Chapter 38. Medication Reconciliation

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Background

According to the Institute of Medicine's *Preventing Medication Errors* report,[1] the average hospitalized patient is subject to at least one medication error per day. This confirms previous research findings that medication errors represent the most common patient safety error.[2] More than 40 percent of medication errors are believed to result from inadequate reconciliation in handoffs during admission, transfer, and discharge of patients.[3] Of these errors, about 20 percent are believed to result in harm.[3, 4] Many of these errors would be averted if medication reconciliation processes were in place.

Medication reconciliation is a formal process for creating the most complete and accurate list possible of a patient's current medications and comparing the list to those in the patient record or medication orders. According to the Joint Commission[5] (p. 1),

> Medication reconciliation is the process of comparing a patient's medication orders to all of the medications that the patient has been taking. This reconciliation is done to avoid medication errors such as omissions, duplications, dosing errors, or drug interactions. It should be done at every transition of care in which new medications are ordered or existing orders are rewritten. Transitions in care include changes in setting, service, practitioner, or level of care. This process comprises five steps: (1) develop a list of current medications; (2) develop a list of medications to be prescribed; (3) compare the medications on the two lists; (4) make clinical decisions based on the comparison; and (5) communicate the new list to appropriate caregivers and to the patient.

Recognizing vulnerabilities for medication errors, numerous efforts are underway to encourage all health care providers and organizations to perform a medication reconciliation process at various patient care transitions. The intent is to avoid errors of omission, duplication, incorrect doses or timing, and adverse drug-drug or drug-disease interactions. The Joint Commission added medication reconciliation across the care continuum as a National Patient Safety Goal in 2005.[6] The Institute for Healthcare Improvement (IHI) has medication reconciliation as part of its 100,000 Lives Campaign. This chapter reviews the evidence for medication reconciliation and makes recommendations for nursing practice.

Medication Reconciliation

A comprehensive list of medications should include all prescription medications, herbals, vitamins, nutritional supplements, over-the-counter drugs, vaccines, diagnostic and contrast agents, radioactive medications, parenteral nutrition, blood derivatives, and intravenous solutions (hereafter referred to collectively as medications).[6] Over-the-counter drugs and dietary supplements are not currently considered by many clinicians to be medications, and thus are often not included in the medication record. As interactions can occur between prescribed medication, over-the-counter medications, or dietary supplements, all medications and

supplements should be part of a patient's medication history and included in the reconciliation process.

The steps in medication reconciliation are seemingly straightforward.[7] For a newly hospitalized patient, the steps include obtaining and verifying the patient's medication history, documenting the patient's medication history, writing orders for the hospital medication regimen, and creating a medication administration record. At discharge, the steps include determining the postdischarge medication regimen, developing discharge instructions for the patient for home medications, educating the patient, and transmitting the medication list to the followup physician. For patients in ambulatory settings, the main steps include documenting a complete list of the current medications and then updating the list whenever medications are added or changed.

However, the process of gathering, organizing, and communicating medication information across the continuum of care is not straightforward. First, there is tremendous variation in the process for gathering a patient's medication history. Second, there are at least three disciplines generally involved in the process—medicine, pharmacy, and nursing—with little agreement on each profession's role and responsibility for the reconciliation process. Third, there is often duplication of data gathering with both nurses and physicians taking medication histories, documenting them in different places in the chart, and rarely comparing and resolving any discrepancies between the two histories.

Additionally, patient acuity may influence the process of reconciliation. For example, a patient admitted for trauma may result in cursory data gathering about the medication history. Alternatively, a patient with numerous comorbidities may stimulate gathering a more complete list of current medications. In general, there is no standardization of the process of medication reconciliation, which results in tremendous variation in the historical information gathered, sources of information used, comprehensiveness of medication orders, and how information is communicated to various providers across the continuum of care.[7]

Safety Vulnerabilities Necessitate Medication Reconciliation

A multitude of factors—such as patients' lack of knowledge of their medications, physician and nurse workflows, and lack of integration of patient health records across the continuum of care—all contribute to a lack of a complete medication reconciliation, which in turn creates the potential for error.

Physician and nurse workflows have not traditionally included making a regular inventory of all medications a patient is taking (including prescription medications, over-the-counter drugs, herbals, and other complementary drugs such as vitamins) or verifying these lists with the patient. There has been no standard regarding what constitutes a comprehensive medication history or where medication information is kept in the paper or electronic health record. A patient's medication history may be found in the nursing admission database, the medication administration record, the physician history, and/or the pharmacy profile. When health care information is not integrated across settings, organizations, and among clinicians, it is not easy to validate or fill in the gaps from patient-reported information. Patients and family members may not be good historians of a medication record, and due to limited access to pharmacy records, only an incomplete recording of current medications may be obtained. Lau and colleagues[8] compared community pharmacy drug lists with hospitalized patients and found 25 percent of prescription drugs in use at home were not recorded on the hospital admission record.

In inpatient facilities, there are several situations where medication reconciliation is needed. Generally, patients are admitted to the hospital for a specific procedure, such as surgery, or on an urgent basis. When specialty health care providers are focused on the one component of care related to the specific encounter and do not take a holistic view to other aspects of the patients' health care needs and practices, it is easy to overlook medications that may cause an adverse event when combined with new medications or different dosages. Some of the patient's daily medications may be discontinued during a hospital stay, and when there is a lack of a formal reconciliation process on discharge, the need to restart medications upon discharge may be overlooked. One example would be discontinuing an anticoagulant during a hospital stay and neglecting to restart it upon discharge. Another example is when orders from one unit of care (such as intensive care) are discontinued and new orders are written when the patient moves to another unit of care (such as a general care unit). The policy necessitating the rewriting of orders makes it easy for the prescriber to overlook medications that may need to be reordered when no formal medication reconciliation process is in place. These factors combine to create an unsafe medication environment in acute care settings.

Research Evidence

Medication reconciliation studies have focused on the accuracy of the medication history during various transitions: ambulatory to acute care inpatient setting, skilled nursing facility to acute care inpatient setting, inpatient acute care setting to skilled nursing facility, inpatient acute care setting to discharge, inpatient floor to the intensive care unit (ICU), and ICU to discharge. Little research has focused on outcomes related to the prevalence of errors resulting from a lack of or an incomplete patient medication list.

Reconciliation in the Ambulatory Setting

Medication discrepancies in outpatient records were addressed in three studies. Ernst and colleagues[9] found discrepancies in 26.3 percent of charts of patients requesting prescription renewal. Of the charts with discrepancies, 59 percent omitted medications from the electronic medical record medication list. Miller and colleagues,[10] upon examining patient records of an ambulatory family practice, found that while 76 percent of patients had prescribed medications, 87 percent of charts had incomplete or no documentation of those medications. Three years following institution of a reconciliation process, which included a form on the chart listing all medications ordered for a patient, 82 percent of charts had complete prescription medication documentation. Similar findings were noted in a study of cardiology and internal medicine practices[11] and in a group of patients receiving dialysis.[12] Whether patients used the prescribed medications as originally prescribed or if their medications were changed by another physician was not reported. The reconciliation process requires verification with the patient regarding their use of the prescribed medications.

Reconciliation in Acute Inpatient Settings

Nine studies examined medication reconciliation in acute inpatient settings. Bayley and colleagues[7] identified that the common discrepancies in medication history from ambulatory to inpatient care were omitted medication orders, altered doses, or incomplete allergy histories.

Vira and colleagues[13] found a 38 percent discrepancy rate in their study of newly hospitalized patients. Gleason and colleagues[4] found more than half of the patients they studied had discrepancies in medication histories or admission medication orders.

Among the most common medication discrepancies between what is in the patient's history and what is ordered upon admission to the hospital was omission of a medication that patients reported taking prior to admission.[13] These discrepancies result from incomplete documentation of the patient's medication history and a lack of time to search for the information. Nursing staff have been noted spending in excess of an hour per patient admission or transfer trying to accurately identify medications a patient has been receiving,[3] including getting a list of preadmission medications from the patient and filling in gaps through the pharmacy and primary care physician.

Chevalier and colleagues[14] examined nurses' perceptions of medication reconciliation practices. More than 60 percent of nurses reported that determining the medications a patient was taking at home, clarifying medication orders at transfer, and ensuring accurate discharge medication orders was a time-consuming process. Time requirements and staffing resources were identified as a barrier to completing the process. Although implementing a medication reconciliation process will likely consume more health care provider time initially, the process may become more efficient once in place. A standardized reconciliation process has been reported to reduce work and the rework associated with the management of medication orders. Rozich and colleagues[15] reported that implementing a systematic approach to reconciling medications was found to decrease nursing time at transfer from the coronary care unit by 20 minutes per patient, and pharmacy time at hospital discharge by more than 40 minutes. Stover and Somers[16] reported that case managers performing the reconciliation process spent 5 to 10 minutes per day completing the process with new admissions, and each case manager typically reviewed eight new admissions each day.

One challenge to having an accurate patient medication history is the lack of a standardized location in the patient chart where the information may be found. A nurse may need to check the nursing admission database, the medication administration record, the physician patient history and progress notes, and the pharmacy database. Rozich and Resar[15] found that prior to initiation of a reconciliation process, details of the current medications in the inpatient chart were nonexistent or incorrect 85 percent of the time. Similar findings were found in family practice.[17] Nickerson and colleagues[18] found that of the medication history discrepancies they identified, 83 percent had the potential for harm. Others reported that when a medication reconciliation process was instituted, it reduced discrepancies from 70 percent to 15 percent.[3, 19] Vira and colleagues[13] reported that a medication reconciliation process prevented the potential for harm in 75 percent of cases.

Transfers From Inpatient Floor to ICU and Discharge From the ICU

Two studies by Pronovost and colleagues[20, 21] examined medication reconciliation in the ICU. Examining discrepancies between medications a patient was receiving in the ICU and the discharge orders from the surgical ICU resulted in 94 percent of discharge orders needing to be changed. Following implementation of a paper-based medication tracking system, the error rate of discharge medication orders was reduced to zero.[20] Following implementation of a reconciliation process using an electronic form at discharge from a surgical ICU, only 21 percent of orders required changing.

Admissions Between Skilled Nursing Facilities and Hospitals

A study of medication changes during transfer from nursing home to hospital and hospital to nursing home found inaccurate and incomplete reconciliation of medication regimens.[22] The mean number of medication orders altered per patient on admission to the hospital from a nursing home was 3.1, and from the hospital to the nursing home was 1.4. Sixty-five percent of the medication changes were discontinuations, 19 percent were dose changes, and 10 percent were substitutions for medications with the same indications. The investigators estimated that 20 percent of the medication changes led to an adverse drug event.

Inpatient to Discharge

Four studies looked at the process of discharge from the hospital to home. Bayley and colleagues,[7] in a qualitative study including nurse, physician, and pharmacist informants, reported that reconciliation failures at discharge stemmed from not resuming medications held during the hospital stay, and insufficient patient education at discharge. These failures resulted from incomplete gathering of the home medication regimen at admission and rushed discharges.

Moore and colleagues[23] found that 42 percent of the patients they studied had one or more errors in the discharge medication orders. Most often medications that should have been restarted were not. The medications commonly involved were cardiovascular (36.4 percent), gastrointestinal (27.3 percent), and pulmonary (13.6 percent). Sullivan and colleagues[24] found that 59 percent of discrepancies not corrected at discharge could have resulted in patient harm.

The use of a multipart paper prescription form for discharge medications was found to improve accuracy. The form integrates admission medications, in-hospital changes, and discharge medications. One part of the form is used as the prescription, the second is placed in the chart, the third is given to the patient with instructions for home management, and the fourth is sent to the primary care physician. Accuracy of medication prescriptions with the use of a multipart form was 82 percent, as compared to 40 percent without the use of an integrated process.[25]

Medication History Accuracy With Electronic Health Records

The electronic health record is generally believed to contain more accurate information and facilitate easier retrieval of information than paper-based medical records. Studies of medication lists in electronic health records have found the data are only as accurate as what has been entered. Wagner and Hogan[26] found discrepancies between the number of medications patients reported taking (5.67) and that listed in the electronic record (4.69). Data entry errors accounted for 28 percent of the discrepancies, while 26 percent were related to failure of the clinician to enter medication changes into the electronic record.

DeCarolis and colleagues[27] found that a computerized medication profile was inaccurate in 71 percent of the patients they studied. They demonstrated that implementation of a standardized medication reconciliation process reduced the number of patients with unintended discrepancies by 43 percent, thereby significantly decreasing the potential for medication errors. However, developing and implementing an electronic reconciliation process requires technical support. Kramer and colleagues[28] reported needing grant funding with hospital matching funds for development and programming. Reprogramming is required anytime there are system upgrades.

Use of a computer order entry system can reduce errors at the time of discharge by generating a list of medications used before and during the hospital admission. The medication list with instructions can be printed and used for education and review with the patient.[7] The utility of such a system depends upon the prior implementation of an admission medication reconciliation system. Some electronic discharge medication ordering systems allow for direct transfer of the orders to the community pharmacy and to the primary care physician, as well as keeping a permanent record on the electronic health record.

Clearly there is a need for patients, families, health care providers, and pharmacies to have a single electronic medication record with everyone working from the same record and all medications being reconciled against this record. Electronic systems make it easier to access medication histories, but they need to be kept up to date, and information must be correlated with patients' actual medication use.

Electronic prescribing network systems are being developed that can instantaneously provide a patient's medication history to pharmacists, consumers, and health care providers, while protecting patient privacy. Additionally, electronic prescribing allows for key fields such as drug name, dose, route, and frequency. Electronic prescribing also allows for decision support such as checking for allergies, double prescribing, and counteracting medications.

Evidence-Based Practice Implications

There are numerous areas for nurse involvement in the area of medication reconciliation. The following are generally consensus recommendations; they have not been subjected to systematic study for effectiveness unless noted.

Define the Steps in the Reconciliation Process

A first step in having an accurate listing of medications is defining the steps in obtaining a complete medication history. IHI suggests three steps to the process: (1) verify by collecting the list of medications, vitamins, nutritional supplements, over-the-counter drugs, and vaccines; (2) clarify that the medications and dosages are appropriate; and (3) reconcile and document any changes.[29] Each health care setting needs to develop standards for who is responsible and how the process will be completed. Whittington and Cohen reported that the accuracy of medication lists went from 45 percent to 95 percent with the implementation of reconciliation standards.[30]

Clearly Identify Responsibilities for the Process

Health care professionals need to clearly identify team roles and responsibilities for medication reconciliation. This needs to include evaluating existing processes; identifying a standard location in the patient chart where the medication history is kept; and determining who will put the medication history onto the agreed upon place in the chart, the time frame for resolving variances, and how to document medication changes.[31] These processes would eliminate the duplication of history taking and documentation that currently exists in many settings.

Consider Use of a Standardized Form

Many settings have found the use of a standardized medication form facilitates an accurate list that is accessible and visible.[32] Numerous examples are available on the IHI and Joint Commission Web sites.

Have an Explicit Time Frame for Completion

Many organizations have a process in place that calls for reviewing the patients' medication list at every primary care visit and within 24 hours of an inpatient admission. High-risk medications such as antihypertensives, antiseizures, and antibiotics may need to be reconciled sooner, for example, within 4 hours of admission.

Design Education Programs for Health Care Professionals

Medication reconciliation is a complex process. Education programs need to include the research about medication reconciliation and the steps being put into place to make a safer system for patients.

Design and Implement a Monitoring Process

Implement a reconciliation review of open and/or closed patient records. Assess adherence to the process and identify the potential for and any actual harm associated with unreconciled medications. Auditing tools such as the Improvement Tracker on the IHI Web site may assist health care settings in tracking their findings over time. Share results with providers so they are able to note progress over time.

Educate Patients and Family Members To Serve as Advocates

Patient education needs to be a major focus in medication reconciliation. Patients may not be accurate historians.[32] Recognition that information is being gathered from laypeople needs to be acknowledged and assistance needs to be offered to make the information as accurate as possible. A number of approaches have been identified to assist patients and families—for example, reconcile the medication list at every ambulatory visit.[9] Establish a process where patients bring their medications, including all over-the-counter preparations, to every health care encounter.[9, 33] Use of a universal patient medication form has shown promise in North Carolina; the form can be found at www.scha.org. In addition, educating patients about their medications allows them to keep better track of the medications they are taking.

Challenges

There are many challenges associated with implementation of effective medication reconciliation programs across the continuum of care. First, developing and implementing effective programs is very complex considering the various sites of care, the need for standardization in the process, and the importance of including the patient in the process.

Garnering executive leadership and support, obtaining physician and nurse understanding of the need for medication reconciliation, and actively participating in the design and implementation of programs may be difficult in many organizations where providers already feel burdened. There is a time commitment in both obtaining the medication history and completing the reconciliation process.

Research Implications

Research is needed on all aspects of the medication reconciliation process to provide an evidence base for impacting the prevention of adverse drug events. The Institute of Medicine report *Preventing Medication Errors*[1] found that currently most of the studies reported in the literature have small sample sizes and are single-site quality improvement projects. Multisite studies across the continuum of care are needed to assess the scope of the problem. Intervention studies using a variety of approaches, both paper based and electronic, are needed to determine the accuracy, feasibility, and simplicity of maintaining accurate lists of a patient's medication history.

The medication reconciliation process takes time, initially an additional 30 to 60 minutes per admission.[15] If an inpatient unit has multiple discharges and admissions, this can translate to the need for additional full-time staff. If nurses are responsible for the process, nursing hours per patient day may need to increase. Study of how medication reconciliation processes change the workflow and time associated with it are needed.

Busy clinicians are resistant to changing their workflow. Designing and testing streamlined processes that will work across the continuum of care, from the ambulatory to the inpatient setting, and having all stakeholders involved in the design will facilitate the process.

Studies of the sustainability of medication reconciliation processes need to be carried out. What does it look like at 6, 12, and 24 months? Are improvements being maintained?

Patients need to be full partners and self-advocates in the medication reconciliation process. Studies on systematic, multifaceted education programs regarding how to best maintain a current and complete listing of all medications need to be undertaken, as recommended in *Preventing Medication Errors*.[1] Studies should also address what techniques (e.g., the use of a medication card) work best to maintain an accurate list of medications.

Conclusion

There is some evidence to demonstrate how a medication reconciliation process is effective at preventing adverse drug events. Few studies have been published demonstrating how to do the process effectively or outlining the costs associated with design and implementation of programs. Nonetheless, an effective medication reconciliation process across care settings— where medications a patient is taking are compared to what is being ordered—is believed to reduce errors. Comparing what is being taken in one setting with what is being prescribed in another will avoid errors of omission, drug-drug interactions, drug-disease interactions, and other discrepancies. Medication reconciliation is a major component of safe patient care in any environment.

Search Strategy

Searches were carried out using the terms "medication reconciliation," "medication verification," "medication safety" "medication systems," and "medication errors." OVID databases for CINAHL®, MEDLINE®, and Google databases were searched. English-language health care literature from 1965 through March 2007 was reviewed. Additional searches were carried out on numerous patient safety Web sites, such as the Institute for Safe Medication Practices, the National Patient Safety Foundation, the Joint Commission, and the Institute for Healthcare Improvement. Reference lists from articles on medication reconciliation were also used to identify additional publications.

Articles that describe various components of the reconciliation process were found. Studies tended to be about one of the steps in the handoff process, such as admission from home to an acute care facility. No studies were identified that described the reconciliation process along the entire continuum of care from admission to an acute care facility, transfer from one level of care to another (such as critical care to general care), and discharge back to the community to the primary care practitioner or skilled care facility. The majority of articles were descriptive, and published studies were primarily quality improvement projects with small sample sizes limited to single clinical sites.

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Evidence Table. Medication Reconciliation

Study	Aim	Design & Sample	Site	Outcome
Bates 1999[34]	Assess strength of patient risk factors for adverse drug events (ADEs)	Nested case control 4,108 admissions	11 medical and surgical units in 2 tertiary care hospitals	Adverse drug events more frequent in sicker patients with longer hospital stay. Few risk factors emerged when controlling for level of care and pre-event length of stay. Prevention strategies should focus on improving medications systems.
Bayley 2005[7]	Enhance understanding of how patient handoffs are related to risk of adverse medical events before and after implementation of an information technology solution	Informant interviews	One primary care practice and four inpatient facilities (one academic medical center and three community hospitals)	Based on thematic analysis of qualitative data, identified information barriers due to work processes, role definitions, and individual discretion which can assist in designing effective technology solutions.
Bedell 2000[11]	Examine frequency of discrepancy between medications prescribed and those taken and associated causal factors. Compare medication containers and reported use of medication with medical records	Descriptive design 312 medical records in ambulatory setting	5 cardiology and 3 internal medicine practices	545 discrepancies among 239 patients (76%) 278 (51%) taking meds not recorded in chart 158 (29%) not taking recorded meds 109 (20%) taking different dosage than in chart. Predictors of discrepancy: age of pt, number of meds and multiple physicians
Boockvar 2004[22]	Identify medication changes during transfer between hospital and nursing home and ADEs caused by these changes	Descriptive study of residents of 4 nursing homes admitted to 2 academic hospitals. Nursing home and hospital records reviewed to identify changes in medication regimens between sites. Medications matched and compared regarding dosage, route, and frequency of administration	4 nursing homes	During 122 admissions, the mean numbers of medications altered during transfer from nursing home to hospital and hospital to nursing home were 3.1 and 1.4, respectively (p<.001). Changes in drug use were discontinuations, dose changes and class substitutions. Of 71 bidirectional transfers, ADEs attributable to medication changes occurred during 14 (20%). Overall risk of ADE per drug alteration (n=320) was 4.4% Most medication changes (8/14) implicated in causing ADEs occurred in the hospital, most ADEs (12/14) occurred in the nursing home after nursing home readmission.

Study	Aim	Design & Sample	Site	Outcome
Chevalier 2006[14]	Measure nurses' perceptions of patient safety, medication safety and current medication reconciliation practice at transition points in a patient's hospital stay	Descriptive survey of 111 nursing staff	Three general medicine units	Inconsistent medication reconciliation completion due to insufficient time and lack of communication among heath care professionals.
DeCarolis 2005[27]	Compare usual process of obtaining medication history to systematic reconciliation process	Comparison of pharmacist obtained medication history to inpatient medical record and computerized outpatient medical profile.	1 VA medical center	71% of patients had inaccurate computerized profile. Unintended order discrepancies in 58% of patients. Medication reconciliation system reduced unintended order discrepancy to 43%
Ernst 2001[9]	Assess accuracy of data in the EMR and document frequency and types of discrepancies that occurred.	Compared prescription renewal requests with electronic medical record data. 950 prescription-renewal requests for 134 medications over 3 month period.	Family Medicine Outpatient Clinic	Medication discrepancies were noted for 250 (26.3%) requests. 58.8% of the discrepancies were for prescriptions patient was taking but that were not ordered in the EMR medication list.
Gleason 2004[4]	Identify type, frequency, and severity of medication discrepancies in admission orders. Assess whether pharmacist obtained admission med histories decreased number of med errors.	Convenience sample compared 204 pharmacist conducted medication histories from patients to medication and allergy history documented in patient charts	725 bed tertiary care academic medical center. Direct admissions to 12 adult medical-surgical units	Interviews took on average 13.4 minutes. Discrepancies in medication histories and admission medication orders identified in more than 50% of patients. 22% could have been harmful if no intervention.
Kramer 2007[28]	Establish feasibility of electronic system for pharmacist and RN admission and discharge medication reconciliation and assess effect on patient safety, cost, satisfaction among providers and nurses	Pre-post electronic reconciliation process	283 patients on general medicine unit, 147 in preimplementation phase and 136 in postimplementation phase.	Preimplementation RNs identified more incomplete medication orders and dosage changes Post implementation greater numbers of allergies were identified, pharmacists completed significantly more dosage changes and patients reported higher level of agreement re discharge medication instructions. Lack of MD participation, 25% did not complete electronic discharge report

Study	Aim	Design & Sample	Site	Outcome
Lau 2000[8]	Compare medication history in hospital medical record with community pharmacy records prior to admission	Prospective observational study of 304 patients	General medical units of 2 acute care hospitals	61% of patients had discrepancy from community pharmacy records to inpatient medication history. 26% of prescription medications in use prior to admission were not listed in hospital medical records.
Manley 2003[12]	Determine rate of drug record discrepancies in a hemodialysis population	Prospective observational study of 63 patients	Outpatient hemodialysis center	60% of patients had drug record discrepancies.
Miller 1992[10]	Improve family practice office chart documentation of prescribed medications through use of duplicate prescription forms	Descriptive study of implementation of duplicate prescription forms Baseline chart review – 67 charts Duplicate prescription form: 1 week = 50 charts; 40 months = 60 charts	Ambulatory family practice	Baseline: 51 patients (76%) had prescribed medications with 87% of charts with incomplete or no documentation 1 week: 83% of charts had complete prescription medication documentation 40 Months: 82% of charts had complete prescription medication documentation
Moore 2003[23]	Determine prevalence of medical errors from inpatient to outpatient setting	Descriptive study of 86 patients inpatient and ambulatory medical records	950 bed urban teaching hospital and affiliated primary care practice	42% of patients had at least 1 medication continuity error
Nickerson 2005[18]	Determine clinical impact on drug therapy problems (DTP) of pharmacist review of discharge medications at discharge	Randomized clinical trial with 6 month followup of 253 patients	2 inpatient family practice units	Pharmacist intervened in 481DTP with average per patient of 3.49. Control group retrospective chart review found 56% had DTP
Paquette-Lamontagne 2002[25]	Improve accuracy of patient profile information in community pharmacies with use of discharge prescription forms	Quasi experimental intervention with 89 patients	Medical units in 3 teaching hospitals	82% of medication profiles in experimental group were complete as compared to 40% in control group
Pronovost 2003[20]	Reduce medication errors with a reconciliation process using paper form at discharge fro surgical ICU	Intervention using paper medication discharge form for ICU discharges	Surgical ICU	At baseline 94% of discharge orders were changed due to discrepancies. At Week 24 discharge error rate was 0
Pronovost 2004[21]	Reduce medication errors with a reconciliation process using an electronic form at discharge from surgical ICU	Intervention using electronic medication discharge form for ICU discharges	1,455 patients in surgical ICU over 1 year period	21% of patients required medication order change. 6% due to allergy discrepancy

Study	Aim	Design & Sample	Site	Outcome
Rozich 2001[15] Rozich 2004[3]	Reduce medication discrepancies at health care transition points through the implementation of a medication reconciliation process on admission, during transfer and at discharge from the hospital	Descriptive study of implementation of medication reconciliation process	Acute care inpatient units Baseline 20 charts per week for 6 weeks the ongoing chart review	Baseline medication discrepancy rate 213 per 100 admissions. 7 month post introduction of reconciliation process rate was 42 per 100 admissions.
Vira 2006[13]	Describe potential impact of medication reconciliation process to identify and rectify errors at time of hospital admission and discharge	60 randomly selected patients. Compared admission medication orders with patient medication vials and interviews with patients, caregivers and outpatient health care providers. At discharge, pre-admission and in patient medications compared with discharge orders and written instructions.	Inpatient community hospital	60% of patients had minimum of 1 unintended variance with 18% having minimum of 1 clinically important variance. None were detected outside of reconciliation process
Wagner 1996[26]	Assess correspondence between medications the patient taking and documentation in EMR	Descriptive comparison of patient report and chart review study of 312 medical records	Outpatient geriatric center	Mean number of medications per patient: 5.67 Mean number of medications listed in EMR: 4.69 Missing medication recording attributed to patient misreport (36%) and MD/NP failure to note medication changes in EMR (26%)
Whittington 2004[30]	Reduce percentage of admission ADEs caused by errors in reconciliation through use of admission reconciliation form as hospital medication record and discharge prescription form	Descriptive study of implementation of medication reconciliation process Number of patients enrolled not reported	4 hospitals	Change from 45% to 95% accuracy of medication list on implementation of reconciliation process.
Winterstein 2006[35]	Evaluate medication safety infrastructure of critical-access hospitals in Florida	Qualitative assessments using self-administered survey and site visits of 7 hospitals.	7 critical access hospitals in Florida	Characteristics targeted for quality improvement included medication reconciliation. Admission medications infrequently reviewed, and readmissions were associated with higher prevalence of medication errors