Artificial Intelligence in Early Disease

CNHP 6000:

Research Methods for Health Professionals

Student Name

**Introduction**

Artificial Intelligence (AI) revolutionizes healthcare, particularly early disease detection.1Therefore, it is important to identify when there is a need for accurate and timely diagnosis when the global population ages and the incidence of chronic diseases increases. The problem with traditional diagnostic methods is that a lot of data is produced, and human factors that affect it include fatigue, experience, and time. Aware of how AI performs the best at processing big input data flows and identifying subtle relations between them, this approach will be effective in identifying early signs of diseases and enhancing patient’s quality of life.

Current scientific literature has researchers exploring its AI potential in different specialties of medicine. There are several cases where the performance of AI algorithms has been comparable to or even superior to that of physicians in tasks such as interpretation of medical images, electrocardiograms, or disease prediction based on electronic health records. For instance, oncology has noted enhanced potential to show early cancer detection through systems that have adopted artificial intelligence technologies. When discussing the work of AI in diagnosing and treating colorectal liver metastases, Rompianesi et al2 focused on integrating technology into cancer treatment planning and diagnostics.

AI has proved useful in aspects such as the prediction of tendencies of heart attacks and other kinds of cardiovascular events. Suzuki et al3 have demonstrated that AI can assist in identifying patients with atrial fibrillation during sinus rhythm based on the ECG study. To their surprise, they discovered that the current labeling method influences the ability of an AI algorithm to identify ‘silent’ atrial fibrillation, which would reduce instances of stroke and other severe complicating factors resulting from an unobserved irregular heartbeat. Such capability provides insight into how artificial intelligence can be effective in extending the detection times and the subsequent results in cardiovascular therapy.

The use of this technology has also been tested for the detection of neurodegenerative diseases. Venugopalan et al4 have stated multimodal deep-learning models to present solutions for the early-stage detection of Alzheimer's disease. Their research employed different imaging technologies to improve the visualization of brain alterations concerning Alzheimer's. They proved that, in this case, AI interventions can detect these alterations even before the clinical symptoms manifest themselves years later. This approach emphasizes the future possibilities of artificial Intelligence in enhancing early detection and management of neurodegenerative diseases.

 This body of work shows how the advanced application of AI could fundamentally uphold an exhaustive primary screen of afflicting diseases. Nonetheless, the application of AI in clinical practice still needs to be improved .1Issues such as the lack of explainability of the AI algorithms, problems associated with training data bias, and the sheer size of data required for proper generalization are some challenges that still have to be overcome. Also, healthcare professionals' understanding and appreciation of AI tools remain significant in their application.

Nevertheless, the promising trends in AI-driven early disease diagnosis illustrate the advantages of its application: higher diagnostic accuracy, lower costs, and better patient outcomes.5 As artificial intelligence technologies advance, one needs to evaluate the effectiveness of such concepts and define the possibilities of implementing them in the current clinical setting.

This study aims to assess the effectiveness of using AI in identifying diseases at the initial stage of clinical practice to enhance the number of accurate diagnoses and the quality of the impressions of clinicians working with these tools. By analyzing the impact of AI on diagnostic results and providing insight into physicians' sentiments and perceptions, this study offers a balanced review of the current applications and future possibilities of AI in early-stage disease identification.1

The research hypothesis of the study is that the application of AI diagnostic tools will enhance the efficiency of early disease detection rates more than traditional diagnosing techniques on their own and will be positively received by Healthcare professionals as a useful addition to their routine practice.

**Methods**

***Sample Population***

The study's target population encompasses 200 healthcare practitioners, such as X-ray technicians, pathologists, general practitioners, and those between the ages of 30 and 65 currently employed in key metropolitan hospitals in the United States of America. Target participants should have worked in their occupations for at least two years and know or have utilized AI-assisted diagnostic devices. Participants who have no experience using AI-based diagnostic tools in any healthcare specialties or are not actively practicing medicine at the time of the survey are also excluded from the study.

Each hospital involved must give informed consent for the study through its respective Institutional Review Board (IRB). The IRBs of all the hospitals involved are anticipated to assent to the research proposal explicitly.

It is necessary to gain a written informed consent from all engaged healthcare providers. The consent form focuses on explaining the objective of the study, the duration of the study, the process of choosing the participants, the tasks involved, the possible benefits for the participants, the measures that the researchers will be willing to take in cases of occurrences of any unpredictable risks that may occur, the measures that will be taken to ensure that personal information belongs solely to the participant, the steps that the participant can take to withdraw from the study at any given

***Study Design***

The study is a diagnostic accuracy mixed-methods design because the quantitative study focuses on diagnostic accuracy. In contrast, the qualitative study explores healthcare professionals' perceptions, regardless of their capabilities for accurate diagnosis. The patients in the study will be randomly allocated to either the conventional diagnostics group, which will maintain their regular practice of diagnostics, or the enhanced diagnostics group, which will receive the support of AI-based diagnostics in addition to the conventional one.

***Intervention***

Individuals will be asked to identify key diagnoses from theoretical, de-identified patient cases with medical histories, laboratory data, and imaging material related to early disease detection (like neoplastic and cardiovascular disease). For each case, participants will give their primary assessment based on the given data, express their confidence level in diagnosis on a scale of 1-5, and suggest additional investigations. In assessing the diagnostic accuracy, responses will be compared with the actual outcomes of the presented cases. Participants will also be expected to revisit and explain to others the cases, which will test their recall and understanding of the study material and their ability to analyze the necessary data and come up with diagnostic conclusions. A numerical scale from 0 through 3 will be applied for reasoning and interpretation, where 0 will refer to absolutely wrong answers and 3 — to the best possible answers.

Participants in the intervention group enrolled in a study will use four AI applications: the diagnostic algorithm based on artificial neural networks for the analysis of medical images, the natural language processing system for the analysis of clinical records and patient histories, and the machine learning model predicting the risk of disease.6 They will give performance feedback on the AI tools that shall involve evaluating the accuracy of the AI suggestions as either accurate, partially accurate, or inaccurate; rating the usefulness of the AI insights as high, moderate, or low; and lastly, reporting on any mismatches between the AI suggestions and their diagnosis in the form of an open-ended feedback section. Thus, this evaluation will be beneficial in comparing the efficacy and efficiency of the proposed AI solutions in diagnosing diseases and choosing an effective treatment mode.

It will also be clear how long it took to conclude whether AI aids in diagnosis and saves time compared to traditional diagnosis. Besides, participants will also fill in a perception of the diagnostic system of the 5 Likert scale survey, which includes perceived ease of use, perceived usefulness, and the degree of confidence of the subjects on their diagnosis, whether traditionally done or through the AI model.7 Pre- and post-study qualitative focus group interviews with 20 participants from each group of study participants, irrespective of their intervention condition, will be conducted.8

The data analysis will include a comparison of the diagnostic accuracy rates of the control and intervention groups, where t-tests and ANOVA will be used to establish differences in the diagnostic performance of the groups. Also, the two groups' diagnosis time will be calculated using t-tests to determine the patient's diagnosis rate. Chi-square tests for categorical outcomes, including true positive and false positive results, will be performed to analyze the relationship between survey responses and group assignment (AI-based or traditional diagnostic methods).9 The assessment will be done both pre- and post-intervention, that is, after 180 days, and the data will be analyzed using SPSS software (version 28.0, IBM Corp.).

Besides the quantitative data analysis, the qualitative data collected from the interviews with healthcare practitioners will be analyzed through thematic analysis to reveal common themes regarding their attitudes toward AI in diagnostics. This approach will assist in capturing the different perceptions of AI in clinical practices and its influence on the diagnostic choices made. Regression analysis will reduce confounding factors such as disease type, patient characteristics, and healthcare facility type and size.10 The significance level will be set at **p < 0.05.**to enhance the validity of all the results and the findings in each analysis.

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