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The effect of artificial intelligence on the modernization of nursing practice

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> **Abstract---**This research performs a systematic review on the impact of artificial intelligence on the modernization of nursing. The key types of artificial intelligence in the research are clinical decision support systems, mobile health, sensor-based technologies, voice assistants, and robotics. The study will cover all geographical locations and all nursing fields. Sources of data for the research journal articles and clinical studies reports on the impact of artificial intelligence in nursing. Information will be extracted from various databases such as PubMed, Google scholar, and clinicaltrials.gov. A quantitative and qualitative analysis of the data collected will be conducted to reach findings that are free from bias.

> *Keywords*---nursing, artificial intelligence healthcare, clinical decision support systems, mobile health, sensor-based technologies, voice assistants.

Introduction

Modern medicine is a highly dynamic and competitive field where researchers are developing new ways of saving and advancing human life. Artificial intelligence is viewed as the future of medicine where various algorithms and applications have been developed and are being implemented to reduce mortality rates and improve patient care. The most significant field of medicine impacted by artificial intelligence is nursing. This study conducts a systematic review to understand the impact of these technologies on the modernization of nursing practice.

Artificial intelligence in medicine refers to the implementation of machine learning models and deep learning to improve the health services provided and the overall customer experience. The high rate of development in technology has led to artificial intelligence being an influential part of healthcare. Medical professionals such as nurses are using different forms and applications of artificial intelligence to provide the best care to patients (Ronquillo et al.,2021). The most common

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forms of artificial intelligence include clinical decision support systems, mobile health, and sensor-based technologies, robotics, and virtual voice assistants.

A clinical decision support system provides professionals with the necessary information for decision-making due to all the available data on patients available on the electronic health records system (Bizzo et al., 2019). Mobile health and sensor-based technologies utilize patient data to provide personalized medical care to patients remotely. Sensor-based technologies provide information on patients, weight, sleep patterns, and physical wellness providing a clear picture of patients' conditions (Murnane & Choudhury, 2020). This form of technology is highly efficient in managing chronic diseases. Robotics and voice assistants are developing avenues in the field of medicine. There are several robots worldwide well known for undertaking nurse duties and assisting in nurse tasks (Robotics in nursing,2020). Some of these robots are Robot Dinsow of Japan and Thailand, Robot Paro, and Robot Pepper of Belgium. Voice assistant technology has been specifically beneficial in ensuring patients especially the elderly is reminded to take their prescriptions on time and refill them, therefore increasing the degree of medicine adherence and reducing cases of regular hospital visits (britt,2021), Some virtual assistant technologies also manage chronic illnesses by monitoring patients and providing information to nurses back in the hospitals. The most well-known types of voice assistants are Sugar pod, Alexa, Orbita, and Dr.AI.

Various studies have been conducted to establish the role and the impact of artificial intelligence in medical care and nursing specifically. There have been concerns about the negative impact of artificial intelligence on nursing and an issue that has promoted this study. This research aims to find out the real impact of artificial intelligence in nursing. The available research on this particular topic has been independent studies conducted by experts to provide new information on artificial intelligence and healthcare. Therefore, the research gap exists where there are few systematic reviews published on this topic. This review aims to fill the gap by providing a conclusive finding on all available data on the effect of artificial intelligence on nursing. The review will be based on multiple published data and aim to understand the impact of various forms of artificial intelligence on nursing. This study will be able to provide a clear picture of the true impact of artificial intelligence in nursing and health care in general.

Research Objectives

- To determine the impact of clinical decisions, support systems application on the modernization of nursing practice.
- To determine the effect of mobile health and sensor-based technologies application on the modernization of nursing practice.
- To determine the effect of robotics and voice assistants application on the modernization of nursing practice.

Research Questions

• What is the effect of the application of clinical decisions support systems on the modernization of nursing practice?

- What is the effect of the application of mobile health and sensor-based technologies in nursing practice?
- What is the effect of the application of robotics and voice assistants in the modernization nursing practice?

Findings from this review will be beneficial to various stakeholders in the healthcare industry. The main stakeholders are nurses whose job description requires them to directly interact with different forms of artificial intelligence. Information from the review will provide nurses with a true understanding of how artificial intelligence affects the job. Patients will also benefit from the study by understanding the opportunities or threats that artificial intelligence brings to their road to recovery. The government will also use the information from the study to formulate laws and regulations governing the area of artificial intelligence in healthcare.

The research is a systematic review and will focus on analyzing data from published in journal articles and clinical studies review. The articles will be obtained from various databases including PubMed, google scholar, websites like clinicaltrials.com, and websites from government agencies that as the Food and Drug Administration and the European medicine agency (Tianjing n.d). A quantitative and qualitative analysis of the findings will be conducted to determine the results of the study. The study will cover all geographical locations and all fields of nursing.

A systematic review is a technical research, therefore one of the major limitations associated with the review is the time allocation. Since reviews differ from one to another, the researcher has no objective way of determining the amount of time that will be allocated for the studies. Another major limitation arises from data collection from regulatory information and clinical trials. It is public knowledge most clinical trials do not provide the necessary information from the studies and findings. Researchers often publish only positive results leaving out negative results to allow their products to be on the market(Tianj& Wynn,2014) This case, therefore, hinders reviewers from accessing the detailed and raw data that is significant in the research((Tianj& Wynn,2014) The final limitation is that data and finding published on regulatory authorities websites that is the Food and Drug and Administration agency and European Medicine Agency is often short and in summary lacking detailed information that is relevant for the review. Information published on these websites also are those that companies and researchers find beneficial for their cause and not pure raw information required for research (Tianj& Wynn,2014).

Scoping Review and Research

There are various aspects of artificial intelligence that are the various technologies in the medical field that significantly affects the roles of nurses and ultimately the patients. The basic role of artificial intelligence in healthcare is to transform huge amounts of raw data into knowledge that guides the decisions and actions of nurses and doctors. In nursing, the artificial intelligence tools include mobile health and sensor-based technologies, clinical decision support, and voice

11508

assistants and robotics. There are various research studies conducted on these technologies.

Clinical decision support system are technological tools that are structured to provide professionals with the necessary information for accurate and efficient decision-making (Bizzo et al.,2019). Clinical support tools include order sets, reports, dashboards, clinical practice guidelines, and electronic health records. The medical professionals are therefore equipped with the necessary information based on huge amounts of data. The decision support provided by the artificial intelligence consists of nursing diagnoses, fall risk prediction, and guided decision trees to prevent catheter-associated urinary tract infections (Shaikh et al.,2021) Other forms of clinical based support are in the identification of at-risk patients by processing more diverse and complex patient information from the health records imputed in the hospitals' systems electronic health records (Shaikh et al.,2021).

The clinical decision supports system had been operating for years but only as standalone solutions but not well-integrated into the point of care for patients as artificial intelligence provides. Artificial intelligence is designed to overcome issues of alarm fatigue and nurse burnout. It aims to provide solutions that are efficient, intuitive, and informative (Douthit et al., 2020).

There are various ways in which artificial intelligence is changing the health care systems. Artificial intelligence is the clinical decision support system that can process large volumes of data and provide the healthcare personnel with the right suggestions for the next steps in treatments, show potential problems and provide enhanced efficiency (Bizzo et al., 2019). Artificial intelligence enables large amounts of data to be obtained and interpreted in real-time. This information is optimally analyzed and used. The clinical decision support tools can drastically improve diagnosis, treatments, and prognosis (Shaikh et al., 2021). It also provides a prediction for various probabilities of a medical outcome or risk of diseases as provided by biomedical imaging data. The system can analyze historical, present, and new patient data and provide suggestions for concerns of safety, errors, or customized care improvements to the user (Shaikh et al., 2021). Artificial intelligence has the capability of predicting the importance and new precision leads to new ways of optimizing patient care (Douthit et al., 2020).

The most significant use of artificial intelligence in clinical decision support systems is in enhancing diagnostic accuracy which in turn reduces mortality rates and general hospital stays especially for patients admitted in the emergency rooms and intensive care units(*Artificial intelligence for clinical decision support*,2020) The availability of data from improved electronic health records and suggestions provided enables healthcare professional and patients to make an informed decision hence reducing medical errors. Clinical burnout is one of the major causes of diagnostic errors and other complications that affect service delivery. Therefore, the role of artificial intelligence in the assistance of various roles of nurses and other professionals helps in providing the best medical care for every patient (Douthit et al., 2020).

Despite the benefits of incorporating clinical decision supports systems in healthcare there are also major challenges associated with implementation (Ronquillo et al.,2021). The system cannot be efficiently implemented unless the clinicians have adequate knowledge and training on how the system operates. Therefore, it is important for proper training to be conducted before the implementation of the systems. Some errors can occur due to information missed by the systems therefore a human aspect is required to work together with artificial intelligence (Ronquillo et al.,2021). Nurses should be involved in the development and implementation of the systems to maximize the best out of artificial intelligence (*Artificial intelligence for clinical decision support*,2020)

Mobile health (eHealth) is the use of wireless devices such as mobile phones to provide health care services. It is an introduction of information technology and telecommunications as a service delivery technique in health care. This technology utilizes digital data to support health from a remote distance and consist of electronic health records, clinical decision support system, and professional instructions tools (Doswell et al., 2013). This form of artificial intelligence involves the collection, storage, retrieval, management, and use of information for the provision of better health care for patients. There are various applications and technologies currently in the market including smartphones apps and wearable devices that assist in managing chronic illnesses of patients in their natural environments. Information is passed from patients to healthcare providers every day showing a clear picture of the physical state of patients (Doswell et al., 2013). Wearable sensors provide accurate information on sleep patterns, heart rate, and overall activity of patients. These sensors based technologies provide information on body and weight movement as well as information of patient surrounding that is the quality air, light, temperature, and sound. In hospitals, nurses use these technologies in monitoring patients who have been moved from inpatient to outpatient care.

Various research studies have been conducted to establish the benefits of mobile health and sensor-based technologies and compared to the challenges they provide in the medical care sector. One major benefit of eHealth is its capacity to provide patients with better access to medical care providers. It enables patients to send messages, schedule appointments, and be able to connect with clinicians throughout the day at any time (Doswell et al.,2013). This eliminates the traditional system of queuing to access services in hospitals. It also reduces traffic in hospitals since patients are provided with services in the comfort of their homes(Doswell et al.,2013). The convenience that mobile health application provides has proven to be cost-effective and efficient for every stakeholder involved (Doswell et al.,2013).

Mobile health and sensor-based technologies have also proven to improve medication adherence. It ensures that once patients leave the inpatient facility they can get and refill their medications on time and also contact clinicians whenever they need (Murnane & Choudhury 2020). The technologies have automated medications, refill reminders, track remaining medications, and educational information that will improve patients' chances of taking their medications on time.

11510

Mobile health and sensor-based technologies have been beneficial in ensuring that patients are monitored remotely without being on hospital grounds. The technology enables patients to provide information to their medical health providers at the comfort of their homes without any intrusive methods (Murnane & Choudhury 2020). It, therefore, enables nurses to track the medical conditions of patients in between clinic visits and also notify nurses when the patients' conditions are deteriorating (Murnane & Choudhury 2020). Sensor-based technologies are influential in monitoring and managing patients who are chronically ill. The major form of data transmitted includes weight, blood pressure, glucose meters, diet data trackers, and heart rate monitors (Bettina,2020).

Mobile health sensors have enables medical practitioners to efficiently and accurately reconcile medication and improve patient accuracy. Patients, especially those taking a lot of medications at once may at times forget their names and their use which may turn to affect their safety. These technologies, therefore, provide the necessary information for patients and doctors when required(Bettina,2020). It reduces the chances of drug-on-drug interactions which may occur by double administrations or wrong prescriptions(Bettina,2020). It provides healthcare providers with overall information on the number and type of medications that the patients as been taking (Murnane & Choudhury 2020).

Mobile health and sensor-based technologies have also proven to improve communication and coordination between patients and nurses (Bettina,2020). Artificial intelligence in mobile health enables nurse's patients and doctors to easily connect across the health system such as tracking appointments, referring physicians, and mobile health records access (Bettina,2020). It is also beneficial in alerting providers or incoming patients and also information on all admitted patients. It enables providers to see the current condition of patients, where they have been, the provider who treated them, and the types of medications prescribed to them (Murnane & Choudhury 2020).

Voice assistant is a form of artificial intelligence software that audibly communicates and provides a response to commands that are spoken. The available technologies with voice assistant software include Siri, Alexa, and google assistant. The artificial intelligence software can simulate humans. It can be applied in various aspects of healthcare, outpatient education, communication, and monitoring of patients' health (Britt,2021). The health virtual assistant market is still developing with many companies working to develop new algorithms (Britt,2021). There is also various voice assistant in the market that is changing the medical industry. These virtual assistants' artificial intelligence includes Sugarpod, Alexa, Orbita, and Dr. Al.

Sugar pod is a virtual assistant artificial intelligence developed by Wellpepper. It is highly influential in managing type 2 diabetes. The features available in this technology include foot scanners, mobile interface, and Alexa-generated voice functionality.it provides users with customized service that helps in managing medications, providing care plans, and tracking patients' progress (Britt,2021). The foot scanner is able to detect early signs of diabetic foot ulcers before it becomes severe. Orbita is a virtual assistant with a voice platform that reminds

11512

elderly patients to take their patients. Amazon has also partnered with Giant Eagle pharmacy to develop prescription management services. Alexa will be able to set patient medication reminders and order refills in order to reduce cases of non-adherence (Britt,2021). Dr. AI is another type of virtual assistant algorithm with an Alexa skill that is able to conduct deep learning and conduct emotional intelligence in order to diagnose patients. With extensive training, the virtual doctor has been equipped with tools that can point out possible medical problems from a patient's conditions (Britt,2021). It also has a feature that provides first aid advice to most common conditions such as fever management and treatment of a cut. Voca.ai is a virtual assistant developer that is working with Carnegie Mellon University to develop an artificial intelligence software that can detect coronavirus by the sound of the patients' voices (Britt,2021).

The benefits of voice assistants have proven to be more than the negative implication of artificial intelligence. Concerns have been raised about the potential loss of privacy and the threat of cyber-attacks. This artificial intelligence has enables patients to save money on the cost of admittance that may occur due to a lack of adhering to medical prescriptions (Douthit et al., 2020). Virtual assistants reduce the time that nurses take to input data into the system since the software easily understands medical terms and time saves up time for patients who need urgent care (Douthit, et al, 2020). Other benefits of voice assistance in hospitals include insurance verification and pre-certification where details of the patient are easily updated and accessed, assistance in invoicing and billing by updating the latest prescription and record of patients, and management of appointments Douthit, et al., 2020) Voice assistance technologies enables nurses to provide the best quality care for patients.

Robotics is a developing field in the medical industry which includes surgical, rehabilitation, and hospitals robots. The field also includes smart prostheses, bionics, robotic nurses, and surgical robot training. Various robots have been in operation assisting in providing the best medical care for patients. The accuracy and efficiency of this form of artificial intelligence have proven to reduce the mortality rate in hospitals, reduce cost and minimize time spent in hospitals (tietze & McBride.,2020). The available robotic technology assisting nurses today includes Robot Dinsow, Robot Paro, and Robot Pepper.

Robot Dinsow is used by hospitals in Thailand and Japan to monitor elderly patients through video and can set up video chats with their families (*Robotics in nursing*,2020). It also provides alerts to the family of patients through the phone and also provides reminders on medications and physical workouts for the patients (*Robotics in nursing*,2020). Robot Paro is used worldwide to provide enhanced care for patients. The robot is able to monitor and manage patients stress levels and socialization by imitating patients' behavior through the best form of light, audio, temperature, and posture (*Robotics in nursing*,2020). Relaxed patients are therefore able to interact with caregivers efficiently on a relaxed environment (*Robotics in nursing*,2020). Robot Pepper is a humanoid robot that works in Belgian Hospital reception. It greets people, guides patients to their appointments (*Robotics in nursing*,2020). With its knowledge of twenty languages, the robot is able to communicate with patients identify emotions such as joy, sadness, surprise, and anger (*Robotics in nursing*,2020). It interprets non-verbal

cues like head shakes, smiles, changes in vocal tones, and also frowns (Robotics in nursing, 2020).

There have been concerns about the probability of robots replacing nurses in hospitals. Various research has been conducted on this case and found that the basic human aspect in medical care is irreplaceable. Robots are developed through programs, software, and algorithms. Therefore, they lack human beings' ability to reason and use common sense (Tietze, & Mcbride (2020). Robots depend on programming to understand human emotions therefore no artificial intelligence can completely replace human beings (Christoforou et al., 2020). On the operational basis, the robot may become inefficient if it faces cases of ethical dilemma, a circumstance not programmed in the system and has the potential to harm human life (Christoforou et al 2020)

Robots have been significantly being beneficial in the medical field. They are able to offer assistance to nurses on duty. Robots assists in recurring responsibilities of nurses such as retrieval of medicine, delivery of food and prescriptions to patients, and also assist in moving patient from one area to another (Christoforou et al., 2020). Robots assist in providing necessary training to staff such as the simulation of patients' hands in the cases of patient transfer training. Nurse robots have also been able to provide various career opportunities in the medical field such as robotic coordinators who manage and oversee robot operations and tasks. Robotic telemedicine also provides opportunities for the specialist to work with this artificial intelligence in providing medical care to patients remotely (Christoforou et al 2020)

Methodology

The research will conduct a systematic review of all available information on artificial intelligence in nursing. The systematic review focuses on identifying available studies that have been published on the topic of research and the corresponding results from the conducted studies. The findings of the review depend on the type of data that has been considered relevant in the studies. The systematic review requires collected data to be complete, accurate, and accessible for any updates available in the future. Methods used on determining the data to be used should be transparent, free from bias and human error. The sources of data for this research will be journaling articles, conference abstracts, trial registers, clinical study reports regulatory reviews, and individual participant data.

Journal articles are the most common source of data for systematic review. Multiple journal articles on artificial intelligence will be reviewed to understand its effects on nursing. The research will focus on peer-reviewed journals where all the articles have been reviewed by experts in the field. Before publication, experts ensure that the information presented is true and the methods or research are the right ones used to obtain the results. Journals contain first information on new research and are easily accessed through various databases.

Journal articles for this research will be retrieved from various specialized databases. The research will use a research database list from both public and

11514

university libraries. Journal articles will be also retrieved from google scholar which can be easily accessed free through the internet. In order to determine the best article for this study, journal articles to be reviewed will be determined by the following criteria. Review the authors of the articles to determine whether they are experts in their field such as medical doctors or Ph.D. holders. Articles authors will also be reviewed to determine whether they are affiliated with an association such as a university or hospital. The purpose of the article will have determined by reviewing its scope and the type of content available such as whether it is research-based or analytical (LibGuides: How to find scholarly, peer-reviewed journal articles: How to identify a scholarly, peer-reviewed journal article n.d.) The structure of the article will be reviewed to determine whether the article is consistent with a scientific study (LibGuides: How to find scholarly, peer-reviewed journal articles: How to identify a scholarly, peer-reviewed journal article n.d.) The language of the article will be reviewed to determine whether it is formal and technical and professional. Peer-reviewed articles will be most preferred since it provides an objective and logical viewpoint (Tianjin n.d). Only articles published in academic journals will be reviewed. The most significant limitation of using this form of the data source is the probability of articles omitting unwanted outcomes such as in this case, the negative impacts of artificial intelligence in nursing.

Clinical study reports contain extensive descriptions of a clinical problem, its design, its conduct, and the results of the clinical trials. Clinical study reports (CSR) consist of data about the methods which was conducted on the trial and the results of the study, (Tianjing n.d). The research will review various clinical study reports conducted on artificial intelligence in nursing especially robotics and virtual voice assistants. Clinical studies report contains provides the most amount of data on various research topics as compared to any other source of data (Tianjing n.d). The findings and results of the study are often easily understood and therefore can be applied in any systematic review (Tianjing n.d). It should be noted that Clinical study reports are not publicly available therefore the reports will be obtained through the following avenues.

Information on available clinical studies on artificial intelligence will be obtained from Clinicaltrials.gov which is a government website that provides information on clinical studies conducted on various topics affecting the public. Information and data will also be obtained from CSR synopsis which provides summaries on various clinical reports conducted and have an effect on the general public. Information on clinical studies will also be requested from European Medicines Agency, the US Food and Drug Administration agency (Tianjing n.d). Clinical studies reports will be obtained from unsealed litigation documents repositories such as clinicalstudydatarequest.com and other databases such as the Yale University Open Data Access Project. The most significant limitations of using this form of the data source in its inaccessibility to the general public and timeconsuming in nature since these reports are often hundreds of pages long.

The results and findings of clinical trials are sometimes incomplete and misleading where some information of the negative impact of the object of study is removed from findings that are available to the general public. Therefore, to ensure this case does not affect the study, findings and results of clinical studies will be compared to findings and results from other sources of data and establish the accuracy of the information (Tianjing n.d). In this research, clinical studies reports will be influential in determining the harmful impacts of artificial intelligence in the nursing field.

Clinical study reports have been reviewed by regulatory authorities. The reviews have been prepared by government agencies staff such the food and drug and administrations and European medicines agencies on various products that are to be put in the market based on clinical trials and other studies. The regulatory reviews provide information on clinical trials that other articles may have not reported on (Tianjing n.d). The data provided is clearly understood by any reader, therefore it is easier to interpret.

Preliminary research will be conducted to identify the key articles that are most relevant to the study. This will ensure that the idea is valid and avoid the instance of data duplication. Research themes will focus on artificial intelligence in healthcare issues, current information on scientific research and will be consistent with the relevant review methods.

Extensive research will be conducted on Google Scholar and PubMed with key terms being artificial intelligence, nursing, voice assistant and robotics, clinical decision support systems, mobile health, and sensor-based technologies. The search will provide information on available studies on the topic to avoid duplication and any research gaps that need to be addressed.

The eligibility criteria will be based on patient, intervention, comparison and outcome (PICO), the design of the study, and the date (Tianjing n.d). For a journal article or clinical study reports to be included in the research, it should focus on the target patient and population being nurses or medical caregivers, it should be an investigated intervention and there should be relevant comparability between two studied interventions. The outcome of the journal articles or clinical studies reports should be able to answer the research questions and provide adequate information.

For this research, the inclusion criteria will be any journal articles or clinical studies reports evaluating the impact and effect of artificial intelligence on nursing. The effect of clinical decision support systems on nursing. The effect of mobile health and sensor-based technologies on nursing and caregivers. The effect of robotics and voice assistants on nursing. Artificial intelligence and modernization of nursing. The research will cover all geographical locations and every type of nursing profession and medical field. Exclusion criteria will be based on the following; unrelated articles or studies such as articles or studies conducted on artificial intelligence in nonmedical fields, duplicated information, full texts that are unavailable, or articles and studies with abstracts only.

The primary search will be conducted on PubMed and Google scholar. Eventually, the search will be broken down to more extensive on specific databases to access the most useful and relevant results according to the criteria. The PICO formula will be used that is searches people and patients, intervention, comparison, and outcome. The key terms in the search will exclude the desired outcome to remove cases of bias and restriction of eligible data retrieval (Tawfik et al.,2019).

11516

In the PubMed, Google scholar, clinicaltrials.gov, and other websites the search descriptors will include artificial intelligence in medicine\robotics and nursing\voice assistants and nursing\mobile health\ sensor-based technologies and nursing\ clinical decision support systems\ clinical trials and artificial intelligence\modernization of nursing. These searches will provide adequate information for the review.

After extracting articles from the relevant databases and websites, the results will be imported into one library where duplicates that are articles and studies with the same authors or titles will be deleted. Thereafter the remaining data will be imported to an excel file for proper screening based on author's names, year of publication, journals, and abstracts. A manual search will also be conducted through three basic strategies that are reference list searching, citation tracking, and related studies searching. This will ensure all remaining studies follow the inclusive criteria and are not duplicated (Tawfik et al.,2019)

Data analysis will be done to combine and summarize the results included in the studies and journal articles. The analysis will be divided into qualitative and quantitative analysis to determine whether the results of the study are consistent with other articles or findings.

Conclusion

The research will undertake a systematic review by using the published journal articles and clinical studies report as the source of data. The key inclusion criterial for journal articles will be peer reviewed articles and authors who are affiliated with association. For clinical studies report, the key inclusion criteria is based on the related studies that have been published on Food and drug administration agency and the European Medicines agency websites. Data collection will be conducted by performing key search terms on various websites including PubMed. Google Scholar. clinicaltrials.gov and clinicalstudydatarequest.com. Data analysis will be conducted through quantitative and qualitative analysis to determine the impact of artificial intelligence technologies on the modernization of nursing.

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