Original Paper

Advancing Human-Centered Artificial Intelligence in Clinical Decision Support: Sociocognitive Human-in-the-Loop Study in HIV Care

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Abstract

Background: Artificial intelligence (AI)-powered clinical decision support systems (CDSS) have shown promise in improving prediction, monitoring, and treatment optimization across clinical domains, including HIV care. However, translating AI outputs derived from electronic health records (EHRs) into clinically meaningful, trustworthy, and actionable decision support remains challenging, underscoring the need for more human-centered and socioecologically grounded CDSS design.

Objective: This study aims to explore how we can effectively translate the outputs of machine learning models based on HIV EHRs to a real AI-powered CDSS for HIV care. Using the human-in-the-loop method, we engaged a set of stakeholders, including HIV physicians, nurse practitioners, infectious disease pharmacists, social workers, and case managers. Stakeholders interacted with an AI-powered CDSS prototype to identify barriers and challenges to adoption, as well as to inform a more holistic and context-aware AI-powered CDSS design.

Methods: We conducted a field study at Prisma Health in South Carolina that included pre- and post-surveys, interactive usability testing sessions, think-alouds, and in-depth interviews with 16 HIV clinicians between March and September 2025. We analyzed survey responses using descriptive statistics and then transcribed and analyzed think-aloud and interview data using an etic and emic approach.

Results: Clinicians identified multiple challenges and design considerations for AI-powered HIV CDSS, demonstrating that clinician-AI interaction is inherently sociotechnical and embedded across multiple socioecological levels. While clinicians relied on familiar clinical indicators as cognitive anchors for interpreting AI predictions, they emphasized that social determinants of health were central to their own risk assessment and clinical decision-making. Additionally, clinician accounts suggested that their trust in AI is conditional and develops over time, with explainability and actionability emerging as critical factors for translating predictions into meaningful clinical interventions.

Conclusions: Findings highlight the need to move beyond technically accurate prediction toward AI-powered CDSS designs that align with clinicians' cognitive practices and socioecological realities of HIV care. By extending a sociocognitive framework through empirical grounding in HIV clinical practice, this study offers design insights for developing AI-powered CDSS that are trustworthy, context-aware, and capable of supporting actionable decision-making in HIV care settings and beyond.

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KEYWORDS

HIV; AI; Artificial Intelligence; Clinical Decision Support Systems; CDSS; HIV Care; CDSS Design; Human-in-the-loop; Human-computer Interaction; HCI

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