ORIGINAL ARTICLE

APPLICABILITY WITH BENEFITS OF ARTIFICIAL INTELLIGENCE (AI) AMONG HEALTHCARE WORKERS IN A TERTIARY HOSPITAL IN NIGERIA

Efegbere, Henry Akpojubaro [1,2,3,4,5, 6,7,8] ; Akpojisheri Erhuvwu[9] ;
Olufunke Onaadepo[10]; Ojimba Okwudili Anastacia [11]; Enemuo Emeka Hycent [12]
; Asogun Danny Akhere [13]; Akaninyene Mark,[14] ;Efegbere Kate Ebruke[2]

1. Department of Community Medicine, Edo State University Uzairue, Edo State, Nigeria
2. Global Community Health Foundation
3. Cashville Development Foundation
4. International Centre of Inter-professional Team Building
5. The Brethren Ministry International
6. International College of Health Sciences and Technology LTD
7. International College of Technology LTD
8. Pan-Global College of Nursing Sciences LTD
9. Department of Nursing Sciences, Edo State University Uzairue, Nigeria
10. Department of Human Physiology, University of Abuja, FCT-Abuja
11. Department of Public Health , Federal Medical Centre Asaba, Delta State
12. Department of Medicine, Nnamdi Azikiwe University Nnewi Campus
13. Department of Community Medicine , Irrua Specialist Teaching Hospital, Irrua, Edo State, Nigeria
14. Hospitals Management Board/ Ministry Of Health, Uyo Akwa Ibom State, Nigeria

Corresponding Author: **Efegbere, Henry Akpojubaro [1,2,3,4,5,6,7] As above**

Email: efegbere.henry@edouniversity.edu.ng ; henryefegbere@gmail.com ORCID Id:https://orcid.org/0000-0002-5599-6584

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ABSTRACT

Introduction: The United Nations Sustainability Development Goals (SDGs) process culminated in the subsequent adoption of the 2030 Agenda for Sustainable Development, with 17 SDGs at its core, at the UN Sustainable Development Summit in 2015. This study is primed and titled applicability with benefits of artificial intelligence (AI) among healthcare workers in a tertiary hospital in Nigeria.
Methodology: The researchers used a self-administered questionnaire and thirty (30) healthcare workers were respondents for the study. Data obtained were analyzed using data analysis tools such as frequency distribution tables and percentages.
Results: The majority of respondents agreed that AI analyzes medical images like X-rays, MRIs, CT scans, and mammograms (60.0%) and that AI processes extensive patient data, including medical history, lab results, and genetic information, to aid early disease diagnosis (43.3%). Most of the respondents agreed that AI analyzes biological data to identify drug candidates efficiently (73.3%). Most of the respondents agreed that AI creates personalized treatment plans based on the patient's medical history, genetics, and lifestyle (83.3%). Most of the respondents strongly agreed that AI-enabled wearables monitor patients' health metrics remotely (53.3%). The majority of the respondents agreed that AI optimizes resource allocation, including staff, equipment and inventory management (23.3%). Most of the respondents agreed that there is a high level of understanding of artificial intelligence (50.0%). The majority are undecided about Hospital leadership support for AI integration in healthcare (66.6%).
Conclusion: The study concluded the integration of Artificial Intelligence in Edo State University Teaching Hospital offers a promising array of benefits for healthcare workers. It enhances diagnostics, aids in treatment decisions, streamlines record-keeping, optimizes workflows, and supports various aspects of patient care. These advancements have the potential to significantly improve healthcare delivery, making it more efficient, accurate, and accessible in the region.

Keywords*:* United Nations Sustainable Development Goals, Benefits of Artificial Intelligence, Healthcare workers

INTRODUCTION

In January 2015, the General Assembly began the negotiation process on the post-2015 development agenda.[1] The process culminated in the subsequent adoption of the 2030 Agenda for Sustainable Development, with 17 SDGs at its core, at the UN Sustainable Development Summit in September 2015.[1]
The health sector has witnessed remarkable advancements in recent years, and one technology that has played a significant role in transforming healthcare is artificial intelligence (AI)[2] Artificial intelligence encompasses the simulation of human intelligence in machines that can learn, reason, and make decisions autonomously. Artificial intelligence is not one technology, but rather a collection of them. Most of these technologies have immediate relevance to the healthcare field, but the specific processes and tasks they support vary widely[3]. By using artificial intelligence in healthcare, medical professionals can make more informed decisions based on more accurate information - saving time, reducing costs and improving medical records management overall.[4]
Artificial intelligence algorithms have demonstrated remarkable accuracy in disease diagnosis and prediction, surpassing human capabilities in some cases. There are already several research studies

suggesting that AI can perform as well as or better than humans at key healthcare tasks.[5] Today, algorithms are already outperforming radiologists at spotting malignant tumours and guiding researchers in how to construct cohorts for costly clinical trials. Machine learning algorithms can analyze vast amounts of medical data, including patient records, lab results, and medical images, to identify patterns and provide accurate diagnoses[6] By leveraging AI, healthcare providers can enhance diagnostic accuracy, reduce errors, and improve patient outcomes. The process of discovering and developing new drugs is time-consuming and costly. AI algorithms can expedite this process by analyzing vast amounts of data and identifying potential drug candidates with higher success rates. AI in healthcare promises to be a game changer - leading the way towards a future where patients receive quality care and treatment faster and more accurately than ever before[7.] Artificial intelligence was first discovered in 1956 by John McCarthy when he held the first academic conference at Dartmouth College where researchers discussed the possibility of creating machines that could stimulate human intelligence. Artificial intelligence has developed or evolved; development in Nigeria is major as a result of artificial intelligence [8-11.] It has helped to increase Nigeria's productivity and output, lack of adequate artificial intelligence may adversely affect the nation's economy.[12-14]

In the 1980s and 1990s, researchers started exploring the potential of Artificial intelligence in medical diagnostics and eventually developed expert systems that were able to assist doctors in diagnosing diseases and recommend treatment options based on patient data and medical knowledge. As technology evolved, Artificial intelligence began to find more extensive applications in healthcare. In the early 2000s, researchers began using machine learning algorithms to analyze imaging data, such as X-rays and Magnetic resonance imaging(MRIs), aiding in the detection and diagnosis of diseases[15]. As AI continues to evolve, it will undoubtedly play a pivotal role in shaping the future of healthcare, improving patient outcomes, and revolutionizing the healthcare industry as a whole[16-17]. However, for a variety of reasons, researcher believe that it will be many years before AI replaces humans for broad medical process domains [18]

AI Types:

AI comprises various technologies rather than a single one, with each supporting specific mechanisms and tasks in healthcare.

1. **Machine Learning**: Neural networks and deep learning are prevailing types of AI. Machine learning, often used in precision medicine, assesses patients' conditions and determines the appropriate treatment procedures based on their medical backgrounds[6, 18.] Neural networks, a complex technology available since the 1960s, are used to predict the development of specific diseases in patients. Deep learning is valuable for diagnosing lacerations and contusions from radiology images, and it is progressively employed for speech recognition, a type of natural language processing (NLP)[18].
2. **Natural Language Processing**: NLP utilizes unstructured healthcare data from electronic health record systems, converting it into a usable and analyzable form. NLP is applied to extract important information from patients' records, such as prescriptions and medical issues, and analyze trends in social media.[2]

3. **Rule-Based Expert Systems**: Used for clinical decision support, rule-based expert systems utilize sets of rules provided by electronic health records (EHR) to reason like human beings [7-6,18]
4. **Physical Robots**: Robots execute pre-detailed functions, such as lifting, welding, and delivering supplies in healthcare settings. Surgical robots, certified since 2000, enhance surgeons' abilities during procedures.[18]
5. **Robotic Process Automation**: An inexpensive and programmable AI technology, robotic process automation is used in healthcare for processing endorsements, revising patient records, and extracting data from images.[4,18]
6. **Artificial Neural Networking:** Artificial neural networks (ANN) simulate the computation of human brain nerve cells, aiding developments in voice recognition, image recognition, and robotics [6,9]
7. **Clinical Decision Support System (CDSS):** CDSS uses previous patient data to accurately diagnose diseases and allows clinicians to integrate their knowledge with CDSS information[9]
8. **Biomarkers:** Machine learning-aided biomarker discovery involves various tests to identify molecular signs of health for improved patient treatment [3,18]
9. **Arterial Spin Labelling Imaging (ASL):** ASL is a non-invasive method of assessing brain perfusion, successfully used in monitoring Alzheimer's disease.[18]

APPLICATIONS OF ARTIFICIAL INTELLIGENCE IN HEALTHCARE

a. Healthcare Drug Creation: Machine learning algorithms are reducing drug discovery time, making the process faster, safer, and more economical. AI assists in discovering new compounds for diseases and identifying the applications of previously tested compounds. For example, AI identified two medicines for treating the Ebola outbreak in West Africa within a day, a process that would normally take months to years.

b. Treatment Design: AI precisely identifies and analyzes medical images, aiding in faster disease diagnosis. It also assists in collecting patient information, diagnosis records, and billing, leading to better care design and patient satisfaction.

c. Disease Progression: AI, using biomarkers, helps document the progression of diseases at different stages, leading to better disease models and data processing.

d. Diagnosis Aid: AI aids in more accurate disease detection, such as skin cancer, outperforming even experienced doctors by automating diagnosis through AI systems.

e. Health Monitoring: Wearables and fitness gadgets equipped with AI monitor individuals' health, analyze data, and provide health status feedback to users.

f. Managing Medical Data and Records: AI plays a crucial role in collecting, storing, normalizing, and tracing healthcare data sources, streamlining data management and analysis in healthcare.

Concerns in Healthcare:

1. Administrative Workflow: AI can help reduce paperwork and manage time-consuming

administrative tasks in healthcare, allowing medical professionals to focus more on patient care.

2. Inadequate Nurses: AI can assist in addressing the shortage of doctors and nurses, improving patient care and reducing waiting times.
3. Surgery: AI can support surgeons during surgeries, making procedures more efficient and reducing the risk of exhaustion.
4. Diagnosis: Faster and more accurate AI techniques can complement healthcare professionals' observations in diagnosing patients' health issues.
5. Health Monitoring: AI can offer faster and more precise health monitoring solutions, encouraging patients to be more proactive about their health.

ADVANTAGES OF ARTIFICIAL INTELLIGENCE IN HEALTHCARE

a. Expanded Healthcare Access: Developing and under-developed nations often lack enough physicians, making it difficult to provide proper healthcare. AI algorithms can be utilized for diagnosis in these regions, improving healthcare accessibility.[3]

b. Improves Record-Keeping: Electronic Health Records (EHR) with AI technologies, like voice recognition and dictation, simplify storing and managing patient data, enhancing the documentation process.[3]

c. Advanced Immunotherapy: AI plays a significant role in advancing immunotherapy for cancer treatment, identifying patients who can benefit from it.[3]

d. Improves Quality of Services: AI's speed and efficiency in diagnosis, treatment, and record-keeping lead to reduced labor and treatment costs, ultimately improving the quality of healthcare services.[3]

RISK FACTORS

Cyber-attacks: AI systems are susceptible to cyber-attacks and cyber- crimes which can sabotage accuracy in diagnosis, sharing of information and drug administration. Ensuring cyber security in medicine is crucial to prevent such attacks. [4,6,18]

Systematic Bias: AI systems can be biased due to insufficiently diverse training data, leading to biased results and worse healthcare for certain minorities. Biases can also result from human physicians' decisions during AI training. [4,6,18]

Mismatch: AI systems may suggest actions that do not align with a patient's condition, potentially harming the patient. This mismatch can be a critical challenge in utilizing AI in medicine.[4,6,18]

THEORETICAL FRAMEWORK

The theoretical framework for this study is based on two key theories: The Technology Acceptance Model (TAM) and the Diffusion of Innovation Theory but we will be focusing more on The Technology Acceptance Model.

The Technology Acceptance Model (TAM): The Technology Acceptance Model (TAM) is a widely recognized and influential theoretical framework that explores the factors influencing the adoption and acceptance of new technologies by individuals. It was first proposed by Fred Davis in 1986 and has since been extended and modified by various researchers. TAM is

particularly relevant in understanding users' attitudes and behaviours towards technology in various settings, including healthcare.

The basic premise of TAM is that an individual's intention to use a technology is primarily determined by two key factors: perceived usefulness (PU) and perceived ease of use (PEOU).

1. **Perceived Usefulness (PU):** Perceived usefulness refers to the user's belief that a specific technology will enhance their performance, productivity, or effectiveness in achieving their goals. In the context of AI in healthcare, individuals, such as healthcare professionals at Edo State University Teaching Hospital, are more likely to adopt AI technologies if they perceive them as valuable tools that can improve patient care, diagnostic accuracy, treatment planning, and overall healthcare outcome.
2. **Perceived Ease of Use (PEOU):** Perceived ease of use refers to the user's perception of how easy it is to use a technology. If AI applications are perceived as user-friendly, intuitive, and require minimal effort to operate, healthcare professionals at Edo State University Teaching Hospital are more likely to accept and integrate AI into their daily practices.

Moreover, TAM proposes that PU and PEOU influence an individual's attitude toward using the technology, which subsequently shapes their intention to use it. Positive attitudes and intentions are more likely to lead to actual technology adoption and usage.

TAM has been widely applied in various healthcare contexts to understand technology adoption by both healthcare professionals and patients. In the case of AI in healthcare at Edo State University Teaching Hospital, TAM can be utilized to examine the attitudes and intentions of healthcare professionals towards adopting AI applications. By identifying factors that influence perceived usefulness and ease of use, stakeholders can better design and implement AI technologies that align with the needs and preferences of healthcare professionals, leading to successful integration and enhanced healthcare services. Additionally, TAM can be used to identify potential barriers to AI adoption and devise strategies to address any concerns or resistance among users, ultimately facilitating the successful implementation of AI in the healthcare system of Edo State University Teaching Hospital.

METHODOLOGY

Study Area: The study was carried out in Benin City, Edo State. Benin City is the capital of Edo State, southern Nigeria. The Major language spoken by the people of Benin City is English, pidgin and Bini language. It is the fourth-largest city in Nigeria according to the 2006 census, after Lagos, Kano, and Ibadan.[19] it is situated approximately 40km north of the Benin River and 320km by road east of Lagos. Benin City is the centre of Nigeria’s rubber industry, and oil production is also a significant industry

Study Design

This study adopts a survey research design, chosen to align with the outlined objectives in chapter one. The design offers an efficient and accurate way to assess information on AI application and benefits among healthcare workers. The study was conducted in Edo State University Teaching Hospital.

Population of the Study

This study focused on healthcare workers at Edo State University Teaching Hospital, Etsako West LGA, Edo State, Nigeria. The total population of healthcare workers were 100 and 30 respondents was selected from the population.

Sampling Technique

Multistage Sampling Technique was deployed.

Stage I: Convenience sampling technique was utilized to select Edo State University Teaching Hospital Auchi due to its proximity to the researchers.

Stage II: Respondents were recruited using simple random sampling technique balloting technique.

Sample size determination

Taro Yamane's formula was used to determine the sample size from the population based on the availability of the subjects that was present in the facility during the study period.

Taro Yamane's formula is given as;

$$n = \frac{N}{1+N(e)^2}$$

Where N = Population of study (100)

n = Sample size

e = Level of significance at 5% (0.05)

1 = Constant

Substituting into the equation above, give 44

Therefore sample size is 44

Study Instrument

Data for this study was collected from both primary and secondary sources. The questionnaire consists of two sections- A and B. Section A consists of the subjects personal information and Biodata while Section B consists of 15 questions that requested the respondent's information on Application and Benefits Of Artificial Intelligence Among Healthcare workers. It had a 5 ratio scale of Strongly Agree, Agreed, Undecided, Disagreed, Strongly Disagreed, which are at the level of utilization.

Validity of Instrument

The instrument of this study underwent face validation, which tests the appropriateness of questionnaire items. The questionnaires were given to the Supervisor for necessary corrections to be made before it was distributed to the subjects. Any ambiquity in questions were corrected.

Reliability of Instrument

The questionnaire was administered to the subjects in test and retest to check the consistency of the instrument. The coefficient of 0.81 was considered an acceptable reliability coefficient.

Method of Data Collection

After permission was granted from the Head/in charge of the Hospital, the researchers went ahead to seek consent from the health workers and explained the aim of the study as well as their involvement in the study. The questionnaire was administered to the respondents to answer and was collected on the same day. The response lasted for about 30 minutes for each respondent to fill the questionnaire

Method of Data Analysis

The collected data was analyzed using frequency tables, percentages, and mean score analysis. SPSS version 26 was employed in data analysis.

Ethical Considerations

The ethical clearance for this study was obtained from the Ethical and Research Committee of the Edo State University Uzairue. Confidentiality, privacy and Anonymity of data were ensured.

Limitation of the Study

This study was carried out on Healthcare workers in Edo State University Teaching Hospital which may limit the generalization of the findings to other Hospitals in the state and Nigeria as a whole. Self- Self-administered questionnaires could pose a limitation too as subjects may not fully appreciate and understand what they are filing.

RESULTS

Data was analyzed and presented in percentage and frequency tables. Thirty (30) copies of the questionnaire were distributed to the respondents, and all copies were properly filled and returned. This put the response rate at 100%, which was suitable for the study.

Table 1: Age distribution of respondents

Age	Frequency (30)	Percentage (100%)
20-30	5	16.7
31-40	11	36.7
41-50	6	20
51-60	5	16.7
Above 60	3	10

Most of the respondents were between the ages of 31-40 (36.7%). Both ages 20-30 and 51-60 have the same percentage (16.7%). Ages 41-50 had a percentage of 20%. lastly, respondents above 60 had the least (10%).

Table 2: Educational Qualification of respondents

Educational Qualification	Frequency	Percentage (100%)
FSLC	-	-
WAEC/GCE/NECO	-	-
OND/HND/BSC	18	60

MSC/PGD/MBA/PHD	12	40

Most of the respondents were OND/HND/BSC holders (60%). Others were MSC/PGD/MBA/PHD holders (40%).

Table 3: Occupation of respondents

Most of the respondents are Nurses (33.3%). Other respondents; laboratory scientists and others had same percentage (16.7%).

Occupation	**Frequency**	**Percentage (100%)**
Medical Doctor	7	23.3
Nurses	10	33.3
Laboratory Scientists	5	16.7
Health Assistants	3	10
Others	5	16.7

Table 4: AI analyzes medical images like X-rays, MRIs, CT scans, and mammograms.

Response	**Frequency (30)**	**Percentage (100%)**
Strongly Agree	12	40.0
Agree	18	60.0
Undecided	0	0
Strongly Disagree	0	0
Disagree	0	0

Table 4 shows that the majority of respondents agreed that AI analyzes medical images like X-rays, MRIs, CT scans, and mammograms (60.0%) and that other respondents strongly agreed. (40.0%).

Table 5: AI processes extensive patient data, including medical history, lab results and genetic information to aid in early disease diagnosis.

Most of the respondents agreed (43.3%). Others, strongly agreed (33.3%). The least respondents were undecided (23.3%).

Response	**Frequency (30)**	**Percentage (100%)**
Strongly Agree	10	33.3
Agree	13	43.3
Undecided	7	23.3
Strongly disagree	-	-
Disagree	-	-

Table 6: AI analyzes biological data to identify drug candidates efficiently

Response	**Frequency (30)**	**Percentage (100%)**
Strongly Agree	0	0
Agree	22	73.3
Undecided	8	26.7
Strongly disagree	0	0
Disagree	0	0

Most of the respondents agreed that AI analyzes biological data to identify drug candidates efficiently (73.3%). Other respondents undecided (26.7%).

Table 7: AI creates personalized treatment plans based on patient's medical history, genetics, and lifestyle.

Most of the respondents agreed (83.3%). Other respondents strongly agreed (16.7%).

Response	**Frequency (30)**	**Percentage (100%)**
Strongly agree	5	16.7
Agree	25	83.3
Undecided	0	0
Strongly disagree	0	0
Disagree	0	0

Table 8: AI chatbots and virtual health assistants engage with patients, answering questions and offering basic medical advice

Response	**Frequency (30)**	**Percentage (100%)**
Strongly agree	0	0
Agree	14	46.7
Undecided	16	53.3
Strongly disagree	0	0
Disagree		

Most of the respondents were Undecided that AI chatbots and virtual health assistants engage with patients, answering questions and offering basic medical advice (53.3%). Other respondents agreed (46.7%).

Table 9: AI creates personalized treatment plans based on patient data

Of 30 participants, majority agreed that Ai creates personalized treatment plans based on patient data (50.0%). Other respondents undecided (33.3%). The least respondents (16.7%).

Table 10: AI-integrated robots enhance surgical precision and dexterity

Response	**Frequency n (30)**	**Percentage (100%)**
Strongly Agree	5	16.7
Agree	15	50.0
Undecided	10	33.3
Strongly Disagree	0	0
Disagree	0	0

Response	**Frequency n (30)**	**Percentage (100%)**
Strongly Agree	0	0
Agree	5	16.7
Undecided	25	83.3
Strongly disagree	0	0
Disagree	0	0

Majority are undecided about Ai-integrated robots enhance surgical precision and dexterity (83.3%). Other respondents agreed (16.7%).

Response	**Frequency (30)**	**Percentage (100%)**
Strongly Agree	16	53.3
Agree	14	46.7
Undecided	0	0
Strongly Disagree	0	0
Disagree	0	0

Table 11: AI-enabled wearables monitor patients' health metrics remotely

Most of the respondents Strongly agreed that AI-enabled wearables monitor patients' health metrics remotely (53.3%). Other respondents agreed (46.7%).

Table12: AI optimizes resource allocation, including staff, equipment, and inventory management

Response	**Frequency n (30)**	**Percentage (100%)**
Strongly Agree	0	0
Agree	7	23.3
Undecided	15	50.0

Disagree	8	26.7
Strongly Disagree	0	0

The majority of the respondents agreed that AI optimizes resource allocation, including staff, equipment and inventory management (23.3%).

Table 13: There is a high level of understanding of artificial intelligence

Most of the respondents agreed that there is a high level of understanding of artificial intelligence were

Response	**Frequency n (30)**	**Percentage (100%)**
Strongly Agree	5	16.7
Agree	15	50.0
Undecided	10	33.3
Disagree	-	-
Strongly Disagree	-	-

(50.0%).

Table 14 : Hospital leadership support for AI integration in healthcare

Response	**Frequency n (30)**	**Percentage 100%**

Strongly Agree	0	0
Agree	10	33.3
Undecided	20	66.6
Disagree	0	0
Strongly disagree	0	0

From table Majority undecided that Hospital leadership support for AI integration in healthcare (66.6%). Others agreed (33.3%).

DISCUSSION

Application of Artificial Intelligence in the health sector

From the findings in table 4 above, majority of respondents agreed that AI analyzes medical images like X-rays, MRIs, CT scans, and mammograms. and that AI processes extensive patient data, including medical history, lab results, and genetic information, to aid early disease diagnosis. Most of the respondents agreed that AI analyzes biological data to identify drug candidates efficiently. Most of the respondents agreed that AI creates personalized treatment plans based on patients' medical history, genetics, and lifestyle. Most of the respondents were Undecided that AI chatbots and virtual health assistants engage with patients, answering questions and offering basic medical advice. This was in agreement with Kourou, Exarchos.K, Papaloukas, Sakaloglou, Exarchos.T and Fotiadis.D (2021) who reported that AI can create personalised treatment plans and previous patient data to accurately diagnose diseases and allows clinicians to integrate their knowledge.

Benefits of Artificial intelligence in the health sector

Of 30 participants, majority agreed that Ai creates personalized treatment plans based on patient data (50.0%). majority were also undecided that Ai-integrated robots enhance surgical precision and dexterity (83.3%). Most of the respondents Strongly agreed that AI-enabled wearables monitor patients' health metrics remotely (53.3%). lastly, majority of the respondents agreed that AI optimizes resource allocation, including staff, equipment and inventory management (23.3%). In agreement with Davenport and Kalakota (2019), Topol (2019) who approved that robotic process automation can be used in healthcare and also agreed that wearables can be essential in Healthcare.

Level of Understanding of artificial intelligence

Most of the respondents agreed that There is a high level of understanding of artificial intelligence (50.0%). Majority undecided that Hospital leadership support for AI integration in healthcare (66.6%). This finding surely is a clarion call on healthcare leaders to embrace the challenges that follow with the huge applicability and benefits of AI.

Conclusion

The integration of Artificial Intelligence in Edo State University Teaching Hospital offers a promising array of benefits for healthcare workers. It enhances diagnostics, aids in treatment decisions, streamlines record-keeping, optimizes workflows, and supports various aspects of patient care. These advancements have the potential to significantly improve healthcare delivery, making it more efficient, accurate, and accessible in the region

Recommendations

The following recommendations were proffered:

i. Collaboration with government and regulatory bodies to develop policies that ensure the responsible and safe use of AI in healthcare.

ii. Investment in training and education to equip healthcare workers with AI-related skills.

iii. Enhance patient education about the role of AI in their healthcare.

iv. Foster collaboration between other specializations/departments in Medicine and Surgery and ICT Directorate to ensure the successful integration of AI into healthcare to promote continuous learning and professional development for healthcare workers to keep up with evolving AI technologies.

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