

Explaining Recommendations via Contextual Reasoning over a Medical Knowledge Graph

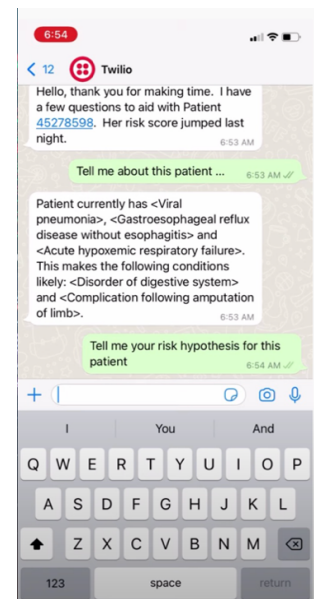
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The need: Supporting caregivers at home for individuals that are not functionally independent is an increasing focus area in healthcare. However, limited ability to continuously watch and monitor individuals motivates designing a new generation of tools that 1) support communications between medical professionals and caregivers, 2) integrate verbal description of symptoms and patient profile into the decision-making process. We propose to demonstrate an intelligent agent that can help with basic risk assessment and triage of medical problems through a conversational medium, with a specific focus on increasing trustworthiness through “reasoning” or “explanation of decisions”.

Technical novelty: Reasoning [1] is defined as the ability to explain a complex decision into a chain of relevant facts, each of which can be generated by a retrieval from a clinical knowledge graph or generated by a machine-learning model. For example, the user will be able to ask “What is this patient’s risk for Long COVID?” Based on such a query, our system will prompt the user regarding the patient’s history, such as cardiovascular issues, especially during a COVID-19 inpatient stay. Depending on the age, it may also prompt regarding the patient’s cognitive or functional decline. Finally, it would generate a risk score and a recommendation, accompanied by explanations combining relevant facts from these answers. Effectively, a patient’s context accounts for current and past history and models multiway relationships between demographics, clinical risk factors, diseases, symptoms and treatments. Traditionally clinical knowledge graphs (SNOMED, PrimeKG [3]) lack patient-level context and provide pairwise relationships between diseases, drugs, etc. On the other hand, patient context-level information is available from structured EHR and/or natural language clinical text [4]. We unify these two knowledge sources to develop a contextual reasoning capability for patient care recommendation.

Demonstration Features The figure on the right shows a snapshot of our current system prototype. It provides a conversational front-end (such as WhatsApp) that communicates with the AI-backend via Flask-based HTTP endpoint. We implement a natural language interface (medical concept extraction, question/answer generation) with a set of reasoning tasks implemented by a combination of knowledge graph algorithms and ML models. **(Reasoning)** We generate explanations for a patient’s evolution towards a specific outcome by finding multi-hop transition pathways in the clinical knowledge graph. We use an extension of our prior work [2] as the context-driven prediction engine. **(Question-generation)** We facilitate conversation through question-generation (using pattern mining and templates) back to the caregiver to increase confidence in the target outcome. We will demonstrate our system using a COVID-19 EHR dataset from Stanford School of Medicine in combination with the OMOP knowledge graph and PrimeKG.



Degree of deployment: The system is a research prototype and has not been operationally deployed.

References

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