

Improving Outpatient Medication Lists Using Temporal Reasoning and Clinical Texts

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Target Population: General

Summary: Accurate and complete medication information at the point of care is crucial for delivery of high-quality care and prevention of adverse events. Medication reconciliation has been mandated by the Joint Commission on Accreditation of Healthcare Organizations. Most reconciliation is done by verbally asking the patient what they are taking and comparing it against a medication list. With electronic systems able to do medication reconciliation, structured data from electronic medical records (EMRs) are aggregated with computerized physician order entry systems' data into a single reconciled medication list. However, critical information such as a change in medication regimen is often in non-structured narrative sources, such as clinical notes. This information must also be reconciled to document the patient's complete and accurate medication record.

Structured data in a standard, predictable form can be easily processed by a computer, but narrative data are not codified and thus pose challenges. "Natural language processing" (NLP) is any system that manipulates free-form text or speech. NLP applications have been developed to identify and extract medical information from non-structured sources; however, few projects have examined the use of NLP as a method for improving medication reconciliation.

This study is investigating the feasibility of extracting medication information from non-structured electronic clinical sources within the Longitudinal Medical Record system, the Certification Commission for Health Information Technology-certified ambulatory-care EMR at Partners HealthCare System. The extracted information can be subsequently used by clinicians at the point of care, thereby reducing prescription and administrative errors. The project is piloting and testing the use of NLP and temporal-reasoning applications, which identify the timing of medication use, to automatically extract and encode medication and associated temporal information from clinical texts, and to chronologically order and classify medications. The study will measure the feasibility and efficiency of these methods and identify tools for improving medication reconciliation.

Specific Aims:

- Extract and encode medication information from clinical texts available in an ambulatory electronic medical record system. **(Achieved)**
- Apply temporal information (a controlled terminology, domain knowledge, and linguistic knowledge)

to develop a mechanism to represent the timing of medication use, detect the changes, and then to organize medications in a chronological order and classify them into appropriate groups. **(Ongoing)**

- Measure the feasibility and efficiency of the proposed methods and tools for improving the process of medication reconciliation. **(Ongoing)**

2010 Activities: The project team identified and sampled patients with chronic diseases in the EMR system and had at least one clinic note per year in the two-year study timeframe. The chronic diseases considered in this study include diabetes, hypertension, congestive heart failure, chronic obstructive pulmonary disease, and coronary artery disease. Two types of data were extracted for these patients: clinical notes and patients' medication information from their structured medication list (SML). The project team manually compared the differences between medications listed on the SML and those recorded in clinical notes to identify the challenges in extracting and encoding medication information included in clinical text.

The research team developed and is currently refining an NLP tool to extract medication names and signatures from free text clinical notes using standard (RxNorm) and local terminologies as a lexicon. The NegEx and ConText algorithms are used to capture contextual information and to tag identified concepts. The TimeText system, a temporal reasoning application, is used to capture durations and other temporal information found within a clinical note.

Grantee's Most Recent Self-Reported Quarterly Status (as of December 2010): Project progress is completely on track, meeting all milestones on time and project spending is roughly on target.

Preliminary Impact and Findings: Based on the manual comparison of the medications listed in the SML and the clinical notes, the project team identified several unique characteristics in clinical texts that present challenges for using NLP for clinical texts. These challenges include: notes containing detailed dosing regimen adjustment and status changes; some medications discussed in notes, but not ordered; negation, e.g., "except for the Lasix"; abbreviations; misspellings; and coreference. Based on the preliminary results, they also found that the NLP tool can be used to accurately extract and encode medication names and signatures from clinical notes.

Strategic Goal: Develop and disseminate health IT evidence and evidence-based tools to improve the quality and safety of medication management via the integration and utilization of medication management systems and technologies.

Business Goal: Knowledge Creation