Teaching Medication Reconciliation Through Simulation: A Patient Safety Initiative for Second Year Medical Students

Lee A. Lindquist, MD MPH^{1,3}, Kristine M. Gleason, RPh², Molly R. McDaniel, PharmD², Allan Doeksen, BA¹, and David Liss, BA¹

¹Northwestern Center for Patient Safety, Institute for Health Care Studies, Northwestern University Feinberg School of Medicine, Chicago, IL, USA; ²Northwestern Memorial Hospital, Chicago, IL, USA; ³Division of Geriatrics, Northwestern University Feinberg School of Medicine, Chicago, IL, USA.

INTRODUCTION: Errors in medication reconciliation constitute a large area of potential injury to patients. Medication reconciliation is rarely incorporated into medical school curriculums so students learn primarily from observing clinical care.

AIM: To design and implement an interactive learning exercise to teach second year medical students about medication reconciliation

SETTING: Northwestern University Feinberg School of Medicine, Chicago, IL

PROGRAM DESCRIPTION: The Medication Reconciliation Simulation teaches medical students how to elicit information from active real-world sources to reconcile a medication history.

PROGRAM EVALUATION: At the conclusion of the session, students completed a Likert scale survey rating the level of improvement in their knowledge and comfort in obtaining medication histories. Students rated their knowledge level as having increased by 27% and their comfort level as having increased by 20%. A full 91% of the 158 students felt that it should be performed again for the following medical student class.

DISCUSSION: The Medication Reconciliation Simulation is the first to specifically target medication reconciliation as a curriculum topic for medical students. Students praised the entertaining simulation and felt it provided a very meaningful experience on the patient safety topic. This simulation is generalizable to other institutions interested in teaching medication reconciliation and improving medication safety.

KEY WORDS: medication reconciliation; medical school curriculums; third year medical students.

J Gen Intern Med 23(7):998–1001

DOI: 10.1007/s11606-008-0567-3

© Society of General Internal Medicine 2008

INTRODUCTION

Physicians typically receive little formal education on obtaining medication histories and performing medication reconciliation throughout medical school. Students often start clinical years

with little knowledge or tools on how to obtain and reconcile medication histories. Routine use of safe medication prescribing behaviors among house staff and medical students is poor and likely caused by this inadequate training and a culture that does not support safe prescribing.^{1,2} Obtaining medication histories is a challenging, high-risk, error-prone activity.^{3–5}

Medication reconciliation is defined as a systematic validation and verification process to ensure accuracy and continuity in the patient's medication regimen from pre-hospital care through admission, transfer, and discharge to the next setting.^{6–9} The Joint Commission also recognized medication reconciliation as an important patient safety initiative and declared it a National Patient Safety Goal.¹⁰ Failures in medication reconciliation frequently incur medication errors, which may be harmful to patients.^{9,11–13} Evidence supports that medication reconciliation is an effective and safe practice to reduce medication errors and the potential for patient harm.¹⁴

AIM

We propose that through teaching the importance of and providing the necessary tools for obtaining an accurate medication history, students will make fewer prescribing errors as physicians. An initial step is to engage students in the problem and the process. This article details a highly interactive curriculum to teach students how to obtain accurate medication histories and perform medication reconciliation.

DESCRIPTION: THE MEDICATION RECONCILIATION SIMULATION

The medication reconciliation simulation took place within an established curricular format for second year students in which issues around the patient, physician, and society are addressed. This overall course spans the entire second year. The medical school class is separated into 4 groups of 40 students. Each group of students has a separate afternoon within any given week, and meets for 2 hours. Our simulation occurred over 1 week, with each of the 4 groups rotating through on their scheduled day. At the time of the simulation, students had completed the first half of their second year, which included microbiology, hematology/oncology, nephrology, neurology, gastroenterology, genito-urinary systems, and endocrinology. Students had also completed the first half of their pharmacology lectures including antibacterials, immu-

nosuppressants, anti-virals, and medications related to the above subjects. While students had instruction on adverse reactions before this simulation, students had not received any instruction on safe prescribing or medication reconciliation.

The simulation was developed to fit this 2-hour format. The faculty for the course included a physician, pharmacist, and an actor playing the role of the patient. Materials for this session included 3 stopwatches (1 minute each), 3 hand flags for each student team, 1 brown bag of 5 pill bottles for half of the teams, 1 medication list for half of the teams, copies of prescription inserts, 2 sample medication packs for each team. The session was divided into 4 parts.

In the first part, the students received a 30-minute lecture by a pharmacist on the necessities of obtaining an accurate medication history and tools available for acquiring more information from pertinent sources. Strategies incorporated into the student lecture included: effectively phrasing questions to obtain medication information from patients, components of a thorough and complete medication list, sources to obtain medication histories, and steps to help identify unintended discrepancies. The second part involved the actress playing the role of an elderly woman “accidentally” entering the room interrupting the lecture trying to find her doctor or pharmacist as she had questions about her medications. The patient had been having red patches (ecchymoses) on the skin and felt “achy” all over. The patient attributed both of these symptoms to her medications. The pharmacist lecturer then sat down with the patient and “helped” by starting a medication history (see Table 1 for the actual script). After 10 minutes of medication-history taking, a partial list from the patient had been obtained.

Table 1. Script for Initial Medication History Taking from Pharmacist

Pharmacist Prompts	Patient Actor Answers
What medications are you taking?	I take about 8 pills in the morning after breakfast and 3 pills with dinner and 2 at night.
What are the names of your medicines?	I don't know them by memory, I have a list. You could call my daughter-in-law because she puts them in my pillbox. She should know but she's traveling through Europe. My doctor read this article about blood clots and started me on amikar. It's supposed to help. I've got more in my bag but I'll show them later after we talk more. They're way down at the bottom.
Do you know what your doses are?	Well, I take the smallest doses because my doctor says I'm very sensitive. Say, my doctor should have my medicine list so why don't you call her?
Where do you get your medications from?	We usually go to the pharmacy around the corner but last week we refilled a couple of my medications at a new pharmacy chain because they just opened and gave me a \$10 gift card.
Do you take any over the counter meds?	What do you mean over the counter? Like pharmacist counter?
Do you ever skip doses?	No.
What do you pay for your medications?	Last year I was on all expensive ones so I ran out in November. This year, my doctor switched me over to “generics”

The third part involved the students ‘helping’ and participating in the medication history/reconciliation taking process. Students were then broken into teams of 3 to 4. They were given 40 minutes to come up with an accurate medication list. Each student team was given a docier with information on pertinent drugs from drug sources, a list of the rules, and a drug list template to complete.

Half of the student teams were given a medication list that the patient brought and the other half were given a “brown bag” with the patient’s medication (see Table 2). Student teams were allowed 20 minutes and then told to exchange the brown bag for a list or vice versa with another team. They then received another additional 20 minutes to continue working through the medication list with the additional information. Teams were also given 3 hand flags that represent “lifelines” that they could use only once. Each lifeline correlated with a 1-minute call/conversation to: (1) a community pharmacist, (2) the patient’s primary care doctor, or (3) another chance to ask the patient a few more questions. When the correct questions were asked, the community pharmacist, patient, and physician office gave the student teams the information listed under each perspective character in Table 3.

The conversation with the patient also involved the patient clarifying the dosing and frequency of the warfarin, simvastatin/ezetimibe (Vytorin), and lantus insulin. When requested, the patient was also able to explain that she was only taking a half pill of metoprolol as it is cheaper to split the 50 mg. When asked about any samples, the patient also pulled out of her tote bag sample packs of omega-3 fatty acid (Omacor) and galantamine, which her physician had given her. When asked about over-the-counter medications and vitamins, the patient admitted to taking omeprazole OTC and calcium.

When students felt that they had a complete medication list, they turned in their list, which could be earlier than the allotted time.

After the allotted 40 minutes had elapsed, the fourth part of the session began with the pharmacist bringing the students together, as a class, to review the complete medication list (see Table 3: The Perfect Medication List) as well as which of the medications were causing the earlier complaints of ecchymoses and muscle aches. The combination of the simvastatin/ezetimibe (Vytorin) and simvastatin, which the patient did not stop taking after the simvastatin/ezetimibe (Vytorin) was started, caused the muscle aches. The combination of the warfarin, aspirin, and the newly added samples of omega-3 fatty acid (Omacor) caused the ecchymoses. With our simulation, we gave the incentive that the group that completed an

Table 2. Initially Given Medication List and Medication “Brown Bag” Contents

Patient's Medication List (as of 10/06)	Brown Bag Contents
1. Simvastatin 1× a day	1. Toprol ×L 50 mg PO daily (old date)
2. Metoprolol 2× a day	2. Furosemide 20 mg PO qDay
3. Aspirin 1× a day	3. Warfarin 2 mg Po qDay as directed
4. Water Pill 1× a day	4. Levothyroxine 25 mcg PO qDay
5. Warfarin 2 on TThSS and 1 MWF	5. Simvastatin/Ezetimibe (Vytorin) 10/40 PO qDay (sample)
6. Levothyroxine 25 mg daily	
7. Insulin shots 1× a day	

Table 3. Medication Lists for Each Character and the Perfect Medication List

Community Pharmacy	Physician Office
Furosemide 20 mg PO qDay	Levothyroxine 0.025 mg PO qDay
Simvastatin 20 mg PO qDay (last filled 8/06)	Metoprolol 50 mg PO BID
Levothyroxine 25 mcg PO qDay	Furosemide 20 mg PO qDay
Toprol XL 25 mg PO qDay (filled 10/06)	Warfarin 2 mg PO qhs
Metoprolol 25 mg PO BID (filled 11/06)	Lantus Insulin 15 U qDay
Metoprolol 50 mg PO BID (filled 1/07)	Aspirin 81 mg PO qDay
Toprol XL 50 mg PO qDay (filled 10/06)	Omeprazole 20 mg PO qDay
Warfarin 2 mg PO qhs (filled 8/06)	Alendronate 70 mg PO qWeek
Amoxicillin 250 mg PO BID (filled 3/06)	Calcium with D 500 mg PO TID
Latanoprost 0.05% 1 qtts OS qDay (filled 1/07)	Galantamine starter pack given
Lantus Insulin 10 mL Vial Use as directed	Simvastatin/Ezetimibe (Vytorin) samples given
Insulin Syringes 1 Box	Omega-3 fatty acid (Omacor) samples given
Patient Tote Bag Contents	The Perfect Medication List
Warfarin 2 mg on TThSS and 1 mg MWF [dose]	Levothyroxine 25 mcg daily
Galantamine ER 8 mg daily (sample)	Metoprolol 25 mg twice daily
Omega-3 fatty acid (Omacor) 1 capsule daily (sample)	Furosemide 20 mg once daily
Calcium 500 mg with Vit D three times daily [frequency]	Warfarin 2 mg on TThSS and 1 mg MWF daily
Lantus insulin 20 units daily—[dose]	Lantus Insulin 20 U daily
	Aspirin 81 mg daily
	Alendronate 70 mg weekly
	Calcium with D 500 mg three times a day
	Galantamine ER 8 mg daily
	Simvastatin/Ezetimibe (Vytorin) 10/40 daily
	Omega-3 fatty acid (Omacor) daily
	Omeprazole 20 mg PO qDay
	Latanoprost 0.05% 1 qtts OS qDay

accurate medication list in the shortest amount of time received a prize.

Each day of the course, 37 to 43 students participated, and among the patient medication lists, there were only 4 groups that had reconciled “perfect medication lists”.

PROGRAM EVALUATION:

At the end of the exercise, students were asked to complete an anonymous survey. The survey was conducted using a retrospective pre-post 10-point Likert scale querying the perceived knowledge and comfort level with medication reconciliation among the participating students before and after the course. Each student was asked to complete a survey, and of the 170 students enrolled in the second year medical school class, 159 students completed the survey. Student self-reported changes pre- and post-course showed a mean increase of 27% (from 4.12 to 6.79, $p < .001$) in knowledge and a mean increase of

20% (from 4.53 to 6.48, $p < .001$) in comfort level using paired t tests.

Students rated the lecture, simulation, and overall appeal on a 5-point Likert scale. On a scale of poor (1), fair (2), good (3), very good (4), and excellent (5)—average scores were lecture 3.30, simulation 3.92, and overall appeal 3.60. Students were also asked in open-ended questions what were the best aspects and what areas could be improved. Responses were given by 83% (132) of the students and reviewed independently by 2 of the authors using content analysis for prevalent themes. Intraclass correlation was for positive responses 0.776 and improvement responses 0.763. Themes are presented in Table 4. In addition, students were queried if the course should be taught again for the following year. Of the medical students, 90.6% (144/159) felt that the course should be performed again for future medical school classes.

DISCUSSION

Errors in medication-history taking and medication reconciliation frequently result in injuries to patients. Medication errors make up a large portion of medical errors. It is surprising to note that very little education on this topic is performed in the curricula of medical schools. We created an active learning workshop that allowed students the opportunity to obtain medication histories and reconcile multiple sources of medication lists. This “simulation” emulates the real-world experience that many clinicians face when admitting patients into the hospital or seeing patients in the outpatient setting.

Overwhelmingly students felt the experience was very useful and illustrated how important it was to communicate clearly with pharmacists, patients, and other physicians. Students discussed ways of improving the process, which were incorporated throughout the week when possible. For instance, there was a long wait on the first day for a couple of the lifelines so an extra “pharmacist” and “physician assistant” were enlisted on the subsequent days.

Timing within the exercise was an issue heavily discussed. Students felt that they needed more time with the lifelines but because of time constraints and to emulate real world experience, we opted to maintain the 1 minute per lifeline. A

Table 4. Open-ended Response Prevalent Themes

Response	Percent, % (n)
Positive responses from students	
Overall simulation was an excellent way to experience how to reconcile medication.	44.0 (70)
Incorporation of the Patient Actor made it fun	17.0 (27)
Interacting “real-world” with the different members of the health care field was valuable.	13.5 (21)
Working with other students in teams was useful.	3.8 (5)
Areas of improvement responses from students	
No changes are necessary	52.1 (74)
The lecture could have been improved	20.4 (29)
Change the time of year when given	9.1 (13)
More information on each drug in packets would be helpful	7.0 (10)
Increase the number of pharmacists, physicians and the time allotted with each lifeline.	4.9 (7)
Reconciling medications is frustrating and too hard.	4.2 (6)

number of students found the time limits beneficial and realistic as the time crunch made them focus on what was most important to ask. Nonadherence was suggested by students as an additional topic as students reflected that patients do not always take their medications as prescribed and the simulation could reflect this.

An oversight that we noticed was that students had not yet been taught formally how prescriptions were written—the Latin abbreviations (i.e., bid for twice daily, qhs for at bedtimes), generic versus brand names, etc. We plan to incorporate this at the end of the lecture before the start of the exercise.

As this was the student's first chance at medication reconciliation, there was a very low number of "perfect medication lists," which was not completely unexpected by the instructors. Limitations of this study were that changes in actual knowledge, skills, and prescribing behaviors among the students were not measured and we were not able to objectively compare our simulation with other course offerings. As this stimulation was prior to any clinical clerkships, we hoped to introduce students and provide a useful experience on the process of medication reconciliation. However, considering that each one of these medication inaccuracies could potentially be a "wrong" order in a hospital admission, there is room for improvement and further education on this patient safety practice.

Future directions include potentially expanding the patient safety curriculum, evaluating student teams in paired sets (second year versus third year) to assess changes from this initial baseline simulation and utilizing videotaped standardized patients to compare their individual skills in obtaining medication histories from baseline to their clinical years.

From a public health standpoint, the Medication Reconciliation Simulation is generalizable to other institutions and could serve as the foundation for the further expansion of patient safety education in the medical school curriculum. In the latter clinical years, continuing medication reconciliation instruction, addressing safety and error issues, and promoting systems-based practice are all further routes to improve the safety of patients and perhaps could be established at a GME or hospital-wide level for related initiatives.

In conclusion, medication-history taking and medication reconciliation are important topics that merit stronger dedication in medical school curriculums. The Medication Reconciliation Simulation, which we developed in conjunction with a lecture on these topics, was well received by students and can be implemented at other medical institutions. Ultimately, by educating students on obtaining a complete and accurate medication history and performing medication reconciliation, we hope to decrease the number of medication errors and make the health care experience for patients safer.

Acknowledgment: The authors would like to acknowledge other supporting members of the Northwestern Center for Patient Safety: Drs. Gary Noskin, David Baker, Gary Martin, and Curriculum Committee Director Dr. Kathy Neely.

Conflicts of Interest: None disclosed.

Corresponding Author: Lee A. Lindquist, MD MPH; Division of Geriatrics, Northwestern University Feinberg School of Medicine, 750 North Lake Shore Drive, 10th Floor, Chicago, IL 60611, USA (e-mail: LAL425@md.northwestern.edu).

REFERENCES

1. Garbutt JM, Highstein G, Jeffe DB, Dunagan WC, Fraser VJ. Safe medication prescribing: training and experience of medical students and housestaff at a large teaching hospital. *Acad Med*. 2005;80(6):594–9.
2. Crook ED, Stellini M, Levine D, Wiese W, Douglas S. Medical errors and the trainee: ethical concerns. *Am J Med Sci*. 2004;327(1):33–7.
3. Bates DW, Cullen DJ, Laird N, et al. Incidence of adverse drug events and potential adverse drug events. Implications for prevention. ADE Prevention Study Group. *JAMA*. 1995;274(1):29–34.
4. Leape LL, Brennan TA, Laird N, et al. The nature of adverse events in hospitalized patients. Results of the Harvard Medical Practice Study II. *N Engl J Med*. 1991;324(6):377–84.
5. Tam VC, Knowles S, 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 Can Med Assoc J*. 2005;173(5):510–5.
6. Pronovost P, Weast B, Schwarz M. Medication reconciliation: a practical tool to reduce the risk of medication errors. *J Crit Care*. 2003;18:201–56.
7. Joint Commission on Accreditation of Healthcare Organizations USA. Using medication reconciliation to prevent errors. *Sentinel Event Alert*. 2006(35):1–4.
8. Ketchum K, Grass CA, Padwojski A. Medication reconciliation: verifying medication orders and clarifying discrepancies should be standard practice. *Am J Nursing*. 2005;105(11):78–9.
9. 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(6):597–603.
10. Joint Commission on Accreditation of Healthcare Organizations USA. 2008 National Patient Safety Goals <http://www.jointcommission.org/PatientSafety/NationalPatientSafetyGoals/> (Accessed January 21, 2008).
11. Cornish PL, Knowles S, Marchesano R, et al. Unintended medication discrepancies at the time of hospital admission. *Arch Intern Med*. 2005;165(4):424–9.
12. 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(16):1689–95.
13. Kohn LT, Corrigan JM, Donaldson MS. *To Err is Human: Building a Safer Health System*. Washington, DC: National Academy Press; 2000.
14. Rozich JD, Howard RJ, Justeson JM, Macken PD, Lindsay ME, Resar RK. Standardization as a mechanism to improve safety in health care. *Jt Comm J Qual Saf*. 2004;30(1):5–14.