

Grant Final Report

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**Medication Reconciliation Technology to Improve
Quality of Transitional Care**

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Abstract

Purpose: We aimed to integrate an electronic MR system with an electronic prescribing system, conduct a trial of MR, and determine whether this alters MR and the incidence of medication errors. We hypothesized that electronic facilitation would improve completion of MR and decrease the incidence of drug-related medical errors.

Scope: Wishard Health Services is a tax-supported, urban healthcare system providing services to residents of Marion County, Indiana. We included patients admitted to the Medicine Service between 15 November 2010 and 30 April 2012, and clinicians who provided care for participating patients.

Methods: We designed and implemented an inpatient computer-based module to manage medications. We randomized inpatient Medicine teams to have, or not have, access to the module for hospitalized patients. Using a six-month ambulatory follow-up period, we reviewed medical records to determine whether MR and any adverse drug events had occurred. We surveyed clinicians about their experiences in managing medications, and conducted focus-group discussions for additional details.

Results: Final analysis is underway. The survey yielded approximately 328 responses. Most respondents (83%) indicated that they usually ask patients to confirm medications. Report of availability of tools to manage medications increased from 36% to 58%. Ease of working with tools improved from 31% to 51%, and perceived clinical benefits increased from 77% to 83%. MR presents significant challenges including time requirements and role definitions. A defined process and tools for conducting MR can improve outcomes, including usefulness, perceived benefits, errors in interpreting medication information, and time required.

Key Words: medication reconciliation; decision making; medical records systems, computerized; medication errors/prevention & control; user-computer interface

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Final Report

Purpose

The process of medication reconciliation (MR) is tedious and time-consuming. Integrating an approach to MR into computerized provider order entry could improve efficiency, medical errors, and quality of care. The specific aims of this study were as follows.

1. Integrate an electronic MR system with an electronic prescribing system.
2. Conduct a randomized controlled trial of MR.
3. Determine whether electronic facilitation of MR alters MR and the incidence of medication errors in ambulatory care.

We hypothesized that electronic facilitation of inpatient MR would improve completion of medication reconciliation and would decrease the incidence of drug-related medical errors.

Scope

Background

Medical errors are common and dangerous. Approximately 20% of medical errors are related to prescription of medications. Most medication errors occur at transitions in care, such as when patients are admitted from ambulatory settings to hospitals or discharged from hospitals to ambulatory settings. Treating drug-related injuries in hospitals costs at least \$3.5 billion per year.

Since prescriptions at hospital discharge are intended to be followed in ambulatory care, improving transitional and ambulatory care requires attention to the discharge prescriptions. With MR, multiple sources of medication information are reviewed, to determine which medications are currently active, and which medications should be prescribed. The Joint Commission has indicated that clinicians should "record and pass along correct information about a patient's medicines", "find out what medicines the patient is taking", and "compare those medicines to new medicines given to the patient".

Context

Although implementation of formal MR systems improves the fraction of cases undergoing MR, we know relatively little about the extent to which MR systems alter clinical outcomes. We and others have demonstrated that active facilitation of recommended care improves outcomes more than just delivering knowledge. Several institutions have created electronic systems to

streamline MR, but systems described in medical literature to date do not integrate with electronic prescribing.

Setting

Wishard Health Services ("Wishard") is a tax-supported, urban healthcare system providing outpatient, inpatient, and community-based health services to residents of Marion County, Indiana. Wishard's hospital and a core of outpatient clinics are located on the campus of Indiana University Purdue University-Indianapolis. Additional community health centers providing primary care are located around the Indianapolis metropolitan area. In 2011, Wishard serviced 990,165 outpatient visits, including 240,735 visits to community health centers. A special program of services is provided for many low-income patients who are not eligible for Medicaid benefits. Wishard has more than 1,000 physicians on its medical staff.

The Regenstrief Medical Records System (RMRS) is an advanced electronic health record system; it includes the Gopher computerized provider order entry (CPOE) system. The RMRS is Wishard's primary instrument for processing data and monitoring clinical activity. Since 1977, it has registered and stored data for all patients visiting primary care and subspecialty clinics. Contained in networked minicomputers, the RMRS is a data repository system that is also connected to CPOE, laboratories, pharmacies, radiology systems, and systems for registration and scheduling. The RMRS contains all medical orders, laboratory results, digital images, radiology and pathology reports, narrative notes from clinical encounters, coded clinical data, hospital discharge summaries, and the dispensing history and charges of all medications by the inpatient and outpatient pharmacy. These data are readily retrievable for individual patients by health care providers using online terminals. The system maintains several additional databases that include data about diagnoses, vital signs, diagnostic tests, hospital discharges, and preventive health services. Clinical decision support is implemented through CPOE. Programmed rules create reminders, such as about drug-drug interactions, needed clinical monitoring, or preventive health services, for clinicians to improve quality or safety of care.

Participants

This study included patients admitted to the Medicine Service of Wishard Hospital between 15 November 2010 and 30 April 2012. We excluded cases with documentation of status as pregnant or prisoner. Participants also included physicians and nurse practitioners from the Wishard Emergency Department or Indiana University Division of General Internal Medicine and Geriatrics who provided inpatient or ambulatory care for participating patients at Wishard, and Wishard pharmacists who provided care for participating patients at Wishard.

Methods

Study design

Based on feedback from end users and discussion among the study team, we designed and implemented a new computer-based module to manage medications. We randomized inpatient Medicine teams to have, or not have, access to the module for hospitalized patients. Using a six-month ambulatory follow-up period after discharge from hospital, we then reviewed medical records to determine whether medication reconciliation and any adverse drug events had occurred. We also surveyed clinicians about their experiences in managing medications, and conducted limited focus-group discussions to gain additional details.

Data sources

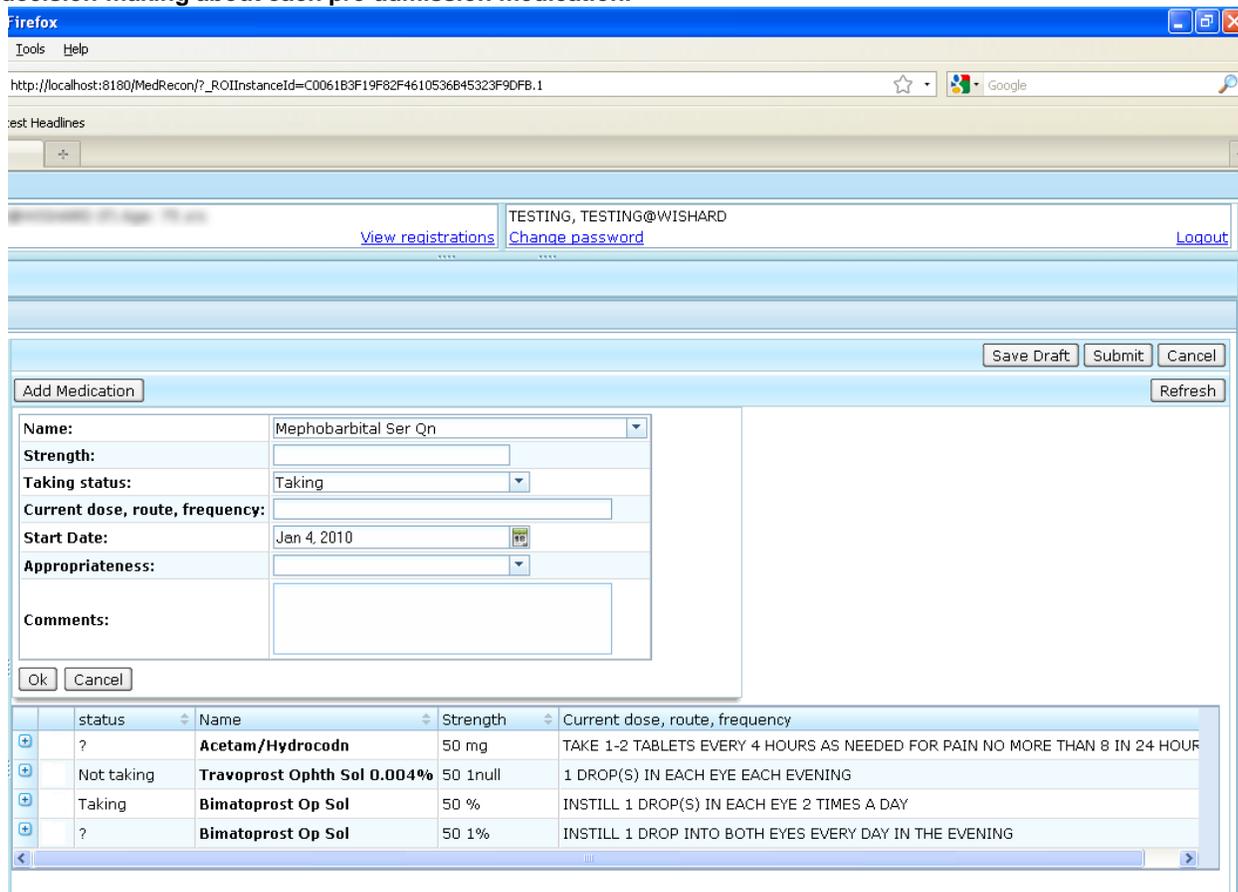
We accessed the comprehensive electronic medical records system for the patients admitted during the study period. Clinicians were also surveyed.

Interventions

At the start of hospital rotations on the Medicine Service, institutional pharmacists and clinicians in the intervention arm underwent a training session, to introduce the study and its goals and methods. A demonstration was provided. A training video, shown during the training, offered a consistent message across sites and allowed later playback and review on demand via Internet. A screenshot of the interventional module is shown in Figure 1 below.

This module was available to clinicians in the intervention group. The module imported information about pre-admission medications, based on pharmacy records. It then allowed the user (clinician) to make corrections and annotations about the medications. The output of the module was made available when ordering inpatient medications, such that the list of reconciled medications could be used directly to order inpatient medications. When the patient was discharged from the hospital, the system would automatically prompt the intervention users to indicate reasons for not prescribing any of the pre-admission medications as new outpatient medications.

Figure 1. Screenshot of the interventional module. The module facilitates correction, annotation, and decision-making about each pre-admission medication.



Measures

This project required matching pre-admission medications with those prescribed at hospital admission and discharge. Matches were defined as occurring exactly, or only by drug name, class, or indication. The following additional variables were collected.

- Baseline characteristics: age, gender, race, payer, number of previous admissions, number of medications
- Providers' characteristics: level of training, gender
- On admission and discharge: number and fraction of outpatient medications prescribed or addressed as to why prescribing did not occur.
- Number and fraction of cases with MR by a pharmacist.
- Number and fraction of cases undergoing any MR.

- Number and fraction of cases where any outpatient medications were not prescribed or addressed as to why prescribing did not occur.
- Reasons for not prescribing outpatient medications.

We also assessed utilization of the intervention.

For patients who returned for follow-up in ambulatory care within six months of hospital discharge, we looked for discrepancies between the discharge medications and the follow-up medications.

For discrepancies identified, the study team reached consensus about potential for harm and potential severity of harm. Adverse drug events were also identified.

By questionnaire, we conducted a before-and-after survey of providers. Providers were surveyed about satisfaction with care, managing medications, and usefulness of local information systems in managing medications.

The analysis period was 01 May 2011 to 31 July 2011.

Limitations

Although clinicians in the intervention group could use the new module, the module itself did not generate orders. Clinicians had to order medications separately from their annotations.

Cross-over of groups occurred due to uncontrollable factors such as night-floaters representing multiple teams. We have elected to conduct a primary analysis of module usage vs. non-usage, with an additional sensitivity analysis according to intervention group.

A subset of the study period was selected for analysis, due to the complexity of review and large volume of data entry, so the findings may not reflect all longitudinal trends of clinicians' changes to their own medical practices.

Results

Principal findings

We are still in the stages of final data analysis about the intervention. We have identified approximately 706 hospital admissions, together in intervention and control groups, during the analysis period. In about 105 of these, clinicians with access to the interventional module completed the module. The study team is completing statistical analysis of the quantitative measures. We are analyzing approximately 4,400 medication records and 370 observations for potential adverse drug events.

Outcomes

Our survey yielded approximately 268 responses in the initial round and 60 responses in the second round; many initial respondents were no longer eligible for the second round. Most respondents (83%) indicated that they usually ask patients to confirm their medications. Report

of availability of tools to manage medications increased from 36% to 58%. Ease of working with tools to manage medications improved from 31% to 51%, and perceived clinical benefits increased from 77% to 83%.

Discharge from hospital. Focus-group participants indicated that patients receive printed medication lists, but that the discharge process needs improvement, including increased consistency, and more education of patients. The pharmacy is helpful in this process. They also indicated that manual review of the discharge medication list may be helpful.

Based on findings, a new prototype was designed and piloted among a sample of clinicians. The design has been reported. The data from pilot testing are in the process of being analyzed. Analysis to date indicates that redesigning the MR process to improve usability of medication management and to add information about predicted medication adherence decreases clinicians' errors in interpreting the information, and markedly decreases the time required for interpretation.

AHRQ Priority Populations

As originally planned, we included providers and patients from the Medicine Service, without any exclusions based on age, gender, insurance status, or race. As a public institution, Wishard serves as a safety net in providing medical care to residents of Marion County, Indiana. Patients receiving care at Wishard have a high prevalence of low income, low education, and Medicaid insurance coverage. In 2011, the payer mix was 26% Medicaid, 18% Medicare, 8.3% commercial, and 45% uninsured.

Discussion

Training. Physicians indicated that their training in medication reconciliation varied. Some were taught in medical school. Formal training during residency had not occurred. One participant indicated, "We really haven't been taught a method to ask for medications". Pharmacists in focus groups indicated that they received this training in school and that students had a competency requirement for medication reconciliation.

Variation among institutions and providers. The institution's campus has five hospitals. Focus-group participants indicated that the various hospitals use different software to conduct or facilitate medication reconciliation, leading to certain inefficiencies and the requirement for extra learning about the information systems. This also led to variation in approaches to conducting the process. One physician commented, "Every intern kind of does it their own way."

Obtaining medication history at the point of care. Participants indicated that physicians frequently interact directly with patients in obtaining the medication history. This direct interaction was thought to be helpful, both for accuracy and for medical decision-making. A paper-based process is often used. Mobile computing was mentioned as a potential improvement. Participants indicated that the process might benefit from patients' greater involvement in direct documentation of their own medication histories. One participant framed the patient as being a member of the care team and having certain responsibilities on that team. There was sometimes a need to double-check the patient's report, such as by asking a family member to confirm what the patient said.

Multiple sources of information. Participants acknowledged that multiple sources of information are not only present, but are often needed, to obtain the most up-to-date, accurate information about medications. They mentioned "wallet cards" and hospital discharge summaries, and added that telephone calls to other hospitals are sometimes needed. Finding all of the information is difficult. Over-the-counter medications need to be included. Due to the multiplicity of sources of information, clinicians need to know how to handle a degree of uncertainty about the information. Pharmacists also indicated a need for a better way to keep track of which patients on a service had had their medications reconciled. They also expressed the need for an easier way to identify medication reconciliation in the medical record.

Roles. Participants indicated varying opinions about the roles of physicians, pharmacists, and medical students in the process of medication reconciliation. Physicians often saw themselves as the "front lines"; in other words, they felt that they should be the first to obtain a comprehensive medication history, and reconcile medications. They indicated that pharmacists could be helpful in this process, to conduct some of the encounters with patients, verify medications, etc. Pharmacists are not always available, such as during nights and weekends, so the best approach would be a coordinated one that could take into account the changing schedules of the team members. Upon discharge, pharmacists might be helpful by reviewing medication information with patients. Some physicians were uncertain whether nurses would conduct medication reconciliation accurately. The value of some redundancy in the process was acknowledged. The computer's role was discussed: the computer could help with computations about refills, and organization of information about medications. Current computer systems, however, are too cumbersome: they require multiple logins, cutting and pasting, etc. The process could be more streamlined. The computer could provide better information and interpretation. Time. Participants consistently indicated that medication reconciliation takes a long time, more than 30 minutes in some cases. Since clinicians in the hospital work under time constraints and pressures, this can pose difficulties for completing medication reconciliation. The lack of time might prompt a physician to call a pharmacist for help.

Conclusions

MR presents significant challenges including time requirements and role definitions. A deliberate process for conducting MR, including a computer-based module to facilitate medication management, can improve aspects of MR, including usefulness, perceived benefits, errors in interpreting medication information, and time required.

Significance

Medication errors are common and dangerous. Most medication errors that occur when patients are discharged to ambulatory environments occur because of problems with MR, including issues with documentation of discharge. Effective approaches to MR could improve outcomes and safety for patients.

Implications

Systematic changes to improve MR should be developed and implemented further, with increased attention to usability, efficiency, role definitions, integration into workflow, and time requirements.

List of Publications and Products

Cadwallader J, Spry K, Morea J, Russ AL, Duke J, Weiner M. Design of a medication reconciliation application - facilitating clinician-focused decision making with data from multiple sources. *Appl Clin Inf* 2013 (March); 4:110-125. Available at <<http://dx.doi.org/10.4338/ACI-2012-12-RA-0057>>.

Three additional publications are being prepared, regarding the survey, pilot testing of redesign, and main outcomes.