



ARTIFICIAL INTELLIGENCE UTILITY TO IMPROVE THE QUALITY OF HEALTH AND PATIENT SAFETY SERVICES: A SCOPING REVIEW

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ABSTRACT

This study aimed to analyze the role of artificial intelligence in enhancing the quality of healthcare services and patient safety. The research followed the methodological framework proposed by Arksey and Malley, and a scoping review was conducted using the PRISMA guideline method. The authors searched several electronic databases, including Pubmed, NCBI, Elsevier, Proquest, EBSCO, Scopus, and Google Scholar, between 2017-2022 using specific keywords related to artificial intelligence, quality of health care, and patient safety. Out of 550 articles obtained, 61 were included in the review. The analysis of the selected studies indicated that artificial intelligence can significantly improve the quality of healthcare services and patient safety, especially in hospitals. However, further research is needed to develop AI systems that can be tailored to the specific needs of healthcare facilities, particularly hospitals and health centers in Indonesia. This study provides evidence for healthcare policymakers and practitioners to consider incorporating AI-based technologies to enhance healthcare quality and safety.

Keywords: Artificial intelligence, quality of health services, patient safety

Introduction

Patient safety is the concept that patients who are in health services can achieve the expected impact. In terms of injury, patient safety is defined as being free from accidental injury by ensuring patient safety through the establishment of an operational system, minimizing the possibility of errors, and increasing prevention so that accidents do not occur in the service process (Pelzang & Hutchinson, 2020). Various studies in the world prove that many incidents that endanger patients occur due to negligence in the health service process, ranging from mistakes, negligence, and accidents that have a detrimental impact on patients. The Institute of Medicine reports 44,000-98,000 Americans die from errors. Medical errors are the main cause, followed by negligence and complications (Larasati and Dhamanti, 2021).

Artificial Intelligence (AI) is a

technological invention that has attracted public attention in the last ten years, AI itself is an interesting and challenging field to develop. With the advent of artificial intelligence, people began to interact with computers and technology (Halim & Prasetyo, 2018). Artificial intelligence in the medical field has been enthusiastically welcomed by the public, because artificial intelligence in the medical field has the 4P (Predictive, Prevention, Personalization, and Participatory) principles. In addition, artificial intelligence in medicine and healthcare has advantages including filling and distributing electronic personal health records, monitoring vital functions with biosensors, and helping to achieve therapeutic compliance. Several AI-based algorithms have been approved in the last decade by the Food and Drug Administration (FDA) including several other digital tools, such as surgical navigation systems for

computer-assisted surgery, virtual reality-reality continuum tools for surgery, pain management, and psychiatric disorders ((Malik, Pathania, & Rathaur, 2019) (Briganti

& Moine, 2020). The purpose of this study was to analyze artificial intelligence to improve the quality of health services and patient safety.

Research methods

Search Strategy

This review uses a Scoping Review approach which is based on the Preferred Report Item Guide for Systematic Reviews and Meta-analysis (PRISMA) (Figure 1). A systematic literature search was carried out in

April-May 2022, across several databases namely Pubmed, NCBI, Elsevier, Proquest, EBSCO, Scopus, Google Scholar with an article publication time span of 2017-2022. The search strategy included the following terms: “Artificial intelligence, quality of health care, patient safety”.

Table 1. Search Strategy material for this study

No	Keywords	Search Strategy
8	Artificial intelligence - related terms	“Artificial intelligence” OR “AI” OR “Machine learning*” OR “neural network” OR “neural networks” OR “intelligent retrieval” OR "knowledge engineering"
2	quality of health care	"health maintenace” OR "medical maintainance” OR "medical management" OR "preventive medicine" OR "wellness program”
3	patient safety	“absence of preventable harm to a patient” OR " analysis of medical error”OR"safety in health care"OR " prevention of adverse effects to a patient" OR " safety of patients”

Table 2. PCC Framework

Population	Patient safety
Concept	Artificial intelligence
Context	Hospital
Keywords	‘Artificial intelligence, quality of health care, patient safety,

Table 3. Inclusion and Exclusion Criteria

Inclusion Criteria	Exclusion Criteria
Consisted of articles that reported " Artificial intelligence, quality of health care, patient safety”	Unrelated articles Artificial intelligence, quality of health care, patient safety”
Published full-text articles from the past 5 years (from 2017 to 2022)	Unpublished full-text articles from the last 20 years (from 2017 to 2022)
Studies published in peer-reviewed journals	The source of the article is a book or poster

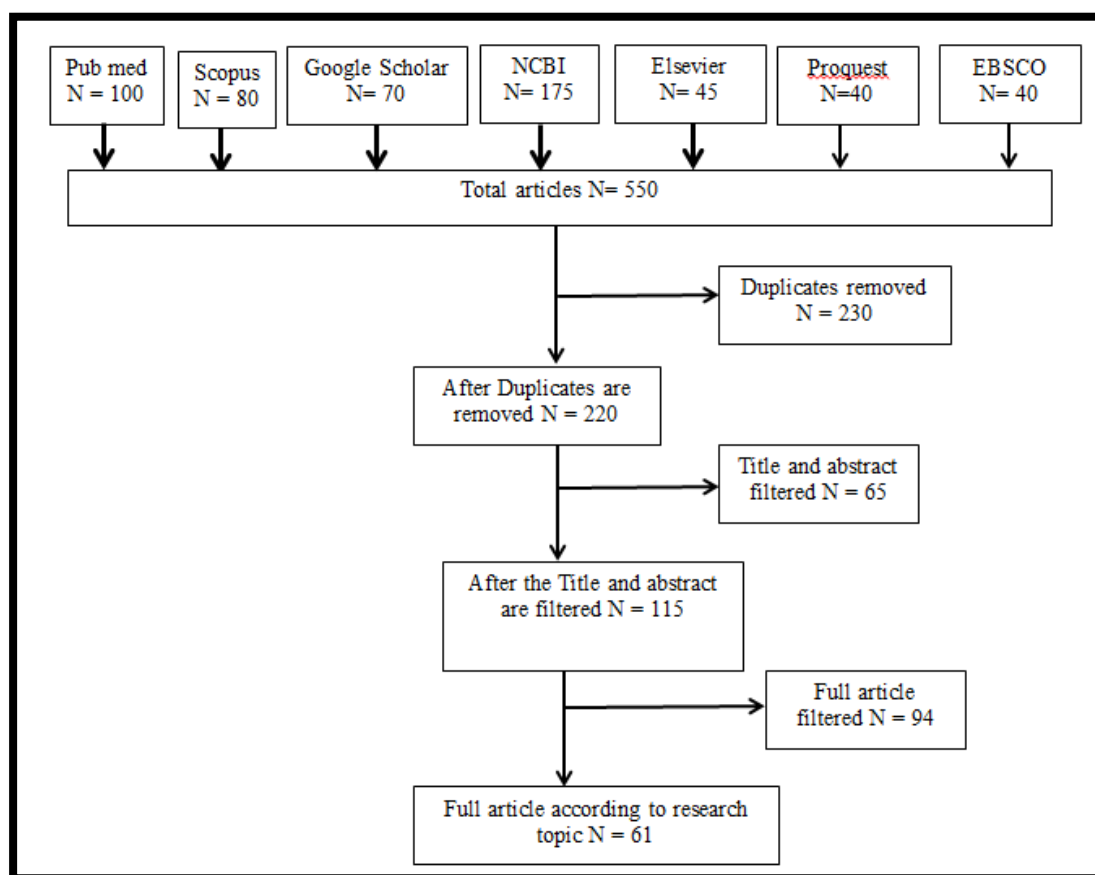


Figure 1. Search Results and Article Selection Process using the PRISMA method

Overview

The research that has been selected based on the inclusion criteria. The articles are reviewed based on the abstract and full-text to be described further in search of similarities and differences in each study and then draw conclusions. Based on the results of searches conducted in Pubmed, NCBI, Elsevier, Proquest, EBSCO Scopus, Google Scholar, a total of 550 articles were obtained which then entered the elimination stage, resulting in 61 articles which were subsequently included in the results of this review.

Results and Discussion

Quality of health services

Quality is the overall characteristics and description of goods or services that show their ability to satisfy customer needs. So that it can be said that quality is something that is used to guarantee the expected goals or outcomes and quality must always follow the latest developments in professional knowledge in order to satisfy customers

(Grøndahl, Kirchhoff, Andersen, et al.2018). The quality of health services is the degree or level of perfection of health services carried out in accordance with applicable service standards. Quality improvement is a process of measuring the degree of perfection of health services compared to standards or principles with systematic and continuous corrective actions to achieve optimum or excellent service quality in accordance with science and technology standards and the capabilities of existing resources (Shenoy, 2021). The quality or quality of health services cannot be separated from customer or patient satisfaction. Quality health services can increase patient satisfaction with the services provided. In addition, patient satisfaction can be used as a benchmark for the success of the service quality of a health facility. Patient satisfaction will be created when what is obtained is greater than expected. Patient satisfaction and safety with clinical management and efficiency are important in ensuring the quality of health services (Allen-Duck, Robinson, Stewart,

2017;(Busse, Panteli, & Quentin, 2019); Oldland et al.2020).

Patient Safety Efforts

Safety is a system that makes patient care safer, including risk assessment, patient risk identification and management, incident reporting and analysis, the ability to learn from incidents and their follow-up, as well as implementing solutions to minimize risks and prevent injuries caused by errors. carry out an action or not take the appropriate action. One of the principles of health care is to save patients with procedures and actions that are safe and do not endanger patients or health care providers. Every health care facility must always maintain the security of its health service process in order to avoid medical errors that can affect the quality of health services. Patient safety is an effort to ensure that all actions and activities related to patients carried out by health workers take place safely and do not cause harmful effects or impacts on patients through a series of activities that have been regulated in legislation. Patient safety is an important point in every medical action, both minor and serious medical actions. Patient safety has a major influence on the image, social responsibility, morals and performance of health workers so that patient safety is related to quality issues and the image of a health service, including puskesmas (Maghiroh & Rochmah, 2017). Based on Permenkes No. 46 of 2015, that health facilities are required to pay attention to service quality and patient safety in every service activity and carried out continuously. The implementation of patient safety and patient safety culture in a health care facility can be influenced by several factors, namely organization, work environment, and cultural factors (Najihah, 2018). In its implementation, patient safety efforts require continuous monitoring so that its implementation is in accordance with the objectives. There are several monitoring strategies that can be used as a monitoring method in the implementation of patient safety efforts (Purwadi, Sulistiadi, & Asyary, 2019). The monitoring strategy used can be adapted to the needs, capabilities and conditions of health care facilities.

Monitoring patient safety efforts aims to ensure that the implementation of patient safety efforts is in accordance with agreed standards and criteria. While the monitoring strategy is a method that is chosen and used to facilitate the monitoring process and the discovery of obstacles during the implementation of patient safety efforts (Lawati, Dennis, Short, & Abdulhadi, 2018); Quenon, et al 2020; (Tingle, 2020).

Artificial Intelligence and Quality of Health Services

Wang et al. reported that, in China, doctors who performed AI-assisted colonoscopy examinations found 20% more polyps than those who did not. The AI-powered system can find polyps that are very small (5 mm or less) or early developments that many gastroenterologists miss during a colonoscopy. (Wang, dkk 2019; (Sato et al., 2019). Therefore, the AI system helps doctors in removing small polyps that may cause problems in the future, improving treatment services, and reducing the possibility of medical errors. (Murphy, Di Ruggiero, Upshur, et al 2021; Gerich, et al,2022)

A research team at the University of Tokyo Medical School reports on the development of an AI system based on a new algorithm and a sequence of parameters. When this system was integrated with a medical AI program, the highest accuracy rate found was 83.5% when applied to the treatment group. However, after the system was connected to the AI system, the accuracy rate increased to 87.3% (Pesapane, Codari, & Sardanelli, 2018). The recently developed AI system can further reduce error rates and is expected to further improve the quality of healthcare services. Radiologists are often cited as the medical personnel most likely to be replaced by AI. This prediction is based on the fact that radiologists can read 50-100 X-rays a day, while AI-powered systems can read 10-100 times more images. In addition, the accuracy of the AI system is superior to that of radiologists. Thus, when the AI system adds radiologists, doctors can take advantage of the time saved by the AI system to have more friendly and meaningful discussions with patients that can help improve the

quality of healthcare services. In addition, with more accurate data retrieval by AI, medical staff can prevent possible medical

errors beforehand (Kueper, et al 2020;(Bohr & Memarzadeh, 2020) (Lee, Grabowski, Habboub, & Mroz, 2020).

Table 4 The utility of AI in the Aspect of Improving the Quality of Health Services

AI Utility on Healthcare Quality Improvement Aspect	AI's Potential for Healthcare Quality Improvement
Clearly understand the roles and responsibilities of clinical governance	AI can recognize new failure modes and governance lapses (such as over-reliance on AI and inadequate human oversight, or an inability to know the reasons for decision-making)
Ensure that the management system provides adequate oversight to identify deviations in health quality	AI systems have the potential to improve monitoring of deviations in health quality
Implement corrective actions in response to risks and deviations in the quality of health services	AI system will help clinical governance framework
Improve diagnostic efficiency and effectiveness	AI system helps doctors perform diagnostics
Build a management system that includes consumer partnership	AI systems help implement effective governance frameworks
Support increased provision	AI systems can be used to filter data and can help by providing more targeted information.

Artificial Intelligence and Patient Safety

Safety in healthcare implies the reduction or minimization of the risk and uncertainty of hazardous events. The safety dimension is changing with the adoption of AI in healthcare. AI and ML, with a low probability of expected and unexpected harm, have been implemented to strengthen security. Thus, minimizing risk is key for AI-driven applications. ML applications are mostly classified as type A (eg, medical diagnosis) and type B applications (eg, speech transcription systems), relying on safety and risk minimization (Lynn, 2019); Habli, Lawton, Porter,2020; Pouyan et al,2020).

Although safety is very important in type A applications, risk minimization is the focus in type B applications. Epistemic uncertainty, scientific uncertainty in the

model, is much less in type B applications. Errors are less common in type B applications and, therefore, safety is less relevant in type B applications. In addition to risk and safety, the cost of an undesired outcome is also used as a parameter to assess the outcome as harmful. ML has become important in the prevention, diagnosis, and management of various disease conditions. The safety of this new strategy has been described in abstract parameters according to the disease area and expected outcomes (Ellahham, et al 2020;(Cecula et al., 2021).

In a study conducted that the ML algorithm was developed to predict flare-ups and provide at-home decision support for patients with chronic obstructive pulmonary disease; it successfully triaged patients with high accuracy and supported patient safety in

validation studies (n = 101) (Swaminathan et al., 2017). The algorithm never underestimates patients who should be sent to the doctor and undertriage patients for emergency room visits in <14% of cases. In comparison, for the same decision, doctors underestimated patients in 22% and 30% of cases, respectively. This model is trained

using a data set labeled doctor. The model's performance was validated by comparing its decision with the consensus decision of a panel of doctors using a non-representative sample of patients (Varshney and Alemzadeh, 2017; Swaminathan, Qirko, Smith, et al. 2017; Varshney, et al 2019).

Table 5. Potential of AI to improve patient safety

The potential of AI to improve patient safety	AI system to improve patient safety
Patient safety and infectious disease	AI systems play a role in detecting infectious diseases more accurately and better
Prevention of medication errors	AI can play a major role in ADE prevention. As more and more patients at risk of ADE are accurately identified before medication is administered or prescribed, most of these occurrences will be preventable.
Venous thromboembolism	AI identifies patients with congenital thrombotic disorders
Prevention of complications after surgery	AI can predict and prevent complications both in the operating room and during recovery.
Diseases of Ulcers	AI system detects ulcer disease
Injury due to accident	The AI system screens accidental injuries both on the surface and on the inside of the body
Diagnostic error	AI systems can help reduce the frequency of diagnostic errors by leveraging pattern recognition, minimizing bias in diagnostics

AI plays an important role in increasing knowledge and improving patient safety. AI has systems for disease prediction and diagnosis, handling large amounts of data, and maximizing efficiency and results in medical disease management. The benefits of AI in various diseases include the prediction of sepsis in the intensive care unit and the diagnosis and classification of malignant lesions, retinal disease, and pneumonia (Esteva et al., 2017) (McCoy & Das, 2017) (Duggal, Brindle, & Bagenal, 2018),(De Fauw et al., 2018); Rajpurkar, et al 2019;(Choudhury & Asan, 2020).

AI principles have been applied in the

treatment process for appropriate, safe, and targeted therapy. There are huge benefits to leveraging AI in patient safety. AI can help in routine clinical practice and research, reducing errors in the diagnosis and treatment of diseases. In addition, good predictive diagnosis, appropriate treatment, and targeted therapy delivery, follow-up and virtual consultations provide cost and time effectiveness are AI advantages for patient safety. (Young, Gupta, Palacios, 2018;(Seyhan & Carini, 2019); (Bates et al., 2021) McInerney, McCrorie, Benn, et al, 2022).

Table 6. Use of AI in Patient Safety

Researcher	AI used in patient safety

Sabetif, Reamaroona, Mathise , Gryaka, et al. (Vickers, 2017)	Machine-learning (ML) can distinguish clinically relevant pulse arterial O2 saturation, blood pressure, and respiratory rate from artifacts in online monitoring datasets
Zhou ,et al. 2022	ML algorithm together with MMD is effective in reducing false alarms
Zhang et al	SVM reduces false alarm rate, 95% overall true positive rate and 85% true negative rate
Mousavi, Fotoohinasab, Afghah, et al	False alarm detection for tachycardia with 100% sensitivity and specificity
Eerikäinen et al (Eerikäinen, Vanschoren, Rooijackers, Vullings, & Aarts, 2016)	Classification of true and false cardiac arrhythmias
Menard et al	The ML method identifies based on reporting risks and enables reporting security
Segal et al (Segal et al., 2019)	AI system to detect errors in medication administration

AI has several advantages in diagnosis and as a support for patient safety. AI enables decision makers to access accurate and up-to-date information to help make better decisions in real time. The application of AI has brought about an evolutionary change in radiological diagnosis by increasing the value and accuracy of image analysis. This is because it allows for better and more accurate analysis of digital images. For example, ML software has been trained to detect changes in Parkinson's disease with DaTscan image analysis. AI is also useful in patient triage. The wearable device has been designed to allow remote monitoring and analysis of vital signs and index of consciousness. Algorithms have been developed to classify disease conditions according to their severity, developed to triage patients and predict survival. Electronic triage (e-triage) has been used in various multicenter hospitals. Based on a retrospective, cross-sectional study of 172,726 hospital visits, e-triage was more accurate than the Emergency Severity Index (ESI) for triage. When compared with ESI, e-triage identified more than 10% (14,326

patients) of ESI level 3 patients who required critical care or emergency procedures and had prioritized (6.2% e-triage vs 1.7% ESI) and required hospitalization (45.4% e-triage vs. 18.9% ESI) (Recht & Bryan, 2017); Zhang and Kagen. 2017;(Mayo & Leung, 2018);(Robertson, Azizpour, Smith, & Hartman, 2018); Kim, et al. 2018,(Bajwa, Munir, Nori, & Williams, 2021).

Conclusion

From the research conducted, 550 scientific articles were obtained and after screening, 61 scientific articles were found that met the requirements. From the results of the analysis carried out, it was found that artificial intelligence can be used to improve the quality of health services and patient safety, especially in hospitals. Further studies are needed, especially the development of artificial intelligence systems that are tailored to the needs of each health facility, especially hospitals and health centers in Indonesia.

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