Exploratory Analysis of Clinical Handoff Conversations using Natural Language Processing and Semantic Analysis

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Introduction

Patient handoffs refer to the transfer of care from one healthcare provider to another and necessitate the transfer of clinically relevant patient information.1 If critical information is inaccurate, incomplete, or misinterpreted, the potential risk of patient harm can increase substantially, and efforts are being made to improve handoffs through standardization. In this study, we analyzed handoff transcripts using natural language processing (NLP) and semantic techniques to better characterize the content of clinical handoffs. We provide a proof-of-concept for an automated pipeline that extracts semantic categories that can be used to compare and analyze handoff conversations.

Data and Methods

The dataset consists of 235 resident-to-resident and 133 nurse-to-nurse handoff transcripts, both collected from four inpatient medicine services at a large, tertiary care academic medical center.2 The deidentified transcript for each conversation was analyzed using (1) a NLP pipeline developed in Python using Natural Language ToolKit (NLTK) and MetaMap3,5 and (2) a manual coding process of dividing the conversations into phrases and identifying 13 unique clinical content categories for the phrases.3 We first performed a phrase-level distribution analysis for the manually tagged phrases, for which we computed the frequency of each manually coded category appearing in resident and nurse handoffs. The automated analysis included word tokenization, part-of-speech tagging, lemmatization, case-lowering, and stop-word removal using NLTK. Then, using MetaMap tool the phrases containing medically relevant terminology were identified and categorized. The extracted categories were merged into higher-level categories according to the semantic groups provided by Unified Medical Language System (UMLS). We then compared and analyzed the overlap between the manually and automatically obtained categories.

Results

Phrase-level distributional statistics revealed differences in the content proportion of handoffs that resident and nurses spend discussing the different categories. Although both residents and nurses spend 35% of the handoff conversing about the Assessment of Active Problems, residents use 15% of the content to converse about Medications/Treatments and 10% to converse about Active Problems, while nurses spend 20% and 4%, respectively. The results of automated NLP analysis using MetaMap tagging are shown in Figure 1. In general, nurse conversation is more about Concepts & ideas and Chemicals & Drugs compared to residents. When comparing the automated tagging results with the manual coding, certain words in semantic categories can be mapped to manually encoded categories – for example, while words belonging to Concepts and Ideas appear in all categories frequently, words tagged as Disorders have a concentration in manual categories Active Problems and Past Medical History.

Discussions and Future Steps

Our analysis provides a proof-of-concept pipeline using automated methods such as NLP and automatic semantic analysis for analyzing and comparing clinical handoffs. In the future, we will conduct a more in-depth analysis on the categories we obtained from MetaMap and perform expert evaluations. Automated NLP analysis for handoffs will be useful in designing standardized clinical handoff documents and evaluating quality of clinical handoffs.

References