CoCA: Visualizing Complex Cases

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Abstract

We demonstrate work to date on CoCA (Complex Case Assistant), an interactive visualization tool aimed at helping practitioners maintain awareness of the multiple conditions and medications that could be involved in symptoms experienced by their complex patients. The visualization combines information from multiple sources and services, including patient information from their EMR or ingested textual summary, a database of disease-symptom relationships, data from FDA.gov containing drug effects and contraindications, population statistics, and Natural Language Processing (NLP) and Entity Extraction services to enable integration across sources.

Introduction

Complex patients with multiple morbidities are increasing due to aging populations, increased obesity, and other factors[1]. Complex patients present a significant challenge to health systems, with multiple potential interactions between conditions, treatments, and symptoms[2]. The complexity of those patients can be such that they can be characterized as unique or rare cases, while the diversity of their conditions can be large. In practice, as treatment of these patients often involves multiple specialists and caregivers, no one person has a full understanding of the patients' conditions as well as their treatment and medications, leading to increased costs and poorer patient outcomes. We have been working to create analyses and visualizations that increase providers awareness and understanding of complex cases, and help providers identify drug interactions and contraindications, potential causes of new symptoms, and potential opportunities to simplify treatment plans.

Prior Work

There has been substantial past work in visualizing patients' medical histories, with various approaches showing the progression of conditions and treatments over time (See Rind, et al.[3] for a good overview). There has also been work on visualizations to help practitioners identify patient cohorts, and compare patients and interventions[4–6]. In contrast, our work focuses on understanding the potential functional and pharmacological relationships between a patients specific conditions, treatments and symptoms at a moment in time.

Approach and Visualization

As part of our visualization tool, Figure 1 shows a patient's conditions on the left, reported symptoms in the center, and medications on the right.

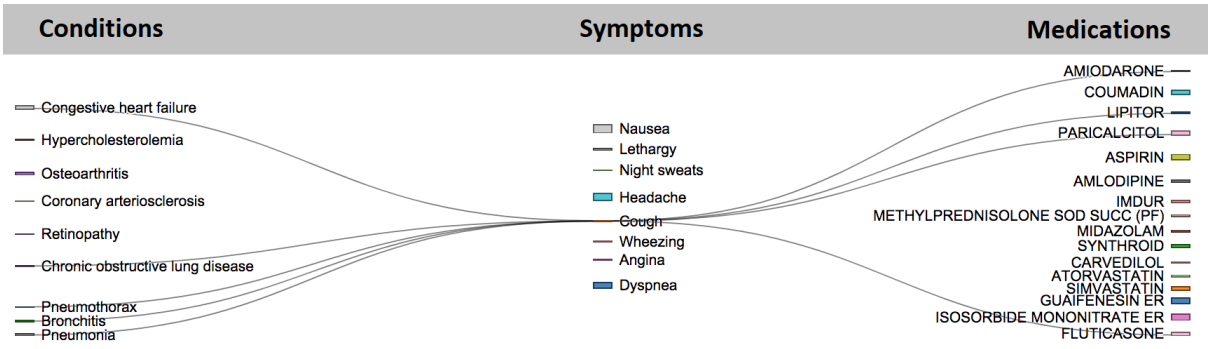

Figure 1: Conditions, symptoms, and medications for one sample patient. The symptom "Cough" has been selected, and lines connect to potentially related conditions and medications.

The user can choose to see all potential relationships between these entities, or select an entity, such as a symptom in question, and only include those links connecting to it. A user can enter a new symptom to be added to the set of those automatically extracted. Further refinements include the ability to modify appearance of nodes and links based on the likelihood and potential severity or strength, and type of nodes. Other visualizations included in our prototype show known interactions between medications, and contraindications between conditions and medications.

The list of conditions, symptoms, and medications can be drawn from the patient's EMR and notes, or from a textual writeup on the patient. An entity extraction service trained on medical data is used to identify these terms and their type in canonical form. A database of disease-symptom relationships, data from PubMed, data from FDA.gov containing drug effects and contraindications, and population statistics are drawn on to determine which nodes should be connected, and the relative strength of those connections.

Conclusion

We believe the direction of this work can enhance how clinicians understand and treat their complex patients, with benefits both for general practitioners as well as for specialists who often focus on just one aspect of their patients' conditions. We are currently collecting feedback from practitioners to refine our tool, and will be conducting an experimental study to understand how it might influence their behavior in caring for their complex patients.

References

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