeredness	Digital innovation provides an opportunity to empower patients with low health literacy and move them away from being passive. Digital innovation helps individuals become more responsible and capable of self-managing their medications.	[33]
	Improved efficiency and	The opportunity presented by digital innovation is to facilitate the allocation of available health resources to	[3]

	appropriateness of care and safety	where they are needed the most, while simultaneously improving the quality of healthcare services.	
	Change in services, products, experiences, and business ecosystem	The opportunity for digital innovation to facilitate new capabilities in designing business models and leveraging healthcare resources to meet patients' expectations and capture value.	[27]
Training/ Education	Building stakeholders' confidence	The opportunity that digital innovation brings is to equip stakeholders with basic knowledge to establish how decisions are made and to better understand the decision support system in healthcare.	[43]
	Smarter education and training	The potential of digital Innovation to enhance remote and augmented reality training for medical procedures. The application of digital innovation in healthcare includes improvements in latency, reliability, data throughput, extended coverage, and security.	[27]
Knowledge Acquisition/ sharing	Knowledge acquisition and knowledge sharing	The opportunity provided by digital innovation allows healthcare professionals to acquire and share new knowledge, ensuring that common goals are achieved effectively. The new generation of digital health technologies requires exposure to new knowledge acquisition to better support healthcare initiatives driven by digital innovation.	[8] [27] [43]
Additional themes	Cost-saving and effectiveness	The opportunity for digital innovation to facilitate the reduction of costs and time consumption, as well as the high risk of fraud and duplication of medical data and products, can be achieved through a more decentralised medical database system.	[1] [3] 18] [21] [28] [29] [30] [44]
	Manage human health	The opportunity that digital innovation brings is to test symptoms and take appropriate or corrective medical measures.	[32] [35]
	Effective time-management	Digital innovation offers health practitioners the opportunity to intelligently organise their time, manage tasks and processes with greater productivity, and improve the quality of their work.	[29] [41]
	Timesaving in the analyses of patients' data	Digital innovation presents an opportunity to reduce the time required for analysing patients' data and providing recommendations for appropriate treatments.	[29] [41]
	Reduced burden and anxiety	The opportunity for digital innovation to reduce the risks of a wide array of diseases and complications that may worsen patients' health conditions.	[29]

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