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Applications of Artificial Intelligence in Achieving Health Security: Prospects and Challenges: The Experience of the United Arab Emirates

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Abstract:
The current study aims to shed light on the applications of artificial intelligence (AI) in healthcare, achieving health security, and accelerating medical decision-making. Using a descriptive-analytical approach, the study explores key AI applications employed by the Emirates Health Services (EHS) in the United Arab Emirates to enhance the quality of healthcare services. It also analyzes the main challenges facing AI implementation in the healthcare sector. The study concludes with several findings, including that AI tools can revolutionize medical treatments and health security by improving diagnostic and treatment accuracy. It recommends significant investment in digital health initiatives and smart healthcare solutions to provide the highest levels of care to patients and the public globally.

Keywords: Artificial Intelligence, Health Security, Digital Health, Emirates Health Services (EHS).

Introduction:

The integration of emerging technologies such as artificial intelligence (AI) with healthcare is one of the most exciting topics today. AI is defined as the ability of machines to simulate human intelligence and perform tasks that typically require human cognition. Combining AI with healthcare has the potential to revolutionize how healthcare is delivered and managed, creating a comprehensive, efficient, and integrated system. AI can help analyze vast amounts of data, identify patterns, and even predict patient outcomes.

With the advancement of global healthcare systems and the rapid adoption of AI in healthcare, research and healthcare organizations are racing to embrace AI technology to improve patient experiences and address some of the pressing challenges facing healthcare today. To gain a deeper understanding of how these emerging technologies impact patients, healthcare professionals, and society at large, while ensuring the continued development of healthcare services in the UAE, efforts are focused on addressing challenges related to healthcare services by improving their quality and efficiency.

The following key points can be discussed: an overview of the current state of healthcare; a closer look at how AI is being utilized in healthcare; its potential future impact; and the challenges of implementing and adopting emerging technologies in healthcare.

In the United Arab Emirates, AI is driving significant transformations in healthcare by improving diagnostic and treatment accuracy, accelerating medical decision-making, and facilitating faster and more effective drug development. AI technologies and big data offer numerous benefits, including enhanced diagnostic accuracy, reduced costs, and personalized treatment plans, all of which lead to overall improvements in healthcare quality. However, these technologies also face significant challenges, such as privacy concerns, data bias, and the complexity of interpreting AI outcomes. Overcoming these challenges requires a commitment to continuous innovation and collaboration between medical professionals and AI experts to ensure the best possible care for patients.

AI plays a pivotal role in developing the UAE's healthcare sector by enhancing efficiency, improving healthcare quality, and streamlining medical decision-making. The UAE is investing heavily in digital health initiatives and smart healthcare

solutions to deliver the highest levels of care to patients and the public worldwide. Furthermore, the UAE aims to establish itself as a hub for healthcare-related AI industries and investments.

Based on the above, the following key question arises:

What role do AI applications play in improving the quality of healthcare services and achieving health security in the United Arab Emirates?

1. The Role of Artificial Intelligence in Improving Healthcare Services and Achieving Health Security:

The healthcare industry is undergoing a transformation driven by artificial intelligence (AI) technologies. Projections indicate that the market for AI technologies in the healthcare sector will grow by up to **1700% by 2030**, compared to 2021.

This rapid growth reflects the unprecedented adoption of AI in the healthcare industry. Currently, about one-fifth of healthcare organizations incorporate AI models into their solutions, highlighting the vital and expanding role of this technology in enhancing and advancing global healthcare (1).

In a short time, AI technologies have become increasingly important to doctors and other healthcare professionals, enabling them to make better decisions regarding diagnosis and treatment, predict disease progression, and discover new therapies. Additionally, AI has played a significant role in disease prevention and reducing the spread of epidemics by identifying individuals at risk and guiding physicians to make appropriate preventive decisions.

The healthcare sector's transformation due to AI underscores its potential to revolutionize the industry. As AI adoption grows, it continues to drive advancements in healthcare solutions, improving the quality and efficiency of care worldwide (2).

In a short period, **AI technologies** have become increasingly important for doctors and other healthcare professionals, enabling them to make better decisions regarding diagnosis and treatment, predict disease progression, and discover new therapies. AI has also played a significant role in disease prevention and slowing the spread of epidemics by identifying individuals at risk and guiding physicians to take appropriate preventive measures.

The **healthcare industry** is undergoing a transformation driven by AI technologies, with projections indicating that the market for AI technologies in the healthcare sector will grow by up to **1700% by 2030**, compared to 2021.

This rapid growth reflects the remarkable increase in the adoption of AI in the healthcare industry at an unprecedented rate. Currently, about one-fifth of healthcare organizations use AI models in their health solutions, highlighting the vital and expanding role of this technology in improving and advancing global healthcare (3).

In a short time, AI technologies have proven increasingly valuable for healthcare professionals, assisting them in making better diagnostic and treatment decisions, predicting disease progression, and discovering new therapies. Moreover, AI has played a crucial role in preventing diseases and reducing the spread of epidemics by identifying individuals at risk of illness and guiding physicians to take preventive actions.

2. Applications of Artificial Intelligence in Health and Medical Care

- **Disease Diagnosis and Prevention:**
  Big data has a significant impact on disease diagnosis and prevention. By analyzing large datasets from patient records, healthcare professionals can identify patterns and risk factors that might be overlooked through traditional diagnostic methods.

For example, big data has been used to identify genetic markers indicating a high risk of breast cancer, enabling physicians to develop more targeted screening and prevention strategies.

As more data is collected and analyzed, AI can help identify individuals at high risk, facilitating targeted interventions and preventive measures to reduce disease incidence (4).

- **Interpreting Medical Imaging:**
  AI tools like *Ultralytics* can analyze medical images such as X-rays, MRIs, and CT scans. This enables the

accurate identification and interpretation of abnormalities, tumors, or anomalies, assisting radiologists in making precise diagnoses (5).

- **Analyzing Pathology Images:** *VisionAI* technology supports pathologists in analyzing tissue samples at a microscopic level. It automates the detection of cancer cells, classifies tumors, and enhances the efficiency of pathology workflows.

- **Retinal Scans for Disease Detection:** Machine learning analyzes retinal images to identify early signs of eye diseases such as diabetic retinopathy and age-related macular degeneration. This allows for timely intervention and the prevention of vision loss.

- **Analyzing Dermatological Images:** Dermatologists receive assistance in diagnosing skin conditions as AI analyzes images of skin lesions, moles, or rashes. The technology provides insights into potential diseases and guides appropriate treatment plans (6).

- **Assistance in Endoscopy and Colonoscopy:** AI aids in the real-time analysis of endoscopy and colonoscopy images, helping physicians detect abnormalities, polyps, or lesions during procedures. This results in more accurate diagnoses.

- **Surgical Assistance and Navigation:** Vision-based AI guides surgeons during procedures by providing real-time feedback on anatomy, highlighting critical structures, and enhancing precision in minimally invasive surgeries (7).

- **Fall Detection and Elderly Care:** AI-powered vision cameras in healthcare facilities or homes can detect falls or unusual movements, ensuring timely assistance for the elderly and enhancing patient safety.

- **Facial Recognition for Patient Identification:** Vision-based AI can identify patients by analyzing facial features, improving accuracy in matching patients to their medical records and ensuring secure access to healthcare information.

- **Gesture Recognition for Rehabilitation:** AI monitors and analyzes patient movements during rehabilitation exercises, providing real-time feedback to both patients and therapists, enhancing rehabilitation programs (8).

- **Monitoring Hygiene Protocol Compliance:** AI-equipped cameras monitor healthcare facilities to ensure adherence to hygiene protocols, such as proper handwashing techniques and the use of personal protective equipment, strengthening infection control measures (9).

- **Early Monitoring of Infant Health:** By analyzing video footage in neonatal intensive care units (NICUs), AI can detect subtle signs of distress in premature infants, enabling prompt medical interventions.

- **Visualizing Blood Flow Patterns:** Vision-based AI processes imaging data to visualize blood flow patterns, assisting cardiologists in evaluating cardiovascular health and identifying vascular abnormalities (10).

3. Risks of Artificial Intelligence in the Healthcare Sector:

The risks associated with medicine and the healthcare sector include the potential for AI errors to harm patients, as well as issues related to data privacy and security.

One example of harm reported is the use of AI-driven pulse oximeters, which, in trials, overestimated blood oxygen levels in patients with darker skin tones, leading to inadequate treatment for their hypoxia.

AI can harm the health of millions through social determinants of health by manipulating individuals, using autonomous lethal weapons, and contributing to mental health issues due to mass unemployment if AI-based systems displace large numbers of workers (11).

Threats also arise from job losses expected to accompany the widespread adoption of AI technologies, with estimates ranging from tens to hundreds of millions over the next decade.

A group of experts stated: "We do not know how society will respond psychologically and emotionally to a world where work is unavailable, nor the impact this will have on the physical health of communities."

The study indicated that "with the massive growth in AI research and development, the window of opportunity to avoid significant and potentially existential harm is shrinking."

Experts warned that "effective regulation of AI development and usage is essential to prevent harm." (12)

They emphasized that "until such regulation is implemented, a moratorium should be imposed on the development of self-improving general AI," according to a report by the British newspaper *The Guardian*.

4. Challenges of Implementing Artificial Intelligence in Medical Care

- **Ambiguity:**
  One of the challenges is that the results of AI models are often unclear to doctors, making it difficult to understand how these models arrive at their conclusions. This poses a challenge in diagnosing diseases, as doctors need to comprehend the underlying reasons for the algorithm's diagnosis to make an informed decision about the treatment plan. This necessitates a new generation of "physician-engineers" who are specialized in medicine and have a deep understanding of statistics and the mechanisms behind these algorithms (13).

- **Privacy:**
  Protecting the privacy of patients' medical data is one of the biggest challenges in using AI in healthcare. AI relies on vast amounts of data to analyze patterns, make predictions, and improve diagnosis and treatment. However, this data often contains sensitive information about individuals' health and medical history.
  To avoid exposing patients to digital risks, it is essential to ensure data protection against breaches and cyberattacks. Ensuring privacy requires anonymizing personal data used in AI model training. Advanced techniques are needed to ensure that individuals cannot be re-identified through anonymized data. Additionally, patients should be informed about how their data is being used and must provide explicit consent for its use. This calls for transparency from medical institutions regarding data collection, usage purposes, and protection methods (14).

- **Data Accessibility:**
  Another challenge is that AI and machine learning systems require large amounts of data to be effective, which can be problematic in healthcare. Often, patients lack prior medical records, making it difficult to access longitudinal data about their health or their family’s medical history. Even when data is available, it is often in non-machine-readable and unstructured formats, making it challenging to process digitally.

- **Choosing Accuracy Metrics:**
  In the field of AI, model accuracy is one of the most important metrics for evaluating the performance of classification models. Accuracy is defined as the ratio of correct predictions to the total predictions made by the model. While model accuracy may seem like a sufficient indicator of a model's effectiveness, relying on it alone can be misleading in many cases.

Each of these challenges highlights the complexities of integrating AI into healthcare, emphasizing the need for careful planning, robust privacy measures, and collaboration between medical and technological experts.

Let’s assume we have a model used to classify the health status of individuals based on laboratory test results. In a test involving 100 individuals who all underwent the same examination, the model classified 90 individuals correctly and misclassified 10. Based on these results, we might conclude that the model’s accuracy is 90%. This appears promising and might encourage specialists to recommend adopting this technology due to its relatively high level of accuracy.

But what if the data details were as follows: out of the 100 individuals, 89 were negative (disease-free), and 11 were positive (diseased). The model correctly classified all 89 negative samples but misclassified 10 out of the 11 positive samples as negative, leaving only one positive sample correctly identified.

In this scenario, although the accuracy remains high at 90%, the model failed to detect most of the positive cases. Out of the 11 positive cases, only one was correctly identified, while 10 individuals were misclassified. This highlights a significant weakness in the model's ability to recognize diseased cases. Therefore, despite the high accuracy, the model cannot be deemed suitable for widespread use in detecting individuals with this disease.

The previous example illustrates that accuracy alone cannot be relied upon to fully evaluate a model's performance. Other metrics play a critical role, such as sensitivity (the model's ability to identify positive cases) and precision (the correctness of the model's positive predictions).

For instance, sensitivity reflects the percentage of positive cases correctly classified. In our example, sensitivity was very low because the model failed to detect most positive cases. This implies that in practical applications, the model may be considered ineffective despite its relatively high accuracy (15).

Bias in Results Due to Imbalanced Training Data: In the field of artificial intelligence and machine learning, the quality and balance of the data used to train models are crucial for obtaining accurate and reliable results. When data is imbalanced—where there is a significant disparity in the number of inputs across different categories—this can lead to biased model outcomes. Below is an example in the medical field to illustrate this issue and explain why addressing imbalance by simply duplicating the underrepresented category is not a practical solution.

Let's assume we are building a model to diagnose a rare disease and have a dataset containing 1,000 medical records. Only 50 of these records indicate the rare disease (positive class), while the remaining 950 records indicate the absence of the disease (negative class).

In this scenario, there is a substantial disparity between the number of records in the two categories. If the model is trained on this dataset, it is likely to learn to classify most cases as negative simply because it encounters significantly more negative cases. For instance, the model might almost entirely ignore positive cases and achieve very high accuracy, as it would correctly classify the majority of cases due to the overwhelming prevalence of negative examples.

To address this problem computationally, data scientists might duplicate the underrepresented class (positive cases) to increase its representation in the training dataset. For example, the 50 positive records could be duplicated 19 times, resulting in 950 positive records to balance the dataset against the 950 negative records (16).

While this method balances the number of examples in each category, it does not reflect the diversity of cases. If the original dataset contains only 50 unique positive cases, duplicating them does not introduce any new information to the model. Instead, the model may learn from the limited repetitions rather than generalizing patterns that could vary in real-world scenarios.

Bias in AI model results due to imbalanced data presents a significant challenge, especially in sensitive fields like healthcare. Addressing this challenge requires solutions beyond simple data duplication to ensure the model learns from diverse cases and better reflects reality. Using advanced techniques for data collection and preprocessing can lead to models that are more balanced and reliable in their performance.

5. Artificial Intelligence at Emirates Health Services (EHS)

The adoption of artificial intelligence (AI) technologies by Emirates Health Services (EHS) across various vital sectors has had a profound impact on our services and patients. The early breast cancer diagnosis initiative using AI, implemented in four of our hospitals, successfully diagnosed 532 patients between 2019 and 2022. Notably, the use of AI in diabetes treatment has significantly reduced the time required for diagnosis and treatment to just two days.

Additionally, the voice recognition system was deployed across 82 targeted hospitals and medical centers. A total of 1,800 doctors were trained, with 1,200 active users of the system, representing 70% of all doctors in the institution across various specialties, roles, and scientific and medical backgrounds. This initiative greatly enhanced documentation efficiency, increasing the volume of documentation and entries into medical records by 83%. Clinical documentation using voice recognition and AI technology reached 97.6% at Abdullah bin Omran Hospital and 90% at Dibba Hospital (17).

Furthermore, 88% of doctors expressed satisfaction with the new clinical documentation processes, and the quality of medical documentation improved by 43%. This, in turn, increased doctors' overall satisfaction with the documentation process to 78% within a year of implementation. The voice recognition system also halved the average patient consultation time from 30 minutes to just 15 minutes.

The system settings were fine-tuned and customized for 168 doctors to suit the nature of their specialties, reducing the error rate from 36% to 7.35% by 2023. The project earned the international "3M Award" in the "Optimal Usage Rate by Physicians" category, competing against other institutions utilizing similar technology. The award is granted to institutions achieving an adoption/usage rate exceeding 50% in the first year of implementation. EHS achieved an impressive adoption/usage rate of 87% at the time of receiving the award.

Thanks to the transformative power of AI, these tangible improvements reaffirm our commitment to enhancing patient experiences and redefining healthcare standards through the adoption of cutting-edge technologies.

6. Emirates Health Services (EHS) Leads in Artificial Intelligence Advancement

Emirates Health Services (EHS) recognizes the vital role AI plays in advancing healthcare and remains committed to providing the highest standards of care. By adopting AI technologies and ensuring their integration into its infrastructure and medical services, EHS demonstrates its dedication to enhancing patient experiences, quality, and safety, improving operational efficiency, driving innovation, and achieving groundbreaking milestones in healthcare delivery.

7. AI Projects at Emirates Health Services (EHS)

- **Early Detection of Breast Cancer:**
  Leveraging AI algorithms in mammography devices, EHS is revolutionizing early breast cancer detection. These algorithms significantly aid in early diagnosis, improving the chances of successful treatment and better outcomes for patients.

- **Heart Rate Monitoring with AI:**
  EHS utilizes AI-powered heart rate monitoring devices to assess cardiac electrical data. Smart algorithms issue audio alerts when a patient approaches a critical condition, enabling timely medical intervention and saving lives (18).

- **AI-Driven Diabetes Treatment:**
  EHS is advancing diabetes care by implementing AI-powered insulin pumps such as the *MiniMed™ 780G* system. This technology mimics the natural pancreas, maintaining a precise balance between insulin and glucose. AI algorithms prevent low blood sugar episodes, enhancing patients' quality of life and ensuring their safety (19).

- **AI-Powered Dementia Diagnosis:**
  EHS employs AI-driven cognitive assessment technologies to detect early signs of cognitive impairment and dementia. Early detection enables timely medical interventions, improving treatment outcomes and reducing the impact of dementia on patients' lives.
- **Voice Recognition System:**
  EHS has implemented an AI-powered voice recognition system that allows doctors to input health data using voice commands. This innovation simplifies documentation processes, saving time and enabling physicians to focus on delivering exceptional patient care.
- **Disease Prediction Using AI:**
  By leveraging data analysis and pattern recognition through the EHS Intelligence platform, AI algorithms predict diseases at an early stage or identify outbreak risks. Early detection of diseases such as diabetes plays a crucial role in successful treatment and reducing the healthcare burden. These algorithms analyze vast amounts of patient data, including medical records and lifestyle factors, with high accuracy in risk classification (20).
- **Hospital Admission Predictions Using AI:**
  EHS utilizes AI algorithms to predict hospital admission risks, enabling timely and appropriate medical interventions. From forecasting acute heart failure onset to assessing emergency unit admission scores, these tools

reduce patient and systemic burdens by allowing proactive measures and minimizing unnecessary hospital admissions (21).

- **AI Mortality Risk Predictions:** EHS has developed a machine learning model to predict COVID-19 patient mortality in critical care. Using key parameters such as demographics, comorbidities, medications, tests, and clinical characteristics, the system provides insights into patterns related to mortality versus survival outcomes. The highly accurate algorithm supports ICU doctors in timely interventions .
- **Promoting Sustainability with Digital Visits via AI:** Aligning with the UAE's 2030 net-zero carbon emissions strategy, EHS uses the EHS Intelligence platform, powered by advanced AI algorithms, to calculate patient carbon footprints. The AI identifies potential digital visits and facilitates the conversion of physical appointments to teleconsultations. This innovative step integrates sustainability goals with improved patient outcomes, offering a sustainable model for high-quality healthcare access (22).
- **AI-Driven Patient Feedback Analysis:** EHS has implemented AI and natural language processing (NLP) to analyze patient feedback and enhance patient engagement and experiences. The EHS Intelligence platform supports a new sentiment analysis program that reviews patient comments and opinions shared on social media.
- **No-Show Predictions Using AI Algorithms:** Based on historical primary care data trends, EHS developed an AI model to predict appointment no-shows. The model utilizes patient and appointment details from the institution's extensive data warehouse in machine learning algorithms to produce actionable insights. It identifies factors and indicators that create no-show risks, classifying appointments from low to high no-show probabilities. The no-show model, which incorporates 16 features, offers high accuracy, assisting primary healthcare managers in optimizing appointment allocations effectively.

8. EHS Intelligence Platform (PaCE)

Emirates Health Services (EHS) has taken a significant step forward with the launch of the **EHS Intelligence Platform (PaCE)**. This centralized platform integrates all data- and AI-driven projects, enabling real-time analytics and the generation of meaningful insights to support quick and effective decision-making at both clinical and administrative levels.

The platform is equipped with a self-service analytical application connected to data stations, facilitating rapid access and distribution of patient statistics and operational facts. Designed as a catalyst for data-driven healthcare transformation, this intelligent system empowers users to leverage various machine learning models and tailored insights to address core business challenges, providing instant access to critical information and knowledge (23).

Conclusion

Artificial intelligence plays a pivotal role in healthcare, revolutionizing the industry by integrating machine learning, natural language processing, and computer vision. These technologies deliver a range of transformative solutions that improve health outcomes, from more accurate disease detection to the development of personalized treatment plans. AI also enhances the patient experience and addresses some of the pressing challenges facing the healthcare sector today.

The integration of AI into healthcare has the potential to transform how care is delivered and managed. Despite the challenges of implementation, the benefits are undeniable. Moving forward, it is essential to work collaboratively to overcome potential issues and ensure AI is utilized appropriately, always prioritizing patient interests.

References:

1. Lee SI, Celik S, Logsdon BA, et al. A machine learning approach to integrate big data for precision medicine in acute myeloid -leukemia. Nat Commun 2018.
2. Steve Barth , AI in Healthcare ,foresse medical, https://www.foreseemed.com/artificial-intelligence-in-healthcare
3. Davahli MR, Karwowski W, Fiok K, Wan T, Parsaei HR. Controlling safety of artificial intelligence-based systems in healthcare. Symmetry 2021.
4. Edelmann, Simone. “Artificial Intelligence in Diagnostics.” Healthcare Transformers, 11 Oct. 2021
5. AI in Healthcare: solutions for a smarter & healthier tomorrow ,ultralytics, 27/09/2024, https://www.ultralytics.com/solutions/ai-in-healthcare

6. Dabdoub, F., Colangelo, M., & Aljumah, M. (2022). Artificial intelligence in healthcare and biotechnology: a review of the Saudi experience. Journal of Artificial Intelligence and Cloud Computing, 107, 2-6
7. Saini, S., & Saxena, N. (2023). A survey of threats to research literature dependent medical AI solutions. ACM Computing Surveys
8. Lekadir, K., Quaglio, G., Garmendia, A. T., & Gallin, C. (2022). Artificial Intelligence in Healthcare-Applications, Risks, and Ethical and Societal.
9. How AI Is Improving Diagnostics, Decision-Making and Care." American Hospial Association, 9 May 2023.
10. Alzahrani, R., Alhenaki, G., Alnazzawi, E., IAlMughaiseeb, A., & Alanazi, A. (2022). Artificial intelligence in health care and its application in Saudi Arabia. International Journal of Innovative Research in Medical Science, 7(11), 666–670.
11. United States Government Accountability Office . Artificial intelligence in health care: Benefits and challenges of technologies to augment patient care. GAO, 2020
12. Lekadir, K., Quaglio, G., Garmendia, A. T., & Gallin, C. (2022). Artificial Intelligence in Healthcare-Applications, Risks, and Ethical and Societal Impacts. European Parliament
13. W. Nicholson Price. “Risks and Remedies for Artificial Intelligence in Health Care.” Brookings, 14 Nov. 2019.
14. https://futureuae.com/ar-AE/Mainpage/Item/9591/%D9%81%D8%B1%D8%B5
15. M. Cascella, Laura. “Artificial Intelligence in Healthcare: Challenges and Risks.” MedPro Group.
16. Davenport, Thomas, and Ravi Kalakota. “The Potential for Artificial Intelligence in Healthcare.” Future Healthcare Journal, vol. 6, no. 2, June 2019, pp. 94–98 Journal, vol. 6, no. 2, June 2019, pp. 94–98
17. https://www.ehs.gov.ae/ar/about-us/emerging-technology/artificial-intelligence
18. https://u.ae/id/participate/blogs/blog?id=1216
19. https://www.ehs.gov.ae/ar/about-us/emerging-technology/artificial-intelligence
20. https://www.emaratalyoum.com/local-section/health/2024-10-21-1.1891164
21. https://www.ehs.gov.ae/ar/about-us/emerging-technology/artificial-intelligence
22. https://www.wam.ae/ar/article/b5pn8lx-%
23. https://www.ehs.gov.ae/ar/about-us/emerging-technology/artificial-intelligence