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Enhancing Depression Management Through AI-Driven Conversational Agent

This research project aims to develop a conversational AI system that improves the medical management of Major Depressive Disorder (MDD) while addressing both the critical challenges of personalized treatment and the broader limitations of AI in healthcare. The treatment of MDD is challenging due to the trial-and-error nature of antidepressant selection, low initial remission rates, and the complex medication history influencing remission. Traditional approaches to capturing patient medical histories are often incomplete, inefficient, and lacking in empathy, whereas current methods for selecting optimal antidepressants do not provide personalized and precise treatment. While AI has the potential to address these challenges, current AI systems suffer from critical limitations, related to subgroup biases, hallucinated or misleading outputs, conversational topic drift, and a lack of empathy. These shortcomings undermine patient and clinician trust and limit the safe and effective use of AI in clinical decision-making.

To overcome these limitations and improve depression management, this project combines the language understanding and generation capabilities of Large Language Models (LLMs) with data-driven analytical models derived from the experiences of 3.6 million patients with 15 antidepressants. The conversational AI also incorporates a dialogue management system to achieve effective goal-oriented dialogue through semi-structured interviews that limit topical digression, maintain an empathetic tone, and increase information accuracy. To enable comprehensive lab testing of the conversational AI, we are also developing a patient simulator capable of natural language interactions. The patient simulator will integrate medical, linguistic, and behavioral profiles to facilitate realistic, diverse, and even adversarial interactions to ensure system robustness and safety, including the expression of suicide risk factors.

This study, funded by the Patient-Centered Outcomes Research Institute (PCORI), aims to enhance patient engagement and optimize antidepressant selection. Establishing a scalable and patient-centered AI model will set a new standard for integrating AI into mental health care, address provider shortages, and improve access to safe, personalized treatment.