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Improving medication safety during hospital-based transitions of care

ABSTRACT

Medication errors are common during transitions of care such as hospital admission and discharge. Problems range from minor discrepancies to actual patient harm. A systematic routine for medication reconciliation can minimize errors, thereby preventing adverse drug events and improving patient safety.

KEY POINTS

Institutional medication reconciliation programs should include taking a best-possible medication history at admission, intervening when patients are at high risk, and involving pharmacy staff when possible.

Clinicians can incorporate additional interventions into their workflows to optimize medication safety for hospitalized patients.

Reviewing the medication list for errors of omission and commission, patient-specific needs, and "high-alert" drugs further decreases the risk of medication errors.

At discharge, patients should receive counseling to ensure understanding of medications and follow-up plans. Hospital physicians should communicate with outpatient providers about medications and rationales for medication changes.

ANY TIME PATIENTS ENTER OR LEAVE the hospital, they risk being harmed by errors in their medications.¹ Adverse events from medication errors during transitions of care are common but often preventable. One key approach is to systematically review every patient's medication list on admission and discharge and resolve any discrepancies. These transitions are also an opportunity to address other medication-related problems, such as adherence, drug interactions, and clinical appropriateness.

This article summarizes the types and prevalence of medication problems that occur during hospital-based transitions of care, and suggests strategies to decrease the risk of medication errors, focusing on medication reconciliation and related interventions that clinicians can use at the bedside to improve medication safety.

DEFINING TERMS

A *medication discrepancy* is any variance noted in a patient's documented medication regimen across different medication lists or sites of care. While some differences reflect intentional and clinically appropriate changes to the regimen, others are unintentional and reflect inaccurate or incomplete information. These unintentional discrepancies are *medication errors*.

Depending on the clinical circumstances and medications involved, such errors may lead to an *adverse drug event* (ADE), defined as actual harm or injury resulting from a medication. Sometimes a medication error does not cause harm immediately but could if left uncorrected; this is called a *potential ADE*.

An important goal during transitions of care is to reduce unintentional medication

TABLE 1

Barriers to successful medication reconciliation

Patient factors

- Limited knowledge of medications
- Low health literacy
- Cognitive impairment
- Not keeping an updated medication list
- Not bringing medications or a list to health care visits

Provider factors

- Limited time, competing demands
- Limited skills and knowledge in taking a medication history
- Lack of “buy-in”
- Insufficient knowledge of medications
- Ambiguity regarding “ownership” of outpatient medications
- Multiple providers and specialists involved in care

System factors

- Unclear roles and expectations
- Insufficient staffing
- Limited resources for information technology
- Electronic tools not well designed, do not facilitate documentation and reconciliation of medications
- Increasing numbers of handoffs
- Failure to integrate processes into providers’ workflow
- Multiple (often conflicting) sources of medication information
- Competing priorities, such as other quality improvement initiatives

discrepancies, thereby reducing potential and actual ADEs.

■ ERRORS ARISE AT DISCHARGE—AND EVEN MORE AT ADMISSION

Hospital discharge is a widely recognized transition in which patient harm occurs. As many as 70% of patients may have an unintentional medication discrepancy at hospital discharge, with many of those discrepancies having potential for harm.² Indeed, during the first few weeks after discharge, 50% of patients have a clinically important medication error,³ and 20% experience an adverse event, most commonly an ADE.⁴ ADEs are associated with excess health care utilization,⁵⁻⁷ and many are preventable through strategies such as medication reconciliation.^{5,8}

Importantly, more errors arise at hospital admission than at other times.^{9,10}

Errors in medication histories are the most common source of discrepancies, affecting up

to two-thirds of admitted patients.^{11,12} More than one-quarter of hospital prescribing errors can be attributed to incomplete medication histories at the time of admission,¹³ and nearly three times as many clinically important medication discrepancies are related to history-taking errors on admission rather than reconciliation errors at discharge.⁹

Most discrepancies occurring at the time of admission have the potential to cause harm, particularly if the errors persist beyond discharge.¹⁴ Therefore, taking a complete and accurate medication history on hospital admission is critical to ensuring safe care transitions.

■ MEDICATION RECONCILIATION: BARRIERS AND FACILITATORS

Medication reconciliation is a strategy for reducing medication discrepancies in patients moving across care settings. Simply put, it is the process by which a patient’s medication list is obtained, compared, and clarified across different sites of care.¹⁵ It has consistently been shown to decrease medication errors compared with usual care,¹⁶ and it is strongly supported by national and international organizations.¹⁷⁻²¹

In clinical practice, many physicians and institutions have found medication reconciliation difficult to implement, owing to barriers at the level of the patient, provider, and system (TABLE 1). In response to these challenges, two initiatives have synthesized best practices and offer toolkits that hospitals and clinicians can use: the Medications at Transitions and Clinical Handoffs (MATCH) program²² and the Multi-Center Medication Reconciliation Quality Improvement Study (MARQUIS).²³

Lack of resources is a widely acknowledged challenge. Thus, the MARQUIS investigators²³ suggested focusing on the admission history, where most errors occur, and applying the most resource-intensive interventions in patients at highest risk of ADEs, ie, those who are elderly, have multiple comorbid conditions, or take numerous medications.¹⁶

Although the risk of an ADE increases with the number of medications a patient takes,⁴ the exact number of drugs that defines high risk has not been well established. Targeting patients who take 10 or more maintenance medications

TABLE 2

Framework for optimizing medication management

Step	Skills and considerations
Obtain a good preadmission medication list	Take a best-possible medication history Leverage information systems
Avoid reconciliation errors	Prevent errors of omission Prevent errors of commission Recognize therapeutic duplication
Review the medication list in the context of the patient's clinical picture	Consider patient and disease factors Assess potentially inappropriate medications Comply with evidence-based guidelines
Prepare the patient and follow-up provider	Identify and address barriers to adherence Provide anticipatory guidance and follow-up

is a reasonable initial approach,²⁴ but institutions should tailor risk stratification to their patient populations and available resources. Patients taking high-risk medications such as anticoagulants and insulin could also be prioritized for review, since these medications are more likely to cause serious patient harm when used without appropriate clinical oversight.⁷

Using pharmacy staff to perform medication history-taking, reconciliation, and patient counseling has been shown to produce favorable patient outcomes, particularly for higher-risk patients.^{16,23}

The MARQUIS investigators found they could boost the chances of success by sharing stories of patient harm to foster “buy-in” among frontline staff, providing formal training to clinicians on how to take a medication history, and obtaining the support of nursing leaders to champion improvement efforts.²³

Additionally, patients should be empowered to maintain an accurate medication list. We address strategies for improving patient engagement and adherence in a later section.

■ BEST PRACTICES FOR IMPROVING MEDICATION SAFETY

Medication reconciliation is one of several measures necessary to optimize medication safety during transitions of care. It typically includes the following actions:

- Interview the patient or caregiver to de-

termine the list of medications the patient is currently taking (or supposed to be taking); consult other sources if needed.

- List medications that are being ordered during the clinical encounter.
- Compare these two lists, making note of medications that are stopped, changed, or newly prescribed.
- Resolve any discrepancies.
- Communicate the reconciled list to the patient, appropriate caregivers, and providers of follow-up care.

At a rudimentary level, medication reconciliation encompasses medication list management along the continuum of care. However, we recommend leveraging medication reconciliation as an opportunity to further enhance medication safety by reviewing the appropriateness of each medication, seizing opportunities to streamline or simplify the regimen, assessing patient and caregiver understanding of medication instructions and potential ADEs, and delivering appropriate counseling to enhance medication use. **TABLE 2** outlines our framework for medication management during hospital-based transitions.

■ STEP 1: OBTAIN A COMPLETE PREADMISSION MEDICATION LIST

The “best-possible medication history” is obtained in a systematic process of interviewing the patient or caregiver plus reviewing at least

Risk factors for adverse drug events:
Age
Comorbid conditions
Polypharmacy

TABLE 3

Questions to elicit a best-possible medication history

Start with an open-ended inquiry about home medications

Tell me what medications you take at home and how you take them.

Ask about as-needed medications

Which medicines do you take only sometimes?
How many doses per week do you take?
Do you take something for headaches? Allergies? To help you fall asleep? For heartburn?

Assess the purpose of each medication

What is each medicine for?
Do you take any other medicines for that?

Ask about medications for specific conditions the patient has

What medicines do you take for your [high blood pressure, diabetes, etc]?

Ask about medications prescribed by subspecialists

Does your [lung doctor] prescribe any medicine for you?

Ask about medications that are easy to forget

Do you take any inhalers, nebulizers, nasal sprays, ointments, creams, eye drops, ear drops, patches, injections, or suppositories?
Do you take any medicines once a week or once a month?

Ask about nonprescription products

Which medicines do you take that don't require a prescription? (over-the-counter, herbal, vitamins, supplements)

Assess recent medication use and adherence nonjudgmentally

Many patients have difficulty taking their medications exactly as they should every day. How often do you miss a dose of your medications? In the last 7 days, how many times have you missed a dose of [medication]?
Tell me about any problems you have had taking your medicines as prescribed.

one other reliable source.²³ The resulting list should include all medications the patient is taking (prescription and nonprescription), doses, directions for use, formulations if applicable, indications, start and stop dates, and medication allergies and reactions.

Review existing information. Before eliciting a history from the patient, review his or her recorded medical history and existing medication lists (eg, prior discharge summa-

ries, records from other facilities, records from outpatient visits, pharmacy fill data). This will provide context about the regimen and help identify issues and questions that can be addressed during the history-taking.

Ask open-ended questions. Instead of just asking the patient to confirm the accuracy of the existing medication list, we recommend actively obtaining the full medication list from the patient or caregiver. The conversation should begin with an open-ended question such as, "What medications do you take at home?" This approach will also allow the clinician to gauge the patient's level of understanding of each medication's indication and dosing instructions. Using a series of prompts such as those recommended in **TABLE 3** will elicit a best-possible medical history, while verifying all of the medications on the existing list.

Clarify discrepancies. Resolve differences between the existing medication lists and the patient's or caregiver's report during the pre-admission interview. Examples include errors of omission (a medication is missing), errors of commission (an additional medication is present), and discrepancies in the strength, formulation, dosing instructions, and indications for the drugs. If necessary, other sources of information should be consulted, such as the patient's medication bottles, pharmacy or pharmacies, primary care physician, and a family member or caregiver.

Assess adherence. The extent to which patients take their medications as directed is an important component of the history, but is often left out. Medication nonadherence rates in the United States are 40% to 70%,²⁵ contributing to poor patient outcomes and imposing extraordinary costs on the health care system.²⁶

Asking open-ended, nonjudgmental questions at the time of hospital admission will help to uncover medication-taking behaviors as well as barriers to adherence (**TABLE 3**). The patient's responses should be taken into account when determining the treatment plan.

Document your findings. After completing the medication history and clarifying discrepancies, document the preadmission list in the medical record. All members of the health care team should have access to view and update the same list, as new information about

the preadmission medications may be uncovered after the initial history.

Make clinical decisions. Complete the admission medication reconciliation by deciding whether each medication on the list should be continued, changed, held, or discontinued on the basis of the patient's clinical condition. Well-designed information technology applications enable the provider to document each action and the rationale for it, as well as carry that information into the order-entry system. Medications marked as held or discontinued on admission should be revisited as the patient's clinical condition changes and at discharge.

■ STEP 2: AVOID RECONCILIATION ERRORS

Reconciliation errors reflect discrepancies between the medication history and the medications that are ordered after admission.

Reconciliation errors are less common than medication history errors, accounting for approximately one-third of potentially harmful medication errors in hospitalized medical patients.⁹ These include errors of omission (a medication is omitted from the orders), errors of commission (a medication is prescribed with no indication for continuation), and therapeutic duplication.

Preventing errors of omission

Medications are often held at transition points for appropriate clinical reasons. Examples include holding anticoagulants and antiplatelet agents in patients who have gastrointestinal bleeding or an upcoming procedure, antihypertensives in patients with hemodynamic instability, and other chronic medications in patients with an acute illness.

Poor documentation and communication of these decisions can lead to a failure to resume the medications—an error of omission—at hospital discharge.

Hospitalized patients are at risk of unintentional discontinuation of their chronic medications, including antiplatelet drugs, anticoagulants, statins, and thyroid replacement, particularly if admitted to the intensive care unit.¹² These errors can be minimized by a standardized medication reconciliation process at each transition and clear documentation of the medication plan.

Communication among providers can be improved if the admitting clinician documents clearly whether each preadmission medication is being continued, changed, or stopped, along with the reason for doing so, and makes this information available throughout the hospital stay. Upon transfer to another unit and at discharge, the physician should review each preadmission medication that was held and the patient's current clinical status and, based on that information, decide whether medications that were held should be resumed. If a medication will be restarted later, specific instructions should be documented and communicated to the patient and the physicians who are taking over his or her care.

Preventing errors of commission

Failure to perform a complete reconciliation at each transition of care and match each medication with an appropriate indication can lead to errors of commission.

One study showed that 44% of patients were prescribed at least one unnecessary drug at hospital discharge, one-fourth of which were started during the hospitalization.²⁷ Commonly prescribed unnecessarily were gastrointestinal agents, central nervous system drugs, nutrients, and supplements.

It is critical to assess each medication's ongoing need, appropriateness, and risk-benefit ratio at every transition. Medications no longer indicated should be discontinued in order to simplify the regimen, avoid unnecessary drug exposure, and prevent ADEs.

For example, proton pump inhibitors or histamine 2 receptor blockers are often started in the hospital for stress ulcer prophylaxis. One-third of patients are then discharged home on the medication, and 6 months later half of those patients are still taking the unnecessary drug.²⁸ This situation can be avoided by limiting use of these medications to appropriate circumstances, clearly marking the indication as stress ulcer prophylaxis (as opposed to an ongoing condition that will require continuing it after discharge), and discontinuing the agent when appropriate.

All drugs, even common and seemingly benign ones, carry some risk and should be discontinued when no longer needed. Thus, medications added during the hospitalization

All drugs carry some risk and should be discontinued when no longer needed

TABLE 4

Provide clear, patient-centered medication lists

Include the brand name and generic name of each drug

Include the indication for use, when possible

Simplify language, avoid medical jargon
(eg, use “high blood pressure” rather than “hypertension”)

Simplify dosing to no more than four times a day—
morning, noon, evening, bedtime

Use numerals (“2” instead of “two”) when applicable

Use explicit text to describe dosage interval in instructions
(eg, “Take 2 in the morning and 2 in the evening” rather than
“Take 2 tablets twice daily”)

Improve typography

Use an easy-to-read typeface (eg, Arial or Times New Roman),
and an easily readable type size (ie, at least 12-point type)
Do not use ALL CAPS

Use the patient’s preferred language

INFORMATION FROM REFERENCES 22 AND 23.

Acute kidney injury often necessitates adjusting or discontinuing medications

to control acute symptoms should also be reviewed at each transition to prevent inappropriate continuation when symptoms have resolved.

One study, for example, found that many patients were discharged with inappropriate prescriptions for atypical antipsychotics after receiving them in the intensive care unit, likely for delirium.²⁹ Documenting that an acute issue such as delirium has resolved should prompt the discontinuation of therapy.

Preventing therapeutic duplication

Therapeutic duplication occurs in about 8% of discharges.¹ These errors often result from formulary substitutions or altering the dosage form in the acute setting. For example, patients who receive a prescription for the substituted agent at discharge and also resume their prehospitalization medications end up with duplicate therapy.

Therapeutic substitution is common at the time of admission to the hospital as a result of formulary restrictions. Drug classes that are frequently substituted include statins, anti-

hypertensives, urinary antispasmodics, and proton pump inhibitors. Physicians should be familiar with the preferred agents on the hospital formulary and make careful note when a substitution occurs. Furthermore, hospital systems should be developed to remind the physician to switch back to the outpatient medication at discharge.

Similar problems occur when home medications are replaced with different dosage forms with different pharmacokinetic properties. For example, a long-acting medication may be temporarily replaced with an intravenous solution or immediate-release tablet for several reasons, including nothing-by-mouth status, unstable clinical condition, need for titration, and need to crush the tablet to give the drug per tube. The differing formulations must be reconciled throughout the patient’s hospital course and at discharge to avoid therapeutic duplication and serious medication errors. Deliberate changes to the dosage form should be clearly communicated in the discharge medication list so that patients and other clinicians are aware.

Hospital systems should also have the capability to identify duplications in the medication list and to warn prescribers of these errors. The ability to group medications by drug class or sort the medication list alphabetically by generic name can help uncover duplication errors.

STEP 3: REVIEW THE LIST IN VIEW OF THE CLINICAL PICTURE

Transitions of care should prompt providers to review the medication list for possible drug-disease interactions, confirm compliance with evidence-based guidelines, and evaluate the risks and benefits of each medication in the context of the patient’s age and acute and chronic medical issues. This is also an opportunity to screen the full list for potentially inappropriate medications and high-alert drugs such as insulin or anticoagulants, which are more likely than other drugs to cause severe harm when used in error.

Acute kidney injury. New drug-disease interactions can arise during a hospitalization and can affect dosing and the choice of drug. The onset of acute kidney injury, for example,

often necessitates adjusting or discontinuing nephrotoxic and renally excreted medications. ADEs or potential ADEs have been reported in 43% of hospitalized patients with acute kidney injury.³⁰

Because acute kidney injury is often transient, medications may need to be held or adjusted several times until renal function stabilizes. This can be challenging across the continuum of care and requires close monitoring of the serum creatinine level and associated drug doses and levels, if applicable. Well-designed clinical decision support tools can integrate laboratory data and alert the prescriber to a clinically important increase or decrease in serum creatinine that may warrant a change in therapy. Modifications to the regimen and a plan for timely follow-up of the serum creatinine level should be clearly documented in the discharge plan.

Liver disease. Similar attention should be given to drugs that are hepatically metabolized if a patient has acute or chronic liver impairment.

Geriatric patients, particularly those who present with altered mental status, falls, or urinary retention, should have their medication list reviewed for potentially inappropriate medications, which are drugs that pose increased risk of poor outcomes in older adults.^{31,32} Patients and providers may have been willing to accept the risk of medications such as anticholinergics or sedative-hypnotics when the drugs were initiated, but circumstances can change over time, especially in this patient population. Hospitalization is a prime opportunity to screen for medications that meet the Beers criteria³¹ for agents to avoid or use with caution in older adults.

As-needed medications. Medications prescribed on an as-needed basis in the hospital should be reviewed for continuation or discontinuation at discharge. How often the medication was given can inform this decision.

For example, if as-needed opioids were used frequently, failure to develop a plan of care for pain can lead to persistent symptoms and, possibly, to readmission.^{33,34} Similar scenarios occur with use of as-needed blood pressure medications, laxatives, and correction-dose insulin.

TABLE 5

Barriers to adherence and suggested solutions

Access to medications

Prescribe inexpensive generic drugs or the lowest-tiered agents on prescription benefit plan
Simplify the regimen—discontinue unnecessary medications
Make sure the patient has prescriptions at discharge
Schedule follow-up appointments for refills
Encourage use of a single pharmacy
Arrange transportation to the pharmacy, engage a secure delivery service, or use a mail-order pharmacy

Forgetting to take medications

Simplify the regimen (fewer daily doses)
Use long-acting formulations
Encourage use of a pill box or reminders

Low health literacy

Incorporate picture-based education
Use “teach-back”

Adverse effects

Provide education, including what to do if adverse effects occur

If an as-needed medication was used consistently during hospitalization, the physician should consider whether a regularly scheduled medication is needed. Conversely, if the medication was not used during the inpatient admission, it can likely be discontinued.

STEP 4: PREPARE THE PATIENT AND FOLLOW-UP PROVIDER

Once a clinician has performed medication reconciliation, including obtaining a best-possible medical history and carefully reviewing the medication list and orders for errors and clinical appropriateness, the next steps are to ensure the patient understands what he or she needs to do and to confirm that suitable follow-up plans are in place. These measures should be taken at all transitions of care but are critically important at hospital discharge.

Preparing the patient and caregiver

An accurate, reconciled medication list should be given to the patient, caregiver, or both, and should be reviewed before discharge.¹⁷

Approximately one-third of Americans

Patients recall and comprehend about half of information provided during a medical encounter

TABLE 6

Tips for conducting medication reconciliation during a postdischarge phone call

Confirm with the patient or caregiver before discharge:

Best day and time of day to call

Phone number where he or she can be reached in the week after discharge, especially if different from the home phone number

Arrange for interpreter services before making the call, if applicable

Review the preadmission medication list, hospital course, and discharge medication list before making the phone call. Note the following:

Medications changed during the hospitalization (new, held, changed, discontinued)

Medications requiring follow-up (laboratory tests, medications that need to be resumed)

Potential barriers to access or adherence identified during the hospitalization

Instruct the patient to bring all medication bottles to the phone and review them one by one

Use a script to prompt the following questions:

Were you able to fill all of your new medication prescriptions after leaving the hospital?

Do you have refills for your medications when they run out?

What problems are you having taking your medications?

Use “teach-back” to reinforce key points

have low health literacy skills, so medication lists and associated materials should be easy to understand.³⁵ Medication lists should be written in plain language and formatted for optimal readability (TABLE 4), clearly stating which medications to continue, change, hold temporarily, and stop.

Patients recall and comprehend about half of the information provided during a medical encounter.³⁶ Thus, medication teaching should focus on key points including changes or additions to the regimen, specific instructions for follow-up and monitoring, and how to handle common and serious side effects.

To confirm patient understanding, clinicians should use “teach-back,” ie, provide the

patient with information and then ask him or her to repeat back key points.^{37,38} The patient and family should also be encouraged to ask questions before discharge.

If not already addressed during the hospital stay, barriers to medication adherence and ability to obtain the medications should be attended to at this time (TABLE 5). Also, the plan to pick up the medications should be verified with the patient and caregiver. Verify that there is transportation to a particular pharmacy that is open at the time of discharge, and that the patient can afford the medications.

Ensuring appropriate follow-up

Studies have shown that timely in-home or telephone follow-up after discharge can decrease adverse events and postdischarge health care utilization.^{39,40} Telephone follow-up that includes thorough medication reconciliation can help detect and resolve medication issues early after discharge and can close gaps related to monitoring and follow-up.

Medication reconciliation by telephone can be time-consuming. Depending on the number of medications that need to be reviewed, calls can take between 10 and 60 minutes. Postdischarge phone calls should be performed by clinical personnel who are able to identify medication-related problems. A pharmacist should be an available resource to assist with complex regimens, to help resolve medication discrepancies, and to address patient concerns. TABLE 6 provides tips for conducting follow-up phone calls.

Resolving discrepancies identified during follow-up calls can be difficult, as changes to the medication regimen are often not communicated effectively to other members of the care team. Physicians should document the complete medication list and plan in the discharge summary, and there should be a method for the caller to record updates to the medication list in the medical record so that they are apparent at the outpatient follow-up visit.

An additional challenge is that it is frequently unclear which physician “owns” which medications. Therefore, designating a contact person for each medication until follow-up can be very valuable. At a minimum, a “physician owner” for high-alert medications such as insulin, anticoagulants, and diuretics

should be identified to provide close follow-up, titration, and monitoring.

There should also be a plan for the patient to obtain refills of essential long-term medications, such as antiplatelet agents following stent placement.

SUMMARY AND RECOMMENDATIONS

Medication-related problems during hospital admission and discharge are common and range from minor discrepancies in the medication list to errors in history-taking, prescribing, and reconciliation that can lead to potential or actual patient harm. Putting systems in place to facilitate medication reconciliation can decrease the occurrence of medication discrepancies and ADEs, thereby improving patient safety during these critical transitions between care settings and providers. Institutional medication reconciliation programs should focus resources on the admission history-taking step, target the highest-risk patients

for the most intensive interventions, and involve pharmacy personnel when possible.

On an individual level, clinicians can incorporate additional interventions into their workflows to optimize medication safety for hospitalized patients. Using a structured approach to obtain a complete and accurate medication list at the time of hospital admission will help providers identify medication-related problems and prevent the propagation of errors throughout the hospital stay and at discharge. Focusing additional time and effort on a comprehensive review of the medication list for errors of omission and commission, patient-specific needs, and high-alert drugs will further decrease the risk of medication errors. Finally, providing discharge counseling targeting patient barriers to adherence and ensuring a proper handover of medication information and rationale for medication changes to outpatient providers will improve the chances of a safe transition.

REFERENCES

- Coleman EA, Smith JD, Raha D, Min SJ. Posthospital medication discrepancies: prevalence and contributing factors. *Arch Intern Med* 2005; 165:1842–1847.
- Wong JD, Bajcar JM, Wong GG, et al. Medication reconciliation at hospital discharge: evaluating discrepancies. *Ann Pharmacother* 2008; 42:1373–1379.
- Kripalani S, Roumie CL, Dalal AK, et al; PILL-CVD (Pharmacist Intervention for Low Literacy in Cardiovascular Disease) Study Group. Effect of a pharmacist intervention on clinically important medication errors after hospital discharge: a randomized trial. *Ann Intern Med* 2012; 157:1–10.
- Forster AJ, Murff HJ, Peterson JF, Gandhi TK, Bates DW. The incidence and severity of adverse events affecting patients after discharge from the hospital. *Ann Intern Med* 2003; 138:161–167.
- Forster AJ, Murff HJ, Peterson JF, Gandhi TK, Bates DW. Adverse drug events occurring following hospital discharge. *J Gen Intern Med* 2005; 20:317–323.
- Johnson JA, Bootman JL. Drug-related morbidity and mortality. A cost-of-illness model. *Arch Intern Med* 1995; 155:1949–1956.
- Budnitz DS, Lovegrove MC, Shehab N, Richards CL. Emergency hospitalizations for adverse drug events in older Americans. *N Engl J Med* 2011; 365:2002–2012.
- Bates DW, Boyle DL, Vander Vliet MB, Schneider J, Leape L. Relationship between medication errors and adverse drug events. *J Gen Intern Med* 1995; 10:199–205.
- Pippins JR, Gandhi TK, Hamann C, et al. Classifying and predicting errors of inpatient medication reconciliation. *J Gen Intern Med* 2008; 23:1414–1422.
- Lau HS, Florax C, Porsius AJ, De Boer A. The completeness of medication histories in hospital medical records of patients admitted to general internal medicine wards. *Br J Clin Pharmacol* 2000; 49:597–603.
- Tam VC, Knowles SR, Cornish PL, Fine N, Marchesano R, Etchells EE. Frequency, type and clinical importance of medication history errors at admission to hospital: a systematic review. *CMAJ* 2005; 173:510–515.
- Bell CM, Brener SS, Gunraj N, et al. Association of ICU or hospital admission with unintentional discontinuation of medications for chronic diseases. *JAMA* 2011; 306:840–847.
- Dobranski S, Hammond I, Khan G, Holdsworth H. The nature of hospital prescribing errors. *Br J Clin Governance* 2002; 7:187–193.
- Gleason KM, Groszek JM, Sullivan C, Rooney D, Barnard C, Noskin GA. Reconciliation of discrepancies in medication histories and admission orders of newly hospitalized patients. *Am J Health Syst Pharm* 2004; 61:1689–1695.
- Rozich JD, Resar KR. Medication safety: one organization's approach to the challenge. *J Clin Outcomes Manage* 2001; 8:27–34.
- Mueller SK, Sponsler KC, Kripalani S, Schnipper JL. Hospital-based medication reconciliation practices: a systematic review. *Arch Intern Med* 2012; 172:1057–1069.
- Joint Commission. Using medication reconciliation to prevent errors. *Sentinel Event Alert* 2006, Issue 35. www.jointcommission.org/assets/1/18/SEA_35.pdf. Accessed March 31, 2015.
- Greenwald JL, Halasyamani L, Greene J, et al. Making inpatient medication reconciliation patient centered, clinically relevant and implementable: a consensus statement on key principles and necessary first steps. *J Hosp Med* 2010; 5:477–485.
- Berwick DM, Calkins DR, McCannon CJ, Hackbarth AD. The 100,000 lives campaign: setting a goal and a deadline for improving health care quality. *JAMA* 2006; 295:324–327.
- McCannon CJ, Hackbarth AD, Griffin FA. Miles to go: an introduction to the 5 Million Lives Campaign. *Jt Comm J Qual Patient Saf* 2007; 33:477–484.
- Leotsakos A, Caisley L, Karga M, Kelly E, O'Leary D, Timmons K. High 5s: addressing excellence in patient safety. *World Hosp Health Serv* 2009; 45:19–22.
- Gleason KM, Brake H, Agramonte V, Perfetti C. Medications at Transitions and Clinical Handoffs (MATCH) Toolkit for Medication Reconciliation. www.ahrq.gov/professionals/quality-patient-safety/patient-safety-resources/resources/match/match.pdf. Accessed March 31, 2015.
- Mueller SK, Kripalani S, Stein J, et al. A toolkit to disseminate best practices in inpatient medication reconciliation: multi-center medication reconciliation quality improvement study (MARQUIS). *Jt Comm J Qual Patient Saf* 2013; 39:371–382.
- Pal A, Babbott S, Wilkinson ST. Can the targeted use of a discharge pharmacist significantly decrease 30-day readmissions? *Hosp Pharm*

MEDICATION SAFETY DURING TRANSITIONS

- 2013; 48:380–388.
25. **Claxton AJ, Cramer J, Pierce C.** A systematic review of the associations between dose regimens and medication compliance. *Clin Ther* 2001; 23:1296–1310.
26. **Osterberg L, Blaschke T.** Adherence to medication. *N Engl J Med* 2005; 353:487–497.
27. **Hajjar ER, Hanlon JT, Sloane RJ, et al.** Unnecessary drug use in frail older people at hospital discharge. *J Am Geriatr Soc* 2005; 53:1518–1523.
28. **Zink DA, Pohlman M, Barnes M, Cannon ME.** Long-term use of acid suppression started inappropriately during hospitalization. *Aliment Pharmacol Ther* 2005; 21:1203–1209.
29. **Morandi A, Vasilevskis E, Pandharipande PP, et al.** Inappropriate medication prescriptions in elderly adults surviving an intensive care unit hospitalization. *J Am Geriatr Soc* 2013; 61:1128–1134.
30. **Cox ZL, McCoy AB, Matheny ME, et al.** Adverse drug events during AKI and its recovery. *Clin J Am Soc Nephrol* 2013; 8:1070–1078.
31. **American Geriatrics Society 2012 Beers Criteria Update Expert Panel.** American Geriatrics Society updated Beers Criteria for potentially inappropriate medication use in older adults. *J Am Geriatr Soc* 2012; 60:616–631.
32. **Gallagher P, O'Mahony D.** STOPP (Screening Tool of Older Persons' potentially inappropriate Prescriptions): application to acutely ill elderly patients and comparison with Beers' criteria. *Age Ageing* 2008; 37:673–679.
33. **Tjia J, Bonner A, Briesacher BA, McGee S, Terrill E, Miller K.** Medication discrepancies upon hospital to skilled nursing facility transitions. *J Gen Intern Med* 2009; 24:630–635.
34. **Boockvar K, Fishman E, Kyriacou CK, Monias A, Gavi S, Cortes T.** Adverse events due to discontinuations in drug use and dose changes in patients transferred between acute and long-term care facilities. *Arch Intern Med* 2004; 164:545–550.
35. **Kutner M, Greenberg E, Jin Y, Paulsen C.** The Health Literacy of America's Adults: Results From the 2003 National Assessment of Adult Literacy. http://nces.ed.gov/pubst2006/2006483_1.pdf. Accessed March 31, 2015.
36. **Crane JA.** Patient comprehension of doctor-patient communication on discharge from the emergency department. *J Emerg Med* 1997; 15:1–7.
37. **DeWalt DA, Callahan LF, Hawk VH, et al.** Health Literacy Universal Precautions Toolkit. www.ahrq.gov/qual/literacy/healthliteracytoolkit.pdf. Accessed March 31, 2015.
38. **Schillinger D, Piette J, Grumbach K, et al.** Closing the loop: physician communication with diabetic patients who have low health literacy. *Arch Intern Med* 2003; 163:83–90.
39. **Coleman EA, Parry C, Chalmers S, Min SJ.** The care transitions intervention: results of a randomized controlled trial. *Arch Intern Med* 2006; 166:1822–1828.
40. **Jack BW, Chetty VK, Anthony D, et al.** A reengineered hospital discharge program to decrease rehospitalization: a randomized trial. *Ann Intern Med* 2009; 150:178–187.

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