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The Impact of Using Artificial Intelligence and Nanotechnology in Maintaining the Safety of Healthcare Facilities

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Abstract:

The current state of healthcare developments has a significant impact on our lives and well-being. The number of start-ups pursuing healthcare innovations is steadily increasing. To put it another way, we would be able to utilize AI as an extension of our brain. Increasing the bandwidth between the digital world and ourselves is the primary objective of the project. We are already using our mobile gadgets to extend ourselves at the moment. The bandwidth is quite limited because we may interact with our devices with our thumbs. This present study evaluates the research question in the light of secondary data, as conceived from a number of previous studies. The researcher pinned some of the keywords and selected or included the studies on the basis of the same. Total 132 studies were touched and 89 were selected finally for the study, A questionnaire was also conducted for health security personnel to determine the impact of using artificial intelligence and nanotechnology in maintaining the security of health facilities.

Keywords: AI, nanotechnology, Healthcare, technology in healthcare.

Introduction:

The healthcare sector is currently one of the largest in contemporary economic situations. AI is currently being utilized in pharmaceutical applications for drug repositioning and discovery, oncology cell imaging, and healthcare structure management for data analysis and patient care optimization. In medical facilities, it is not yet often used. On the other hand, AI is simple to use for straightforward jobs and has already resulted in significant cost savings. **Sim et al (2021)**. The current state of healthcare developments has a significant impact on our lives and well-being. The number of start-ups pursuing healthcare innovations is steadily

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increasing. For instance, Neural ink envisions a future in which our brains are connected to the digital world. To put it another way, we would be able to utilize AI as an extension of our brain. Increasing the bandwidth between the digital world and ourselves is the primary objective of the project. We are already using our mobile gadgets to extend ourselves at the moment. The bandwidth is quite limited because we may interact with our devices with our thumbs. **McNeil et al (2015); Shi et al (2010)** There is still very little voice activation. But ten years ago, we could not have imagined how efficient voice commands and real-time translation would be thanks to machine learning. This milestone has already been reached; previously, pattern recognition in writing was thought to be near science fiction and limited to the human brain. **Farokhzad et al (2016)**, IoT, or the Internet of Things, is already developing quickly. The Internet of Things is a network of gadgets, appliances, and other technology. These appliances are made possible by software and network connectivity, which allows them to communicate and gather data, thereby integrating the real world with the computer-based virtual world. Over time, the quantity of mobile phones has grown significantly. We can now access the internet more quickly and effectively thanks to advancements in mobile networks. Numerous sensors on these devices gather a variety of data, such as our activity and walking distance. When used in conjunction with smart watches, our data collection capabilities are further enhanced, enabling the monitoring of intricate factors like body temperature and heart rate. **Javaid et al (2021)**. Health security also improves the hospital's ability to respond to health and emergency situations, making the response quick and effective, thus increasing the strength and stability of the hospital. Health security personnel are the first point of contact for patients and visitors and are required to ask questions and interact with patients and visitors. Therefore, training health workers to fulfill the two responsibilities of safety management and reception environment emphasizes the importance of occupational safety training of people in both intellectual and technical areas. In addition, health care responsibilities include overseeing high-quality inspection procedures, ensuring that equipment is in good working order, and regularly inspecting facilities for compliance with local and international safety standards, The digital transformation of healthcare and the shift to electronic medical records and medical devices are increasing the risk of cyber threats and the need to monitor health to improve cybersecurity. **Brown et al (2022); Luizzo et al (2022**) Therefore, healthcare security must address these issues with measures including regular risk assessment, strong data protection, and the integration of advanced technologies such as AI and blockchain. Therefore, this review explores the various roles of healthcare in improving hospital security, examining the challenges, best practices, and repair technology in this area. **Nimmagadda (2021)**

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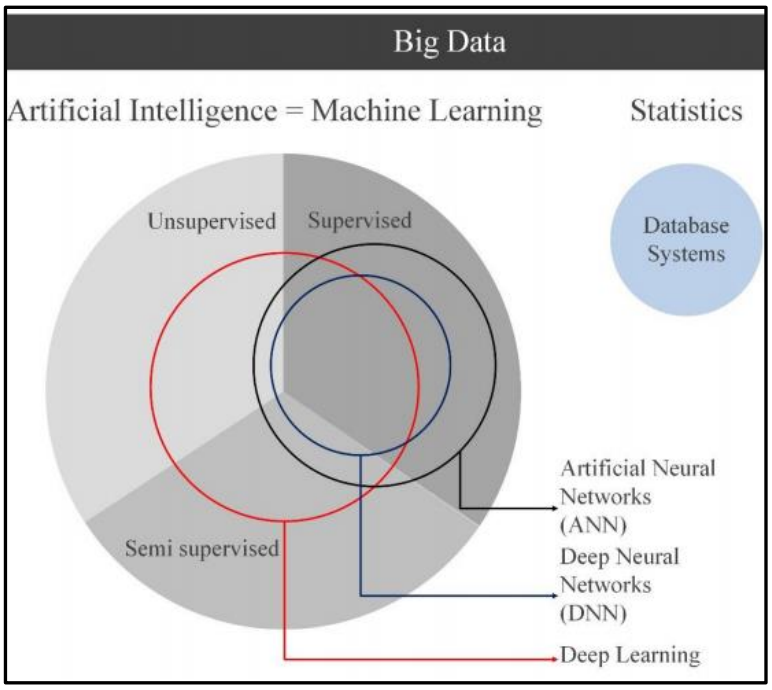
Major Factors Involved:

A. Big Data :

The volume of data has grown rapidly in recent years. The way we upload and store data has changed as a result of recent technical developments. When computers first came out, we could digitize text, images, and videos. Compared to the variety of data kinds we have now, this is a stark contrast. **Sharifi et al (2019)** The volume and variety of data being recorded and stored is enormous. Wearable gadgets with sensors that monitor our location and heartbeat are one example. Some gadgets even record breathing; these are typically used for athletic activity. But new information comes from the internet. Search engine searches yield information about the manner and timing of people's searches for various products. For instance, during a flu season, more people may search for information about immune system strengthening, immunizations, medications, and flu symptoms. Before the real data from the medical visits arrives, the enormous volume of searches might be used to forecast a new flu season. **Zhang et al (2022); Wang et al (2020)**



Source: André Bijl (2018)

Figure 1: AI and Big Data

B. Machine Learning

A set of training data that may be manually classified is provided to machine learning. After that, it will use the knowledge it has gained from the previously classified data to new data sets in order to provide new findings. **Li et al (2017)** Unsupervised, reinforcement, and

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supervised learning are the three primary forms of learning that are determined by the three types of feedback that characterize machine learning. With no output data provided, the agent discovers patterns in the input data through unsupervised learning. Clustering is a typical unsupervised learning activity. It recognizes groups of input instances and patterns. Through a sequence of reinforcements, such as rewards or penalties, the agent learns in reinforcement learning. In supervised learning, an agent learns a function that maps input to output by seeing a few sample input-output pairs. **Manjunath et al (2014); Hu et al (2020)**

C. Neural Networks:

The term "neural network" was coined in an effort to create mathematical models of how biological systems process information. Artificial neural networks, in summary, try to mimic the functioning of the biological brain13. Among the best learning techniques now on the market are artificial neural networks. For some challenges, including learning to decipher complicated data from real-time sensors. **Hamet et al (2017); Huang et al (2020)** In a nutshell, artificial neural networks (ANN) function as the top layer of deep neural networks (DNN). similar to how deep learning uses machine learning. Computer technologies known as artificial neural networks are modeled after the physical neurons found in the human brain. The technical architecture employed in machine learning is another name for artificial neural networks. The artificial neural network is made up of a network of interconnected artificial neurons, which are basic processing units that adapt to their surroundings in order to learn from past experiences.

Objective of the Study:

the main objective of the study is to identify the impact of Artificial Intelligence and Nanotechnology in the field of Health Care.

Research Process:

Reseaerch Design:

This present study is based on secondary data i.e. it is basically a review study, where the previous studies will be considered as a reference to find a better insight of the problem at hand and the respective future aspects of the same. Most of the studies considered were published in reputed journals i.e. scopus, SCI, etc. A questionnaire consisting of 11 open questions (yes, no, and I don’t know) was also conducted and distributed to male and female health security workers. The results of this study were presented.

Time Frame:

The study timeframe extended from November 2024 to March 2025, a period considered due to the abundance of innovations in the fields of artificial intelligence, machine learning, and even nanotechnology.

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Inclusion Criteria:

About 132 studies considered to present a detailed review of the problem at hand and the researcher has identified some of the inclusion and exclusion criteria based on many of the international studies of same nature. In general, the initial criteria were that all the studies should be published or presented in English Language as this is one of the most suited language for the audience of this study. Then on the other hand some of the keywords were identified i.e. “AI and healthcare”, “Healthcare and machine learning”, “Healthcare and nanotechnology”, “Healthcare facilities”, “Big Data”, etc. The studies who do not possess such key words were also excluded. Finally, 89 studies were finalized for the present study, in addition to reviewing the survey results.

AI in Healthcare:

Neural networks are now more powerful than ever. Extremely complex mathematical problems are solved using supercomputers. Compared to a few years ago, computing power has improved considerably more. New businesses typically use cloud computing. Larger businesses are using cloud or hybrid cloud solutions to replace legacy systems. At this time, quantum computers are beginning to be utilized for computations that are significantly more complex than those performed by traditional supercomputers. They claim that by modeling the behavior of matter down to the atomic level, they will find new materials. Quantum computing will make it possible for artificial intelligence to process data more quickly. **Kong et al (2023)**

Smart watches, smart wristbands, and smart eyewear have emerged since the invention of mobile phones. Today's Apple Watch is a standalone computer. It has an LTE antenna and can be used as an internet-connected computer. These wearables provide biometric data like heart rate and movement data like daily steps or walking distance. Perspiration is even measured by certain fitness-specific gadgets. Computer processing units have improved, becoming smaller and more power efficient, which has led to these technological advancements. **Ramalingam et al (2023)** Accenture claims that during 2017, the number of wearable gadgets has tripled. Between 2017 and 2019, the percentage increased from 9% to 33%. "Compared to 2017, more people are now eager to share wearable data with their health insurance plan (up from 65 percent in 2017 to 70 percent in 2019), as well as with other app users or online communities (up from 35 percent in 2017 to 43 percent in 2019). Consumers are less inclined to share data from wearable devices with government agencies (42 percent) or their workplace (35 percent). **Rizi et al (2022)**

Technology such as RFID chips, which have a unique ID that connects to a database containing our personal data, can occasionally be implanted. However, because it is physically invasive, this approach is not favored by most people. Additionally, significant advancements in the way that software is built have led to an increase in the amount of

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software created worldwide, a phenomenon known as ubiquitous computing. **Qian et al (2022); Cui et al (2020)** These platforms are compatible with the majority of operating systems and various kinds of computing devices. A new program's foundation is its expandable and integrated software, which facilitates its availability and cross-platform use. Cars with autonomous driving capabilities are already accessible and getting much better, the sharing economy is a new method of using utilities more efficiently, and 3D printing is used to make consumer goods and parts. For instance, prosthetic components are increasingly being printed using 3D technology in the healthcare industry. With the use of 3D printing and artificial intelligence-generated models, new engineering challenges pertaining to the best design are being resolved. As an example, Autodesk used artificial intelligence to develop an internal part for Airbus that was the best in terms of weight and strength. **Martinho et al (2021)**. The transmission, processing, collecting, and storage of healthcare information for the purposes of early disease detection and preventive diagnosis are all covered by informatics in the healthcare industry. Data related to medical records, disease data, computing capacity, and methods for handling this data are all included in the scope of healthcare informatics. The goal is to deliver high-quality healthcare at a reasonable cost. Electronic health records (EHRs) are among the new data created by these field technologies.**Adrah et al (2023)**. Doctors may benefit from artificial intelligence in diagnosing patients, interpreting vast amounts of genomic data, and forecasting chronic illnesses. The intelligent web73, also known as smart web applications, alters how we use online web apps. For instance, one application that allows users to order meals does not inquire if they want to order, but rather asks if they would like to have fish for the day depending on their preferences. Artificial intelligence would open up new possibilities for healthcare applications as the next user interface. Artificial intelligence can use mobile devices to compare a patient's medical information with those of other patients and with their own data in a time-point fashion. By remotely analyzing the patient, its machine learning program may suggest a workout regimen or issue a health warning. **Nikolova et al (2020)**

Future Application of AI:

Artificial intelligence is being used to drive or support a few other healthcare-related professions. Since it would be challenging to investigate the nanotech system using optical imaging, artificial intelligence would be used to simulate it. Some surgeries will someday be performed more precisely thanks to machine learning in remote surgery. By searching for patterns in data on blockchain platforms, blockchain and AI may eventually collaborate. **Ferreira (2022)**

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Source: https://nextgeninvent.com/blogs/use-cases-of-generative-ai-in-healthcare/

Figure 2: Use of AI in Healthcare

Nanotechnology:

Different matter structures with sizes on the order of a billionth of a meter are the subject of nanotechnology. Even though the term "nanotechnology" is relatively new, functioning gadgets and structures with nanometer-scale dimensions have existed on Earth for as long as life itself. Through the organization of calcium carbonate into robust nanostructured bricks held together by a glue composed of a mixture of carbohydrates and proteins, the mollusk abalone creates extremely durable shells with iridescent interior surfaces. The nanostructured bricks prevent externally initiated cracks from propagating through the shell. The shells serve as an organic example of how much stronger a structure made of nanoparticles may be." **Afantitis et al (2020)**

Since optical pictures cannot be recovered, it is challenging to study novel nano systems in the field of nanotechnology. Sometimes, only a numerical simulation may be used to study images at the nanoscopic scale. Artificial intelligence enables programs and apps to simulate many systems at the atomic level. Artificial intelligence can be utilized in this situation to enhance the simulations' quality and facilitate their interpretation.

Blockchain:

Security and privacy will be crucial in identifying new healthcare prospects. There are now stringent regulations governing the storage of patient data in healthcare facilities. Blockchain may be able to help protect patient privacy by providing decentralized, highly secured data. The ability to use research data and data exchange are two of the biggest issues facing the healthcare industry. The healthcare industry holds data security and privacy to a high standard. A healthcare system may face severe penalties and reputational harm in the event of a data breach. Blockchain technologies significantly lower these risks and may possibly avoid

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such data breaches. Blockchain gained popularity due to the Bitcoin crypto currency and received traction within the healthcare industry to be used as a medium for healthcare data storage solutions. Blockchain is a big, public, secure and decentralized datastore of records, events or so-called blocks. Every block contains a timestamp which is linked to a previous block.

Discussion and Result:

The survey results showed the following: The percentage of male participants was 14.3%, while the percentage of females was higher at 85.7%. The ages of participants in the survey were 25-34 years old at a rate of 95.2%, and the percentage of those aged 35-44 years old at a rate of 4.8%, while there was no percentage of participants aged 45-60 years. Their profession was as follows: health security 83.3%, security guard 11.1%, health inspector 0%, security supervisor 5.6%, and their academic qualifications were: health institute diploma 10.5%, English diploma 0%, secondary school 5.3%, accredited training courses in the field of security 0%, intermediate school 0%, Post-university health security diploma: 31.6%, university health security diploma: 26.3%. As for the participants' answers to the survey questions, they were as follows:

Question	Yes	No	I don't know
Can artificial intelligence help companies comply with occupational health and safety regulations by automatically monitoring risks and reporting them?	76.2%	9.5%	14.3%
Government hospitals in the country are providing new services that rely on artificial intelligence technologies this year. Among the most prominent of these services are internal organization processes	52.4%	4.7%	42.9%
Preserving and enhancing health and safety in the workplace, through artificial intelligence and its development in improving work safety and preventing accidents in facilities	71.4%	19%	9.5%
Are electronic devices used to detect sharp objects and metal objects when passing through electronic gates	85.7%	4.8%	9.5%
Are there electronic circuits and screens to monitor visitors and users of health facilities	90.5%	4.7%	4.7%
Individuals are distributed at all health facility gates for the	81%	14.3%	4.7%

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purpose of internal organization and monitoring visitors to government facilities				
Is there an official dress code for those responsible for monitoring security in government health facilities	85.7%	9.5%	4.8%	
Are there regular training courses for male and female health inspectors, with the aim of developing and acquiring experience and skills to keep pace with the health security requirements of health facilities	61.9%	19%	19%	
Are there any prohibited items (sharp tools, flammable materials, etc.) that individuals are not allowed to bring with them, especially when visiting government health facilities	85.7%	14.3%	0%	
Health security personnel participate effectively in implementing quality, especially in the field of health security, which is the pillar of the health facility	76.2%	0%	23.8%	
Are there daily reports required for the health security personnel to monitor the security situation inside and outside the health facility	85.7%	9.5%	4.8%	

Future Prospects:

Now the field of health security needs changes in the level of responsibility, accountability, daily issues, security issues and many related issues. This will require assistance with advanced data structures, cybersecurity systems, improved patient care and more. Some of these issues are very important to solve and implement. With the development of risk assessment and analysis, the ability to evaluate vulnerabilities and develop risk reduction strategies in health security has increased. Culture has become an important factor in hospitals, requiring doctors to be able to communicate well and be courteous to people of different races and ethnicities. This includes managing bias, understanding culture, and meeting the unique needs of patients. International standards help improve relationships and collaboration in health security. International guidelines, such as the International Association for Healthcare Security (IAHSS), provide a framework for best practices in access control, assessment, and emergency preparedness. These efforts will also strengthen the capacity of global health services to respond to major challenges. AI and machine learning analyze large amounts of data to identify patterns and predict potential threats, enabling effective responses to improve physical and digital security measures.

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Conclusion:

AI has a significant and will continue to have a significant impact on healthcare. Based on projections of spending through 2025, the immediate effects of the present advancements and investments in artificial intelligence will be apparent within the next five to seven years. As we can see from the technological breakthroughs that occurred during the end of the third industrial revolution and the start of the fourth, this innovation had a significant impact on every industry over a 15–20-year span. Health security in healthcare will certainly evolve in parallel with these timelines. Healthcare and medical research will evolve at the same pace as information technology at the dawn of the 21st century, albeit with a 20-year delay. Health security is a multidisciplinary discipline that contributes to the safety and well-being of patients, staff and visitors to hospitals. As healthcare systems become more digital and complex, the integration of advanced technology and risk management is vital to managing hospital security. This review highlights the importance of ongoing health security education, the use of new technologies and international standardization of safe healthcare. Health security issues such as limited capacity, access and security measures must be addressed through effective investments in infrastructure and human resources. Health professionals can improve efficiency, effectiveness and safety in the healthcare environment by using best practices and innovative technologies.

References:

1. S. Sim, NK Wong. Nanotechnology and its use in imaging and drug delivery. Biomed Rep 14 (2021): 1-9.
2. SE McNeil. Unique benefits of nanotechnology to drug delivery and diagnostics. Charact Nanoparticles Intend. Drug Deliv (2011): 3-8.
3. J Shi, AR Votruba, OC Farokhzad, et al. Nanotechnology in drug delivery and tissue engineering: from discovery to applications. Nano Lett 10 (2010): 3223–3230.
4. OC Farokhzad, R Langer. Nanomedicine: developing smarter therapeutic and diagnostic modalities. Adv Drug Deliv Rev 58 (2016): 1456-1459.
5. M Javaid, A Haleem, RP Singh, et al. Exploring the potential of nanosensors: A brief overview. Sens Int 2 (2021): 100130.
6. M Sharifi, et al. Cancer diagnosis using nanomaterials based electrochemical nanobiosensors. Biosens. Bioelectron 126 (2019): 773-784.
7. Y Zhang, Y Zhang, Y Han, et al. Micro/nanorobots for medical diagnosis and disease treatment," Micromachines 13 (2022): 648.
8. F Soto, J Wang, R Ahmed, et al. Medical micro/nanorobots in precision medicine. Adv Sci 7 (2020): 2002203.

Power System Technology
ISSN:1000-3673
Received: 16-01-2025 Revised: 20-02-2025 Accepted: 30-03-2025

9. J Li, B Esteban-Fernández de Ávila, W Gao, et al. Micro/nanorobots for biomedicine: Delivery, surgery, sensing, and detoxification. Sci Robot 2 (2017): 6431.
10. A Manjunath, V Kishore. The promising future in medicine: nanorobots. Biomed Sci Eng 2 (2014): 42-47.
11. M Hu, X Ge, X Chen, et al. Micro/nanorobot: A promising targeted drug delivery system. Pharmaceutics 12 (2020): 665.
12. P Hamet, J Tremblay, Artificial intelligence in medicine. Metabolism 69 (2017): S36-S40.
13. S Huang, J Yang, S Fong, et al. Artificial intelligence in cancer diagnosis and prognosis: Opportunities and challenges. Cancer Lett 471 (2020): 61-71.
14. X Kong, P Gao, J Wang, et al. Advances of medical nanorobots for future cancer treatments," J. Hematol. Oncol. J Hematol Oncol 16 (2023): 74.
15. M Ramalingam, et al. Impact of nanotechnology on conventional and artificial intelligence-based biosensing strategies for the detection of viruses. Discov Nano 18 (2023): 58.
16. KS Rizi. The smartphone biosensors for point-of-care detection of human infectious diseases: Overview and perspectives-A systematic review. Curr Opin Electrochem 32 (2022).
17. S Qian, Y Cui, Z Cai, et al. Applications of smartphone-based colorimetric biosensors. Biosens. Bioelectron 11 (2022): 100173.
18. F Cui, Y Yue, Y Zhang, et al. Advancing biosensors with machine learning. ACS Sens 5 (2020): 3346-3364.
19. A Martinho, M Kroesen, C Chorus. A healthy debate: Exploring the views of medical doctors on the ethics of artificial intelligence. Artif Intell Med 121 (2021): 102190.
20. FA Adrah, MK Denu, MAE Buadu. Nanotechnology Applications in Healthcare with Emphasis on Sustainable Covid-19 Management. J Nanotechnol Res 5 (2023): 6–13.
21. M Nikolova, R Slavchov, G Nikolova. Nanotechnology in medicine. Drug Discov. Eval. Methods Clin. Pharmacol (2020): 533-546.
22. MAM Ferreira, JA Filipe. Ethical considerations on nanotechnology (2022).
23. GM Sacha, P Varona. Artificial intelligence in nanotechnology. Nanotechnology 24 (2013): 452002.
24. A Afantitis. Nanoinformatics: Artificial intelligence and nanotechnology in the new decade. Comb. Chem. High Throughput Screen 23 (2020): 4-5.

Power System Technology
ISSN:1000-3673
Received: 16-01-2025 Revised: 20-02-2025 Accepted: 30-03-2025

25. SE Dilsizian, EL Siegel. Artificial intelligence in medicine and cardiac imaging: harnessing big data and advanced computing to provide personalized medical diagnosis and treatment. Curr Cardiol Rep 16 (2014): 1-8.
26. Brown, Janie Alison,Elaine Watson, and Tamra Rogers. "Hospital security guard's well-being and repeated exposure to personal threats in the workplace: a qualitative study in an Australian hospital."International Journal of Workplace Health Management15.6 (2022): 728-744.
27. Luizzo, Anthony, and Bernard Scaglione.Healthcare Security: Solutions for Management, Operations, and Administration. Productivity Press, 2022.
28. Nimmagadda, Venkata Siva Prakash. "Artificial Intelligence and Blockchain Integration for Enhanced Security in Insurance: Techniques, Models, and Real-World Applications."African Journal of Artificial Intelligenceand Sustainable Development1.2 (2021): 187-224.