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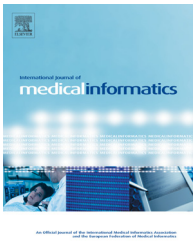

A trial of indication based prescribing of antihypertensive medications during computerized order entry to improve problem list documentation

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ABSTRACT

Background: Maintenance of problem lists in electronic medical records is required for the meaningful use incentive and by the Joint Commission. Linking indication with prescribed medications using computerized physician order entry (CPOE) can improve problem list documentation. Prescribing of antihypertensive medications is an excellent target for interventions to improve indication-based prescribing because antihypertensive medications often have multiple indications and are frequently prescribed.

Objective: To measure the accuracy and completeness of electronic problem list additions using indication-based prescribing of antihypertensives.

Design: Clinical decision support (CDS) was implemented so that orders of antihypertensives prompted ordering physicians to select from problem list additions indicated by that medication. An observational analysis of 1000 alerts was performed to determine the accuracy of physicians' selections.

Results: At least one accurate problem was placed 57.5% of the time. Inaccurate problems were placed 4.8% of the time. Accuracy was lower in medications with multiple indications and the likelihood of omitted problems was higher compared to medications whose only indication was hypertension. Attending physicians outperformed other clinicians. There was somewhat lower accuracy for inpatients compared to outpatients.

Conclusion: CDS using indication-based prescribing of antihypertensives produced accurate problem placement roughly two-thirds of time with fewer than 5% inaccurate problems placed. Performance of alerts was sensitive to the number of potential indications of the medication and attendings vs. other clinicians prescribing. Indication-based prescribing during CPOE can be used for problem list maintenance, but requires optimization.

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1. Introduction

The problem list is an important tool for patient care, helping physicians organize notes and coordinate patient rounds [1]. Problem lists add value to several clinically relevant activities including patient registries, billing support, data mining research and identifying subjects for clinical trials [2–7]. As originally conceived by Weed [1,8], the problem list, as part of the electronic medical record (EMR), has great potential as a linkable index to facilitate better clinical decisions. The Joint Commission requirements for problem lists [9] currently do not specify if problem lists must be in paper or electronic format, but electronic problem lists of "structured data" are required by Medicare and Medicaid to qualify for incentives for the meaningful use of electronic health records [10]. In either form, all of these uses depend on problem list completeness and accuracy. In addition, for the meaningful use incentive the problem list must be "structured data", so a system that automatically allows the clinician to add problems in an encoded manner makes meeting this criteria easier.

Presently, however, problem lists often are incomplete or inaccurate. For example, a study of the Veteran's Administrations EMR [11] found that only 49% of patients with hypertension had the diagnosis on the problem list. Further, a study from Intermountain Healthcare reported that their problem lists are "*usually incomplete and inaccurate, and are often totally unused*" [12].

The completeness and accuracy of electronic problem lists can be improved using clinical decision support (CDS) to semi-automate the creation of problem list entries via indication based prescribing [13,14], or, as recently reported by Wright, using pop-up screens independent from orders [15]. The idea for problem list CDS based on indication based prescribing is that every medication would be linked to a specific indication and supported by evidence to ensure optimal prescribing. However, many medications are used for multiple indications, and not all prescribing is evidence-based. Despite these complications, problem list completeness and accuracy may be improved if medications prescribed through a computerized physician order entry system (CPOE) are used to alert physicians to add potential entries to the patient's electronic problem list, where alerts prompt the common indications of the prescribed medication.

We have previously published results using CPOE and CDS to generate indication-based alerts for diabetes, HIV, hypothyroidism, hyperlipidemia, asthma, COPD, TIA's and off-label use of medications such as IVIG. The accuracy and yield of problem list additions in our previous research depended on the number of indications for a medication [13,14]. For medications with very few indications, such as metformin, the yield of problem list entries and the accuracy of selected alert generated entries were high [13]. For medications with multiple indications, both labeled and not, such as intravenous immune globulin, both the yield and accuracy were lower [14]. This study analyses antihypertensive medications, which also have a wide range of indications.

Over 50 million Americans are affected by hypertension, making it the most frequent primary problem for which patients are seen in clinics in the United States [15]. This disease commonly is treated with pharmacotherapy, typically with more than one medication per patient [15]. However, antihypertensive medications are diverse, with multiple mechanisms of action that also can be used for congestive heart failure, nephropathy, benign prostatic hypertrophy, and disease processes such as migraine prevention and cirrhosis with esophageal varices.

In this study we examined the yield and accuracy of problem list entries selected by physicians using CPOE generated indication alerts for antihypertensive medications. We examined variations in alert accuracy depending on the number of indications for the medication, physician characteristics, and whether the clinical setting was inpatient or outpatient in order to better understand the appropriate uses of this new type of CDS.

2. Methods

2.1. EMR, CPOE, CDS environment

The University of Illinois Hospital and Health Sciences System (UIHHSS) has a 450-bed teaching hospital and a large multi-specialty ambulatory clinic utilizing a commercial EMR (*Millennium*®, Cerner Corporation, Kansas City, MO) as the primary repository for problem lists, clinical notes, test results, medication lists and orders. The EMR is used by all specialties, allowing any clinician to update patient records and problem lists either as free text or using the common discrete coded nomenclatures (ICD-9 CM [16] or SNOMED® [17]). All medication orders are placed by CPOE using a commercially available CDS (*Discern Expert*®, Cerner Corporation) [13,14,18].

2.2. Indication based alerts

Similar indication alerts have been described previously [13,14]. For this implementation, antihypertensive medications were categorized by potential indications: HTN (hypertension), CHF (congestive heart failure), BPH (benign prostatic hypertrophy), and NEPH (nephropathy) (see example in Fig. 1 below). The choices presented to the ordering physician varied by medication category, the association linking the medication to indications was done in-house by physicians and pharmacists. Minoxidil and methyldopa, for example, each offered HTN as the only pre-identified indication. ACE inhibitors prompted choices of HTN, CHF or NEPH, any combination of which could be selected. If the clinician chose to enter free text, the free text was not automatically added to the problem list.

The CDS was triggered when a clinician initiated a new order, a refill, or modified an order for any designated antihypertensive medication. If an indication supporting the use of the medication was already active on the patient's problem list, then no indication alert was shown to the ordering clinician. However, if there was no supporting indication on the problem list, then an alert was presented to the ordering clinician. Depending on the medication, the alert displayed one or more problems as outlined in Table 1. The clinician could select one or more of the offered indications, make a free text