



A rules based algorithm to generate problem lists using emergency department medication reconciliation



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ABSTRACT

Objectives: To evaluate the sensitivity and specificity of a problem list automatically generated from the emergency department (ED) medication reconciliation.

Methods: We performed a retrospective cohort study of patients admitted via the ED who also had a prior inpatient admission within the past year of an academic tertiary hospital. Our algorithm used the First Databank ontology to group medications into therapeutic classes, and applied a set of clinically derived rules to them to predict obstructive lung disease, hypertension, diabetes, congestive heart failure (CHF), and thromboembolism (TE) risk. This prediction was compared to problem lists in the last discharge summary in the electronic health record (EHR) as well as the emergency attending note.

Results: A total of 603 patients were enrolled from 03/29/2013–04/30/2013. The algorithm had superior sensitivity for all five conditions versus the attending problem list at the 99% confidence level (Obstructive Lung Disease 0.93 vs 0.47, Hypertension 0.93 vs 0.56, Diabetes 0.97 vs 0.73, TE Risk 0.82 vs 0.36, CHF 0.85 vs 0.38), while the attending problem list had superior specificity for both hypertension (0.76 vs 0.94) and CHF (0.87 vs 0.98). The algorithm had superior sensitivity for all conditions versus the EHR problem list (Obstructive Lung Disease 0.93 vs 0.34, Hypertension 0.93 vs 0.30, Diabetes 0.97 vs 0.67, TE Risk 0.82 vs 0.23, CHF 0.85 vs 0.32), while the EHR problem list also had superior specificity for detecting hypertension (0.76 vs 0.95) and CHF (0.87 vs 0.99).

Conclusion: The algorithm was more sensitive than clinicians for all conditions, but less specific for conditions that are not treated with a specific class of medications. This suggests similar algorithms may help identify critical conditions, and facilitate thorough documentation, but further investigation, potentially adding alternate sources of information, may be needed to reliably detect more complex conditions.

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1. Introduction

An accurate and accessible problem list is an important resource for care in the emergency department (ED). The problem list quickly identifies important medical conditions that may be related to a patient's presentation or may have significant impact to their treatment plan [1]. In addition to facilitating communication between providers during transitions of care, structured problem lists can be used to drive decision support, streamline workflows, and prevent medical errors [2,3].

Documenting an accurate problem list will soon be a federal requirement for use of electronic health records (EHR). The Cen-

ters for Medicare and Medicaid Services Meaningful Use Criteria, a set of voluntary goals for early adopters of EHR that anticipate future requirements, has long emphasized an up-to-date problem list. As of its 2014 guidelines, the Meaningful Use Criteria now require a minimum of 80% of patients to have at least one entry within the record's problem list [4]. These entries will need to be listed in a structured format such as ICD-10 or SNOMED-CT rather than as free-text within a physician's note. Furthermore, the criteria will soon require electronic records to contain embedded clinical decision support tools that use the problem list [5].

While a structured, easily accessible problem list is a vital resource for emergency physicians, the nature of emergency care makes maintaining a problem list difficult within the ED. Physicians' encounters with patients in the ED are often problem focused, leading to omissions in documentation not pertinent to the emergency visit. As patients' medical conditions and records become increasingly complex, patients may be less able to provide an accu-

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rate and complete history, particularly in the emergency setting. Obtaining and maintaining a useful problem list can be particularly difficult for critically-ill patients who may be unable to provide information themselves. Emergency providers also often have competing priorities such as unstable patients and emergent procedures that take precedence over documentation.

One proposed solution to help maintain an accurate problem list is to automatically generate it from a patient's existing medication list. This would provide emergency physicians with relevant information and help them keep the medical record up-to-date, with minimal effect on existing workflows, as medication reconciliation is generally performed for all emergency department visits, particularly those who are admitted. Previous studies have shown that discrepancies between medication lists and problem lists can help identify patients who have been treated for type II diabetes but have not been formally diagnosed in the medical record [6], and that automatic reminders to providers based on the medications they order can help to improve their documentation of the problem list [7].

To do so, we selected a group of sentinel conditions – obstructive lung disease (asthma and COPD), hypertension, diabetes, thromboembolic (TE) risk (prior venous thromboembolism or high risk condition for embolism), and congestive heart failure (CHF) – which are important to both emergency medicine and primary care, and which are at particular risk of iatrogenic complications within the hospital setting if they are not recognized, such as a patient with unidentified CHF receiving a rapid fluid bolus, causing pulmonary edema and respiratory failure.

Specifically, we hypothesized that such an algorithm could improve upon the existing documentation of the patient's problem list in the emergency department attending physician's note. As a secondary outcome measure, we examined the performance of the algorithm against the standardized problem list contained within the EHR, which exists independently from specific notes and is the specific problem list mandated by Meaningful Use Criteria.

2. Methods

This was a retrospective, cohort study designed to compare the sensitivity and specificity of an automatically generated problem list from the medication reconciliation to the current standard of problem lists created by clinicians within the emergency department and the inpatient wards of the hospital. The study was approved by our institutional review board.

2.1. Study setting and population

We conducted the study in the ED of an urban, academic tertiary care center for a one-month period. The ED is the site of an emergency medicine residency training program, with an annual census of approximately 55,000 patients.

2.2. Study protocol

We identified all consecutive patients admitted from the ED throughout the trial period. Patients were included in the study if they had a hospitalization discharge summary from our institution within one year of the study period, in order to ensure an accurate reference for their existing problem lists and medication list (Fig. 1).

We manually abstracted the “gold standard” problem list by combining the problem lists contained in a patient's last discharge summary note prior to admission. In addition, if primary care notes between the time of the patient's last admission and presentation contained a structured problem list, we included any additional diagnoses it contained. Due to the fact that our hospital's online

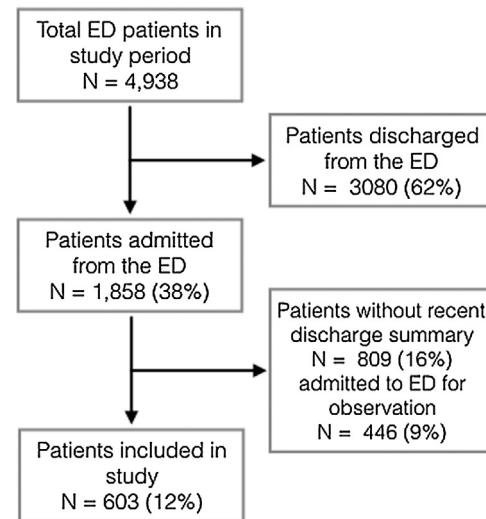


Fig. 1. Enrollment Diagram.

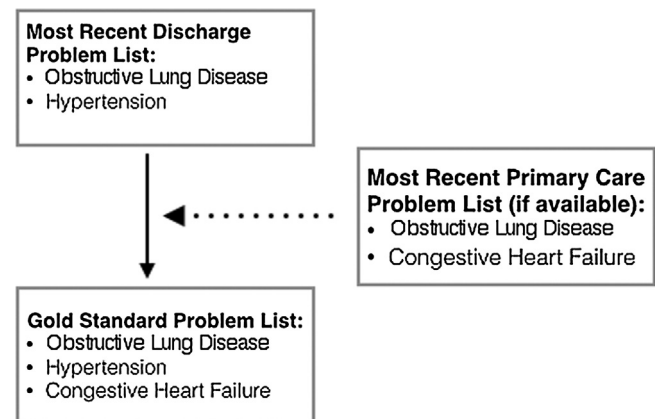


Fig. 2. Creation of the Gold Standard Problem List.

medical record format allows for free-text entries to the problem list, entries had to be manually reviewed by an attending physician reviewer. Diagnoses were included only if they were explicitly listed within a problem list. For example, “Congestive heart failure” and “dCHF” (diastolic congestive heart failure) were included if listed, whereas a description of furosemide given for fluid overload during a patient's hospital course was not. Conflicts between the discharge summary and primary care notes were ruled in favor of the presence of a condition (Fig. 2).

This process was completed prior to review of the problem lists generated from the study algorithm, ED attending note, and standardized EHR problem lists. A specific interface for extracting only the problem list data and patient demographics was established for the study to ensure that the data was de-identified prior to collection and analysis.

The problem list was refined to examine for five sentinel conditions at particular risk for iatrogenic complications. Specifically, the conditions were defined as follows: “Obstructive Lung Disease” included prior diagnoses of asthma, reactive airway disease, or chronic obstructive pulmonary disease. “Diabetes” included both insulin-dependent and non-insulin-dependent diabetes. “Hypertension” included essential hypertension and hypertension secondary to other medical conditions. “Congestive heart failure” (CHF) included systolic and diastolic congestive heart failure as well as pulmonary hypertension. “Thromboembolism risk” (TE) included prior thromboembolic disease (deep venous thrombo-

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