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Developing an AI-Assisted Platform to Support Tuberculosis Care Delivery

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Abstract. Artificial Intelligence (AI) has the potential to "bridge the gap" between healthcare provider and patient needs in low-resource settings to deliver timely, personalized, and empathetic care to individuals with active tuberculosis.

Keywords. Digital Health Technologies, tuberculosis, artificial intelligence

1. Introduction

Tuberculosis (TB) remains a leading cause of death despite being preventable and curable. In 2022, an estimated 10.6 million were infected and 1.3 million people died of TB [1]. In response to urgent need for patient-centered solutions, the TB Treatment Support Tools (TB-TST) intervention was developed combining a comprehensive app connecting patients with treatment supporters and an objective drug metabolite test for adherence monitoring. In a recent pragmatic clinical trial with 556 individuals with active TB across four public health hospitals in Argentina, the TB-TST significantly improved treatment outcomes (higher success and lower default). While participants found the intervention helpful and efficient, a virtual health assistant (VHA) could help the intervention be scalable. Novel artificial intelligence (AI) applications based on Large Language Models (LLMs) hold transformative potential to assist providers with certain tasks and scale up care in regions with over-stretched healthcare providers, yet their full potential and limitations remain underexplored, even more so for languages other than English.

2. Methods

A mixed methods iterative approach will be used to develop and evaluate an AI system to optimize the TB-TST intervention by augmenting healthcare provider reach and

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efficiency. A virtual TB treatment supporter powered by LLMs will be developed using existing data, publicly available open-source LLMs (e.g., Mistral [2], Llama3 [3]) on a secure cloud platform (e.g., Azure), and advanced training techniques. Existing data include 24,902 daily reports, 7,805 interactive messages, 2,465 test strip photo submissions, and 1235 reports of side effects. The existing data will be used for knowledge injection in a process of *few-shot learning* in which examples of conversations are added to the prompt as an illustration of appropriate responses and style. A more elaborate alternative method of knowledge injection that will also be used is *retrieval augmented generation* (RAG) [4] a process in which a larger amount of existing data such as information about TB (i.e., established guidelines, educational materials) is stored in a database, the most relevant parts of which are automatically retrieved and added to the prompt during inference time. The VHA TB supporter will then be evaluated for accuracy, linguistic appropriateness, clinical relevance, and empathy by TB experts using established evaluation methods. Privacy protection strategies will be implemented and evaluated for privacy leakage.

3. Discussion and Conclusions

Initial LLM trained VHAs show promise with accurate and relevant responses to queries. The architecture is being employed using local, smaller parameter models and a cloud-based model within a HIPAA-compliant environment and will be further refined. Next, top performing LLM-powered VHAs will be selected and tested using common care scenarios and established rating methods and expert feedback from think-aloud sessions. The expert ratings of AI-generated messages will be compared to human baseline. This system will incorporate "human-in-the-loop" settings, where suggested responses to patients' messages are generated to improve efficacy, quality, and scalability of the intervention. The AI-generated VHA aims to provide 24/7 support, answer questions, triage symptoms, and guide patients through the healthcare system, thus mitigating the strain on healthcare resources and improve access to care for individuals with TB.

By project completion, we will have a validated functional TB treatment supporter VHA prototype powered by a clinically and linguistically appropriate, empathetically adapted, and privacy preserving LLM. The AI-augmented tool will be ready for further evaluation of its capabilities to provide personalized education and communication tailored to the individual's experiences, literacy level, and cultural background. Insights gained from harnessing state-of-the-art LLMs in health promotion, while delineating potential risks, could contribute significantly to the scientific community's understanding of generative AI in health applications.

References

[1] World Health Organization. Global Tuberculosis Report 2023, 2023.
[2] Jiang, A. et. al. Mistral 7B. arXiv preprint arXiv:2310.06825. (2023).
[3] Meta. Building the future of AI with Meta Llama 3. 2024. https://llama.meta.com/llama3/
[4] Lewis P, et. al. Retrieval-augmented generation for knowledge-intensive NLP tasks. Advances in Neural Information Processing Systems, 33, pp.9459-9474, 2020.