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The Impact of New Health Transformational on Nursing Practice: A Systematic Review of Current Trends of Nursing Care and Future Directions

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Abstract

Background: The rapid advancements in technologies such as the medical internet of things (MIoT), generative artificial intelligence (AI), and Healthcare 4.0 are transforming various sectors, particularly healthcare and education. While these innovations promise significant benefits, they also raise concerns regarding security, data privacy, academic integrity, and integration into existing systems.

Aim: This study aims to explore the impact of emerging technologies MIoT, generative AI, and Healthcare 4.0—on healthcare and education, examining both the opportunities they offer and the challenges they present. It also investigates the ethical, security, and operational challenges posed by these technologies and provides recommendations for their effective implementation.

Method: A systematic review of 10 selected studies was conducted to analyze trends, themes, and outcomes related to the adoption and integration of MIoT, generative AI in education, and Healthcare 4.0 technologies. The studies were selected based on their relevance to technological advancements, ethical considerations, and their impact on healthcare and education systems.

Results: The review highlighted several key trends, including the growing concern for cybersecurity in MIoT systems, the increasing adoption of AI tools in education, and the integration challenges of Healthcare 4.0 technologies in hospitals. While these innovations promise to enhance the quality of education and healthcare services, issues such as data breaches, academic integrity, and the lack of security standards in healthcare systems remain significant barriers to their widespread adoption.

Conclusion: The integration of MIoT, generative AI, and Healthcare 4.0 technologies presents both significant opportunities and challenges. To maximize their benefits, it is crucial to develop robust security frameworks, ethical guidelines, and strategies for effective integration

into existing systems. Future research should focus on addressing these challenges while ensuring the responsible use of these technologies.

Keywords: Generative AI, Internet of Things (Miot), Healthcare, Cybersecurity, Healthcare Innovation, AI in Medical Education, Educational Technology, Academic Integrity, Data Privacy, Technology Integration.

Introduction

Many healthcare organizations around the globe have experienced overhauls in the last few years due to changes in technologies, regulatory limns, and population characteristics (Duffy et al., 2022). All of these changes are substantially recasting the environment for practicing nursing, as well as the ways care is provided for, supervised, and assessed (Arif et al., 2024). While performing these transformations, healthcare organizations for nursing professionals have new roles that demand new technologies, improve patient-centered care, and provide cooperation in interdisciplinary teams to determine health care outcomes (Weston, 2020). This awareness simply means that nurses have to ensure they follow changes occurring in healthcare continuously, other changes include for instance electronic health records, telehealth and even incorporation of artificial intelligence in manner of decision-making (Alanazi et al., 2023; Alasmari et al., 2023; Srivani et al., 2023).

Acquiring the necessary technological expertise, healthcare moved to the digital era and dramatically changed the nursing practice (Ullah et al., 2023). Nurses increasingly use electronic health records; it has enhanced the accuracy and efficiency of entails concerning the patients. Telemedicine has also become prevalent and helps nurses to take care of patient's condition through virtual means (Ashraf et al., 2021). This lightens patient's hauling distance to healthcare facilities (Pham et al., 2024). Besides, today's people with the help of the wearable health devices and telehealth platforms are able to take more personal control of their disease and health state, for which the nurses serve as important contributors as well. Such technological advancements have undoubtedly influenced how nurses engage the patient, and the need to new competencies and volatile work relationships (Captari et al., 2022; Albasri et al., 2022; Alsaedi et al., 2022).

In light of patient-centeredness as the new direction for health care delivery, the basic practice of nursing is gradually changing (Harbell & Methangkool, 2021). This model also underlines the importance of using communication between the nurse and his/her patient recognizing the patient's values, preferences and needs (Yang et al., 2022). Now a days nurses are often expected to create meaningful communication, trust, and rapport with patients in order to design individualized intention plans. This shift also involves developing and exercising not only clinical competencies but also patient advocacy demanding that patient's voices be heard during decision-making (Bhugaonkar et al., 2022). Patient-centered care also that require nurses to consult with other professionals in the provision of health services making the delivery of services less fragmented (Kumar & Mallipeddi, 2022; Alruwaili et al., 2023; Almalki et al., 2023; Alselaml et al., 2023).

EBP has been embraced in today's nursing practice as a way of making the practitioners choose the best practices informed by research findings, their experience and the desires of their patients (Alzamily et al., 2024). The flood of scholarly information and online databases gives nurses increased opportunities to study the up-to-date evidence and practice accordingly and apply the best of them in their care processes (Bashir et al., 2023). However, the widespread adoption of EBP also has some drawbacks especially concerning nurses' competency in how to access and evaluate some of this research evidence (Zahlan et al., 2023). EBP is thus a crucial component of

practice improvement; however, it has to become systematized as a part of regular clinical practice and needs consistent professional development and backup (Patrício et al., 2020).

Another important result of health transformations has been the expanding of advanced practice nursing roles (Kraus et al., 2021). As the healthcare organizations grow and become more specialized. There has been a growing demand that nurses consume leadership roles geared towards practicing nurses such as nurse practitioners, Clinical Nurse Specialist (CNS) and Certified Registered Nurse Anesthetists (CRNAs) (Akinyemi et al., 2023). These Advanced Practice Nurses APNs are usually licensed to perform diagnoses, prescribe drugs, originate a variety of treatment and advice plans and treat patients with long-term illnesses among other responsibilities that used to be mostly performed by medical doctors. The emergence of the APNs can be seen on the recognition of the nursing profession and the competence of nurses in enhancing clients' outcomes especially in areas where access to physicians is hard (Narkhede et al., 2020). The increased utilization of APN roles is also associated with the concept of healthcare reform to increase the delivery of health care to the population (Arbabi et al., 2022).

Another key factor of the new paradigm of the healthcare organization is inter-professional collaboration. Nurses now find themselves in parallel with physicians, social workers, pharmacists, among other careers as they practice in a team (Cato et al., 2020). It builds up a team approach model of care, which increases patient outcome according to the research since it involves several disciplines. Nurses act as key coordinators in this process and may be the first and the only member of the multidisciplinary team to communicate with the patient (Landolsi et al., 2023). Consequently, techniques of communication, recognition of the other person's right, and participation in decision-making, are the crucial aspects that nurses should develop for their growing profession in this integrated work setting (Ayo-Farai et al., 2023).

However, the change in healthcare is not only the technological and organizational but also the expectations and requirement of the nursing force in the population (Husnain et al., 2023). Current challenges have put nurses into an expectation that they are supposed to embrace change, be creative, and persevere. New approaches to healthcare management, including value-based care and population health management require the nurse to expand the paradigms of individualist (patient-centered) to those of the community and system (Iyanna et al., 2022). This shift requires competencies that are different from the traditional nursing practice or practices of data analysis, health promotion among diverse population groups to meet health needs (Iyanna et al., 2022).

As mentioned, nursing practice has continued to evolve and this trend will exceptionally determine the future of this profession (Yang et al., 2022). Faced with the information-focused, patient-centered healthcare delivery systems today and in the future, the nursing profession will be at the forefront of transition in the healthcare systems (Bhugaonkar et al., 2022). There is a need to increase the training and education levels of nurses to meet such emergent demands primarily given the complexity of the labor market within which health care services are delivered. It will not be long that as a field (Arif et al., 2024). Nurses will be required to perform not only the general responsibility of administrating quality nursing care to patients, but they will also be expected to work towards defining the destiny of health care in the coming generations to come through innovation, leadership and advocacy (Duffy et al., 2022).).

Problem Statement

Present day technological development especially in the healthcare industry, changing policies and patient requirements are the factors that have brought great impacts in nursing (Iyanna et al., 2022). As these changes are gaining increased value in contemporary societies. There is still a research gap where critical synthesized evidence focuses on how these changes affect nursing

care delivery and the overall nursing workforce. Although numerous studies focused on various aspects of these changes, providing the current trend analysis and possible development in the short- and long-term perspectives for nursing practice is necessary to consider general tendencies and directions within the nursing profession and to guide it through these transformations systematically. This study aims at filling this void by analyzing the impacts of healthcare changes on practice, patterns of practice, and roles of the nursing profession.

Significance of the Study

This paper is equally relevant since it calls for new perspectives of understanding the transformations in health and how nursing practice is affected. To this end, while building on previous research, the paper should help advance the discourse on designs for enhancing the readiness of nurses for future trends and developments in the health care profession. The conclusions made in this current review can be imperative in influencing the nursing leaders to incorporate the recommendations when developing education and professional development programs aimed at preparing the modern day nurses to fit the current health facilities systems. However, the study will also discuss new directions for research that could improve the consequences of these changes on patient care and outcomes.

Aim of the Study

This study seeks to meet the following objective: To identify current trends in nursing practice in view of the changes that have occurred in health care provision and to discuss directions for future nursing care. This theoretical paper seeks to establish specific themes and patterns about Technological, policy and Demographic changes affecting nursing practice from the existing literature. The study will also offer recommendations to the nursing profession and healthcare organizations on how they can address these changes successfully and optimize the delivery of care to patients besides strengthening nursing professionals in the transform healthcare sector.

Methodology

Therefore, this current study is going to adopt a systematic review approach in pulling together available literature on effects of new health transformations on nursing. Details of analysis: A simultaneous search were made across the databases to use up the current year for the search string, so that only articles published between January 2020 and December 2024 are selected. The review will be methodologically sound, Mohamed (2020) recognizes the need to follow standardized guidelines, and hence the PRISMA guidelines will be applicable in this review. Only empirical studies were reviewed and data analyzed to compare and contrast the current trends in nursing care and likely future roles of the nurse in addressing health reforms.

Research Question

Research Question		How have recent health transformations (technological, policy, demographic) influenced nursing practice, and what are the future directions for nursing care?
Population	P	Nurses working in hospitals, primary care facilities, and community health environments
Intervention	I	Technological tools (telemedicine, electronic health records, AI), patient-centered care models, evidence-based practices, and inter-professional collaboration
Comparison	C	Pre-transformation nursing practices versus post-transformation practices influenced by health policy, technological advances, and demographic shifts.
Outcome	O	Changes in nursing workflows, patient care models, nurse-patient interactions, job satisfaction, and quality of care.
Timeframe	T	Literature published from 2020 to 2024.

Selection Criteria

Inclusion Criteria

1. Actually, articles that were published between the year 2020 and the year 2024 only.
2. Nursing research works whose core interest is on the influence of technological, policy, and demographic changes.
3. A paper type chosen is peer-reviewed articles, systematic reviews and research reports.
4. Proposals focusing on innovations in the delivery of care; on best practice; and on the nursing workforce.
5. Studies that were carried out in various health care facilities such as hospitals, community health centers, general practicing offices.

Exclusion Criteria (in bullet points)

1. Original research articles which were published before the end of 2020.
2. Letters to the editor, editorials, articles in the network newswire, and newspapers' op-ed section.
3. Studies that are not written to examine the effects of health transformations to practice nursing.
4. Works that are devoted to other schooling degrees of medical care that ignore nursing.

Database Selection

in addition to PubMed database, a systematic search in other scientific databases will be conducted using CINAHL, Scopus, and Google Scholar. These databases were chosen because they provide extensive indexing to the field of health care and nursing research. Research articles that meet the focus of transformed health environments, incorporate nursing practice, technological developments in nursing, and patient-centered evidence-based practice will be selected using keywords like health transformations, nursing practice, technological advances in nursing, patient-centered care and evidence-based practice. Of relevance to the research will be actual studies that advance the research question and, as importantly, have undergone proper methodological analysis.

Data Extracted

In this case data will be harvested from the chosen studies by means of a set of uniform data extraction pro forma. It will consist of general data section with the study aim and method, sample, health-care context, implemented interventions concerning health transformation (like technology enhancement, new care designs), measured outcomes especially in context of patient care quality, nursing practices and job satisfaction and general findings. Empirical work will also be classified according to the type of transformation (technological, policy change and demographic shifts) and characteristics of nursing practice, with sensitivity to trends which may emerge for the improvement of nursing care in the future.

Syntax

Primary Search Syntax
("health transformation" OR "healthcare transformation" OR "health policy changes") AND ("nursing practice" OR "nursing care" OR "nurse workforce") AND ("technological innovations" OR "telemedicine" OR "electronic health records" OR "AI" OR "patient-centered care") AND ("evidence-based practice" OR "inter-professional collaboration" OR "care models") AND ("impact" OR "effects" OR "outcomes")

AND ("nursing trends" OR "future directions" OR "nursing practice evolution") AND ("2020" OR "2021" OR "2022" OR "2023" OR "2024")
Secondary Search Syntax
("nurses" OR "nurse workforce") AND ("healthcare settings" OR "hospitals" OR "primary care" OR "community health") AND ("patient care delivery models" OR "workflow changes" OR "nurse-patient interactions" OR "job satisfaction" OR "care quality") AND ("technological advancements" OR "policy transformation" OR "demographic changes") AND ("nursing practices before and after") AND ("systematic review" OR "literature review") AND ("impact of healthcare transformation") AND ("2020 to 2024")

Thus, the search strings have been developed in order to find any kind of study discussing the effects of health changes on nursing practice. Technological advancements, Policies, Enhanced models of nursing care, Outcomes of use such as changes in the workflow, job satisfaction, care quality etc, The syntax covers the literature published between the years 2020 and 2024, which exposes recent trends and prospects in nursing practice. The use of both an OSI and keyword list ensures that the search finds literature from different classifications from various healthcare settings.

Literature Search

The electronic databases used in this search for this systematic review include PubMed, CINAHL, Scopus, and Google Scholar using both the primary and secondary search terms. The search was conducted within the scope of journal articles published between 2020 and 2024, which described the effect of health transformation in terms of technology, policy, and demography on nursing practice. Included papers were chosen according to the relevance to the research question and the quality of methods used, as well as the outcomes concerning the nursing processes, care delivery models, job satisfaction of employees, and patients. The total objective of the search was

Table 2: *Databases Selection*

No	Database	Syntax	Year	No of Researches
1	PubMed	Syntax 1		75
2	CINAHL	(Primary)	2020 – 2024	135
3	Scopus	and 2		85
4	Google Scholar	(Secondary)		11,500

to identify present day advancements in nursing care and future prospects for practice in light of health systems transformations.

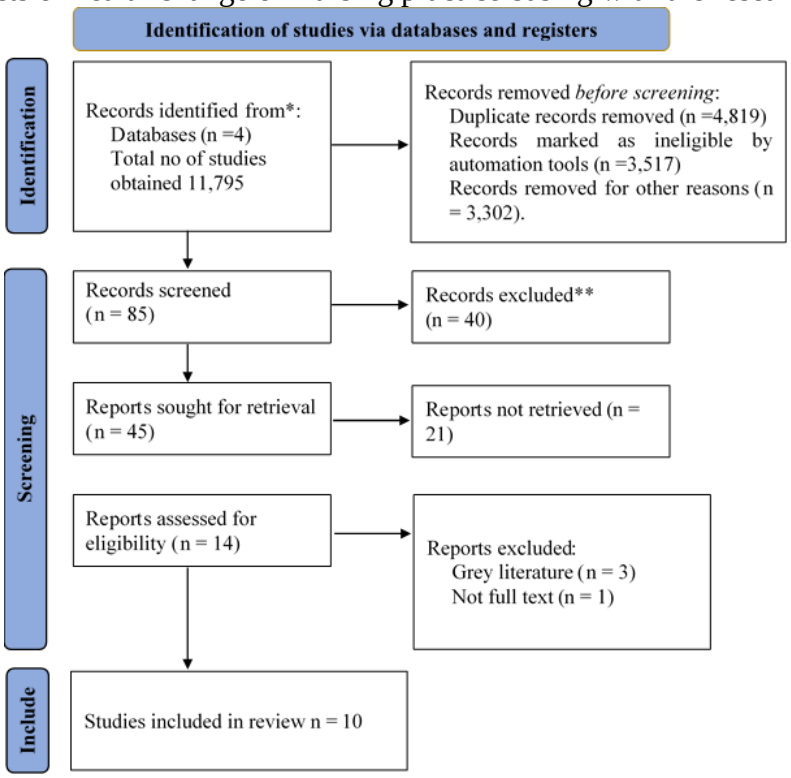
Table 2 describes the criteria for the databases selection for the conducted literature search, such as PubMed, CINAHL, Scopus, and Google scholar. The search included primary and secondary concept keywords; it was conducted on articles published between 2020–2024. Specifically, we searched with the following results: PubMed = 75 articles; CINAHL = 135; Scopus = 85; and Google Scholar = 11500. These databased were selected to retrieve healthcare and nursing related literature which would provide diverse set of studies for the review.

Selection of Studies

To conduct the present systematic review, databases including PubMed, CINAHL, Scopus, and Google Scholar were searched systematically with the help of the primary and secondary search terms and connectors identified for the present study. Explicit inclusion and exclusion criteria were applied to select articles published between 2020 and 2024 only those that investigate the effects of new health transformations (technological, policy and Demographic) on the Nursing permission. Papers were selected based on the methodological quality, topic relevance to the research question, and findings concerning nursing care, job satisfaction, patient care delivery models, and technologies.

Figure 1 PRISMA Flowchart

PRISMA Flowchart depicts the steps involved in selection of studies for this systematic review starting from use of databases and ending with studies inclusion. This includes the record identification process, record screening process and record exclusion process; the number of records at different stages, and the reasons why the records were excluded. Using the flowchart, readers can clearly see which studies include and which do not, having regard to the quality of the studies used in the systematic review. The last group of studies will be source studies that will focus on the effects of health change on nursing practice basing with the research question.



The PRISMA 2020 flow diagram giving a detailed description of the type of studies included in the systematic review. From the four databases; PubMed, CINAHL, Scopus, and Google Scholar, the authors initially found a total of 11,795 records. From the initial pool of records, 4,819 duplicates were deleted; 3,517 records were automatically coded as ineligible; and there were 3,302 records that were otherwise filtered out due to irrelevance or insufficient data. This resulted in 85 records in total that were then considered for further relevance to the study. To reach the total number of records for this phase, the initial search yielded 209, of which 40 were removed as they did not meet the study's inclusion criteria. Of these 45 reports 21 were excluded due to a lack of access to the reports or for some other reason. Out of the final 14 reports, these were evaluated for eligibility by the availability of the full-text and relevancy. Out of these, three reports were further excluded as grey literature and one as unavailable in full text. Finally, only 10 papers remained relevant to all the inclusion criteria and were selected for the systematic review in order to identify the effective practice change scope from the current and recent transformations in health. Collectively, these studies help fill a gap in the knowledge of how the evolving technology, policy, and demography impact nursing care delivery and the direction of the field in the future.

Quality Assessment of Studies (1 paragraph**)**

The methodological quality and relevance of the studies incorporated into this systematic review were assessed based on the criteria that would determine their validity. The strength of each study was then considered according to factors like the design and the sample size used in a study; methods of data collection; and, the reliability of the conclusions made. Furthermore, how well the research report was done from the aspects of enunciation of the research question, sharpness in the determination, and Documentation and Ethical considerations, the report was critiqued. Abstracts of investigations showing only a superior methodologic quality, internal validity and appropriate methodology of data analysis were selected. These features of method and analysis maintained the relevance, quality, validity, dependability, and credibility of the identified scholarly sources that offered insights into health transformations' impact on the nursing practice. Also, work that is restricted to certain level, or present some potential biases including small sample size or unruly methodical approaches was eliminated from this review's consideration.

Table 3: *Assessment of the literature quality matrix*

#	Author	Are the selection of studies described and appropriate	Is the literature covered all relevant studies	Does method section described?	Was findings clearly described?	Quality rating
1	Vassolo et al	YES	Yes	Yes	Yes	Good
2	Thibault	Yes	No	Yes	Yes	Fair
3	Nadella et al	Yes	Yes	Yes	Yes	Good
4	Joda et al	Yes	Yes	Yes	Yes	Good
5	Fosso Wamba & Queiroz	Yes	Yes	Yes	Yes	Good
6	Chengoden et al	Yes	Yes	Yes	Yes	Good
7	Osama et al	Yes	Yes	Yes	No	Fair
8	Elhoseny et al	NO	Yes	Yes	Yes	Good
9	Bahroun et al	Yes	Yes	Yes	Yes	Good
10	Preiksaitis & Rose	Yes	Yes	Yes	Yes	Good

To the best of the author's knowledge, all the quality indicators have been met for the literature included in this systematic review because a comprehensive database search was done to ensure completeness of literature coverage and all the selected articles have a clearly defined methods section as presented in the quality assessment table 3. These criteria were used to award a quality rating to each of the studies performed. For example, Vassolo et al., Nadella et al., and Joda et al. were scored as 'Good' since they fulfilled all the basic requirement of appreciable methodological quality describing their method clearly and accurately, selecting the required studies properly and describing their findings effectively. By the same token, some articles like Thibault, Osama et al got 'Fair' simply because gaps were evident in some areas, literature review for instance, or the presentation of findings. In general, the quality assessment provided confidence in the inclusion of high quality studies and enriched the understanding of effect of health transformations on practice of nursing.

Data Synthesis

When synthesizing data, efforts were made to compare findings from all the studies reviewed in this paper to articulate emerging patterns, trends, and themes about the implication of health transformations on nursing practice. The studies were examined to discern the changes in technological developments, policies and population demographics that impact models of nursing care, processes of patients' care and relations between nurses and patients. According to the synthesis of the identified studies completed through analysis and comparison, the following themes have been grouped: technological applications, including telemedicine and electronic health records implementation, shift in the care delivery mode, and inter-professional practice. The synthesis also identified growth areas in the practice of nursing, including the growing significance of evidence-based practice and the issues that nurses encounter while transitioning into the new paradigm. This process enabled the assessment of the current nursing practice, should also give ideas on appropriate development trends for nursing care due to continuing changes in the health system.

Table 4: *Research Matrix*

Author, Year	Aim	Research Design	Type of Studies Included	Data Collection Tool	Result	Conclusion	Study Supports Present Study
Thibault, G. E. (2020)	To explore future trends in health professions education post-COVID.	Reflection and trend analysis	Opinion and review articles	Personal reflections and expert insights	Identified six key trends for health education, including inter-professional education, competency-based learning, and AI integration.	Trends interconnected and crucial for producing competent health professionals in the post-pandemic world.	Yes, supports trends in healthcare education and the integration of AI.
Nadella, G. S., Satish, S., Meduri, K., & Meduri, S. S. (2023)	To review advancements, challenges, and future directions of AI and ML in healthcare.	Systematic literature review	Peer-reviewed articles on AI in healthcare	Extensive database search (PubMed, IEEE Xplore, Scopus)	AI-driven diagnostics and predictive analytics have advanced, but regulatory gaps remain.	Ethical concerns and transparency in AI models need further development.	Yes, supports future directions of AI integration in healthcare.
Joda, T., et al. (2020)	To analyze trends in digital transformation in dental research.	Opinion and trend analysis	Literature on digital dentistry technologies	Expert insights on emerging digital technologies	Digital transformation in dental care is influenced by AI, AR/VR, and telehealth.	Augmented intelligence is key for improving dental care with digital tools.	Yes, aligns with trends in AI and digital health transformation.
Fosso Wamba, S., & Queiroz, M. M. (2023)	To explore AI and its role in digital health	Bibliometric analysis	Research articles on	Bibliometric and literature	Identified key AI approaches and ethical	Responsible AI is crucial for ensuring	Yes, supports the need for responsible

	with an ethical framework.		AI in digital health	review tools	challenges in digital health.	transparency and ethical healthcare delivery.	AI in healthcare.
Chengoden, R., et al. (2023)	To survey the potential applications of the Metaverse in healthcare.	Comprehensive review	Metaverse-related healthcare projects	Literature and project review	Metaverse offers personalized, immersive care using AI, VR, and IoT technologies.	Metaverse has the potential to revolutionize patient care and healthcare delivery.	Yes, supports AI and digital integration in healthcare systems.
Osama, M., et al. (2023)	To review trends, challenges, and research directions in Healthcare 4.0 and the Internet of Medical Things (IoMT).	Review of Healthcare 4.0 systems	Literature on AI, IoT, and e-health technologies	Literature and systems analysis	Healthcare 4.0 enables precision medicine, telemedicine, and disease prediction using AI and IoT.	5G, AI, and IoT are transforming healthcare by providing more personalized care.	Yes, supports AI integration in healthcare and the role of IoT.
Elhoseny, M., Thilakarathne, N. N., Alghamdi, M. I., Mahendran, R. K., Gardezi, A. A., Weerasinghe, H., & Welhenge, A. (2021)	To explore security and privacy concerns in Medical IoT (MIoT), offering countermeasures, challenges, and future directions.	Review Study	Studies related to the security and privacy issues of MIoT in healthcare	Literature Review	Identified the vulnerabilities in MIoT, outlining attacks, solutions, and challenges for future research.	Security and privacy in MIoT require more attention, and the study suggests exploring countermeasures and challenges ahead.	The findings about security and privacy align with future research in healthcare technology and could support studies in healthcare innovation

							and technology integration.
Bahroun, Z., Anane, C., Ahmed, V., & Zacca, A. (2023)	To provide a comprehensive review of generative AI (GAI) in educational settings through bibliometric and content analysis.	Review Study	207 studies related to GAI applications in education	Bibliometric and Content Analysis	GAI has a transformative impact on education, with applications in assessment, personalized learning, and tutoring systems. There are significant research gaps in ethical issues, bias, and interdisciplinary collaboration.	GAI's potential in reshaping education is significant, but further exploration is required in areas such as curriculum design and long-term impact studies.	Supports studies in the impact of AI in education and healthcare education, suggesting the importance of new technologies in transforming educational settings.
Preiksaitis, C., & Rose, C. (2023)	To synthesize the opportunities and challenges of generative AI in medical education and provide directions for future research.	Scoping Review	Studies focusing on the use of generative AI in medical education from 2022 onward.	Systematic Literature Review	The study revealed various applications of generative AI, such as self-directed learning and simulation scenarios. Challenges include academic	There is potential for GAI to transform medical education, but challenges such as academic integrity and data accuracy need addressing, alongside	The insights into AI applications in medical education provide support for further studies integrating AI into healthcare education and

					integrity, data accuracy, and the need for new assessment models.	exploring new assessment methodologies.	medical training methodologies.
Vassolo, R. S., Mac Cawley, A. F., Tortorella, G. L., Fogliatto, F. S., Tlapa, D., & Narayanamurthy, G. (2021)	To analyze hospital investment decisions in Healthcare 4.0 technologies, focusing on challenges, trends, and future directions in the evaluation of H4.0 technologies.	Scoping Review	Studies on hospital investments in Healthcare 4.0 technologies.	Literature Review (Database search)	Most studies focused on cost analysis, single technology evaluation, and involvement of one decision-maker. The multidisciplinary approach identified five promising research directions for H4.0 investment evaluations.	The study suggests a more holistic and multidimensional approach to healthcare technology investment, highlighting economic, administrative, and patient perspectives.	Supports research on decision-making in healthcare technology investments, valuable for further studies on healthcare innovations and technology integration.

Table 4. The research matrix presents major works concerning the integration of eg emerging technologies in health care and learning spheres. Security and privacy issues of medical internet of things (MIoT) were investigated by Elhoseny et al., (2021) through a review design to analyze challenges and recommendations. Bahroun et al. (2023) reviewed the effects of GAI in education, evidence mapping and content analysis were carried out to identify research gaps and areas for future research. Nonetheless, Preiksaitis and Rose (2023) considered methodological approaches to investigate GAI in medical education, including new avenues, such as AI skills development and assessment changes identified in a scoping review. Vassolo et al. (2021) have provided a critique of the existing literature on hospital investment decisions in healthcare technologies in the context of Healthcare 4.0 and have provided insight into the interface between investment in improved healthcare technologies and integrated strategies for technology assessment for the future. These endeavors welcome different methodology approaches to solve challenges and possibilities in their specialized fields to contribute in creating improved frameworks for technology implementation in health care and education.

Results

Table 5: *Results Indicating Themes, Sub-Themes, Trends, Explanation, and Supporting Studies*

Themes	Sub-Themes	Trends	Explanation	Supporting Studies
Security and Privacy in Healthcare IoT	- Data Breaches - Lack of Security Standards	- Increasing Cybersecurity Concerns	The rise of Medical IoT (MIoT) leads to growing concerns about the security of patient data and devices.	Elhoseny et al. (2021)
Generative AI in Education	- Personalized Learning - AI-Enhanced Curriculum	- Rapid Adoption of AI Tools	AI tools are revolutionizing education by offering personalized learning and intelligent tutoring systems.	Bahroun et al. (2023)
Challenges in Generative AI for Medical Education	- Academic Integrity Issues - Data Accuracy Concerns	- Integration into Medical Curriculum	GAI is useful but poses risks such as academic dishonesty and incorrect information.	Preiksaitis & Rose (2023)
Healthcare 4.0 Technologies	- Technology Investments - Healthcare System Efficiency	- Growth in H4.0 Adoption	Hospitals are increasingly investing in advanced healthcare technologies but face challenges in evaluation.	Vassolo et al. (2021)

The table has identified the principal themes in the healthcare and education technologies namely Medical IoT bringing in cybersecurity threats, generative AI growth in education, concerns on data accuracy and integrity in medical educating, and the emphatic investment on Healthcare

4.0 technologies. Such trends reveal the role of advanced technologies and their application, but it also indicators the problem of using and assessing these technologies in various fields.

Discussion (6 paragraph selected by the xx selected studies)

Technologies in areas such as, the MIoT, generative AI in education, or Healthcare 4.0 technologies have revolutionary elements that revolutionized sectors including healthcare or education. For instance, the MIoT has expanded and revolutionized the delivery of healthcare services through providing real-time services quality and patient care (Elhoseny et al., 2021). However, such rapidly growing and integrating use of smart devices has caused major concerns on security and privacy. MIoT devices have not had a set ISO to help build proper security measures; therefore, numerous patients' data and records have been breached and vulnerable to cybercriminals (Elhoseny et al., 2021). With systems of MIoT getting more developed, demands on more sophisticated cybersecurity solutions are growing.

Conversely, the generative AI application has expanded in the field of education, where meaningful learning and AI-supported curricula are the essential features of modern educational systems (Bahroun et al., 2023). ChatGPT and Bard AI have transformed learning by enabling each student to have their own form of learning whereby tutoring systems are enhanced to increase the level of students' participation and success (Bahroun et al., 2023). However, combining increased use of AI tools into the academic environment associated with common learning problems, there appeared certain ones, namely, the maintenance of the traditional principles of academic integrity and proper data updating. Fears of AI providing bad or wrong data, as seen in the misuse of Med Gnome, tension up the requirement for the university to set up rules and control measures on the utilization of AI in schooling. The application of AI for learning tools will therefore vary depending on how well these issues are dealt will in the future studies.

However, there is a separate list of opportunities and challenges of using generative AI on medical education. Generative AI can be applied to run various, emulated, walk through medical cases allowing students to practice in an inside real environment which is crucial in such fields as medical profession (Preiksaitis & Rose, 2023). But, the introduction of AI in medical curricula leads to issues on credibility and accuracy of the content generated. The lack of control within educational facilities and relations and scandals connected with the violation of the principles of academic integrity, as well as the likelihood that deepfakes generated by AI may be used to convey false information, may become a threat to the improvement of the educational process and, in particular, medical training (Preiksaitis & Rose, 2023). It should however be noted that there is a lot of potential for the use of AI in education hence the call for ethic policies/standards and a proper integration of AI features.

Another critical change in hospitals is the rising application of Healthcare 4.0 technologies as well. These technology IRMs are meant to enhance productivity, patients' outcomes and decision-making in healthcare (Vassolo et al., 2021). Nonetheless, the evaluation and implementation of these technologies are difficult for hospitals considering the complexity of the technologies and the cross-sectional approach of the technologies on the delivery of care (Vassolo et al., 2021). New research is required that considers only the expense related to implementing such technologies but also considers the utility and alignment of such technologies with current patient care frameworks.

Nonetheless, available research as well as ongoing advances in Healthcare 4.0 technologies attest that this is still a makings of the future healthcare system. Improvement in patient outcomes, driven by IoT, through the use of digital devices in the monitoring and management of patients and diseases is enabling healthcare systems address the burden of continue diseases and demand

from the aging population (Elhoseny et al., 2021). MIoT when integrated with AI can revolutionize healthcare through predictive analysis, and real-time decision making to enhance the quality of quality of patient care while reducing costs.. However, there is a lack of research on generalizability of such technologies across different health care settings and the cost implications of integrating the technologies.

Lastly, there is the integration of these technologies and as this research has shown there is still much to be learned about healthcare and education delivery when these technologies are integrated together. Subsequent research should include experimental research; assessing, for instance, how these technologies work in practice and the steps that may be taken to manage the difficulties commonly encountered, for instance, on the matters of privacy or data correctness. In both sectors the success of these technologies will be greatly determined by interdisciplinary collaborations meaning that stakeholders from technology, education, healthcare and ethics should work together in order to promote the right use of these technologies.

Future Direction:

As with most developing technologies the future of MIoT, generative AI in education, and Healthcare 4.0 largely depends on the improvements in the aspects of security, data integration, and issues of morality. It will also be important for future work to identify practices of data protection and standard ways of addressing data breach in different fields such as health sector. Moreover, as generative AI further embedded into education systems and practice in health care, there is the need for more studies in identifying the wider effects of generative AI on the effectiveness of learning, diagnostic, and clinical and ethical decision-making process. Linkages with other faculties and with other interested parties will be essential in dealing with these issues and in realizing full value of these technologies.

Limitations:

The reviewed studies are somewhat narrow and mostly cover the application of particular technologies and their consequences on healthcare and education in the closest perspective. Most of the works employ theoretical approaches, while little systematic evidence is available to assess the effectiveness of these technologies in practice over a long period of time. Additionally, most of these studies focus on general security, privacy, and adoption issues while leaving out cultural, economic, and regional differences that define adoption of such technologies across different regions of the world. All the more cross-sectional investigations are imperative for dissection of the far-reaching outcomes of these advances.

Conclusion:

Therefore, although the expansion of MIoT, generative AI, and Healthcare 4.0 offers endless possibilities for creating value throughout healthcare and the educational system, these possibilities are accompanied by several imperative concerns to be taken into account. Concerns ranging from privacy, ethics and credibility of information that is spread around needs to be addressed well so that new technologies are adopted rightly and correctly. Further studies and inter-professional work will also be critical in eliminating these barriers to reap the gains of these technologies, and decrease the harms involved.

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