Accuracy and safety of medication histories obtained at the time of intensive care unit admission of delirious or mechanically ventilated patients

Corey D. Cicci, PharmD, Department of Pharmacy, University of North Carolina Medical Center, Chapel Hill, NC, USA

Seyram S. Fudzie, PharmD, MPH, BCPS, Department of Pharmacy, University of North Carolina Medical Center, Chapel Hill, NC, USA

Stacy Campbell-Bright, PharmD, BCPS, BCCCP, Department of Pharmacy, University of North Carolina Medical Center, Chapel Hill, NC, USA

Brian P. Murray, PharmD, BCCCP, Department of Pharmacy, University of North Carolina Medical Center, Chapel Hill, NC, USA

Kalynn A. Northam, PharmD, BCCCP, Department of Pharmacy, University of North Carolina Medical Center, Chapel Hill, NC, USA

Address correspondence to Dr. Northam (kalynn.northam@unchealth.unc.edu).
Twitter: Kalynn_Ro

Purpose. Obtaining an accurate medication history from patients on hospital admission is a priority in pharmacy practice. Timely and accurate histories are imperative as they may help determine the etiology of illness and prevent medication errors. We conducted a quality improvement project to assess the accuracy of alternate-source medication histories obtained for critically ill patients who were delirious or mechanically ventilated at the time of intensive care unit admission.

Methods. Included patients were 18 years of age or older, admitted to the medical intensive care unit from August 2017 through January 2018, and had a medication history obtained from a family member or outpatient pharmacy due to active delirium or mechanical ventilation. Patients were directly interviewed after resolution of delirium or extubation. Discrepancies between the initial and follow-up histories were documented and categorized using the National Coordinating Council for Medication Error Reporting and Prevention (NCC MERP) Index for Categorizing Medication Errors.

Results. Forty patients were included. One hundred four discrepancies were documented, with a median of 2 discrepancies per patient. The most common types of discrepancies were addition (51.9%), followed by omission (24.0%). NCC MERP index category A (51%) was the most common error classification identified.

Conclusion. Discrepancies between initial and follow-up medication histories occurred at a frequent rate in delirious or mechanically ventilated patients; however, these discrepancies tended to be of low risk severity.

Keywords: intensive care units, medication errors, medication reconciliation, patient safety, quality improvement

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Medication reconciliation is the process of comparing medications a patient is routinely taking with those administered in various phases of care.[1] Part of the reconciliation process is obtaining an accurate medication history upon hospital admission. Accurate histories are imperative to prevent treatment interruptions, therapeutic duplications, and other medication errors. One study indicated that 61% of patients will have at least 1 medication history discrepancy identified during the medication reconciliation process.[2]

Over the last 2 decades, efforts have been made to improve the medication reconciliation process. In 2005, The Joint Commission added medication reconciliation as a National Patient Safety Goal and continues to encourage organizations to improve their medication reconciliation processes.[3] Studies have indicated that a pharmacy-led medication history process improves the accuracy and completeness of information obtained. One study demonstrated that medication histories are more complete and accurate when

collected by pharmacists instead of other healthcare providers.[4] Another study demonstrated the importance of pharmacy-led medication history taking in the care of critically ill patients, with a median of 3 discrepancies per patient identified in a sample of 303 completed medication histories.[5]

Obtaining an accurate and complete medication history for critically ill patients is challenging. Patients may be poor historians secondary to delirium or may be unable to communicate due to mechanical ventilation. In these situations, healthcare providers often use alternative methods to complete medication histories, such as reviewing outpatient pharmacy records of prescription filling and interviewing family members. However, the accuracy and safety of medication histories obtained from these alternative sources has not been assessed. Given the potential impact on patient safety, we conducted a quality improvement project to determine the accuracy and safety of medication histories obtained through alternative methods for delirious or mechanically ventilated intensive care unit (ICU) patients compared to medication histories obtained directly from patients once these initial limiting factors were resolved.

Methods

We conducted a quality improvement project in our 30-bed medical ICU within an 803-bed academic medical center. Our objective was to determine the accuracy and safety of our standard medication history process as applied to delirious or mechanically ventilated patients. Patients 18 years of age or older who were admitted through the ICU from August 2017 through January 2018 (a 6-month period) and from whom a medication history was obtained through an alternative method secondary to ongoing delirium or mechanical ventilation were included. Delirium was defined as a positive Confusion Assessment Method for the ICU (CAM-ICU)[6] score recorded in the electronic health record (EHR) prior to completion of the

KEY POINTS

- Obtaining accurate and complete medication histories for critically ill patients who are delirious or mechanically ventilated at the time of intensive care unit (ICU) admission is challenging.

- There is limited published evidence regarding the quality and safety of medication histories that are obtained from alternative sources.

- In a sample of ICU patients who were delirious or mechanically ventilated at the time of initial medication reconciliation, discrepancies between alternative-source and patient-provided medication histories were found to be frequent but tended to be of low risk severity.

initial medication history. Patients were excluded if they resided in a facility from which a medication administration record to enable completion of the medication history was expected to be received, if in-hospital mortality occurred prior to the follow-up medication history interview, or if patients had continued delirium at hospital discharge, were placed on comfort measures, were transferred to another facility before delirium resolved or extubation occurred, or were deemed poor historians and unable to report home medications during the follow-up medication history interview. Additionally, patients were excluded for protocol violations (ie, after delirium resolved or the patient was extubated, a follow-up medication history interview was not completed by the project team prior to discharge). The medical center's institutional review board determined the project was consistent with a quality improvement initiative and met criteria for exemption.

Within our institution, medication histories are collected by a pharmacy representative (a pharmacist, student pharmacist, or pharmacy technician), all of whom receive standardized training in obtaining a proper medication history. Our institutional goal is to complete medication histories within 48 hours of admission, including in critically ill patients. Our standard process for obtaining medication histories for patients in the ICU who cannot be directly interviewed due to active delirium or mechanical ventilation involves obtaining outpatient pharmacy fill records or interviewing family members. Both sources are used only if clarification of information provided by the initial single source is required. Information collected is documented in our EHR, which pharmacists and providers review during the medication reconciliation process.

Patients meeting the inclusion criteria were identified by performing daily chart review. Initial medication histories were obtained by a pharmacy representative (not a project team member) using the standard process described above. A member of the project team conducted a follow-up medication history interview with the patient once delirium resolved or the patient was extubated. Two project team members completed the same standardized medication reconciliation training as is required for all pharmacy representatives and performed all of the follow-up medication history interviews. Delirium resolution was defined as having 2 consecutive negative CAM-ICU scores documented in the EHR.

Our primary objective was to quantify the number of medication discrepancies between the initial and follow-up histories. A discrepancy was defined as a difference between the initial and the follow-up medication histories. Each discrepancy was classified as an omission (a medication was missing from the initial list), addition (a medication was erroneously listed on the initial list), incorrect dose, incorrect frequency, or incorrect drug. All discrepancies identified were reviewed

Figure 1. Definitions of discrepancy severities used in NCC MERP Index for Categorizing Medication Errors. NCC MERP indicates National Coordinating Council for Medication Error Reporting and Prevention.
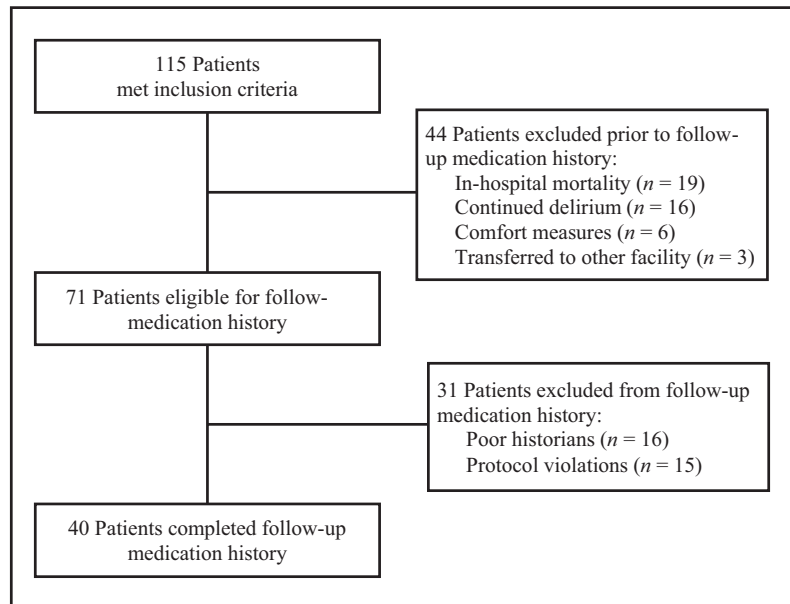
Category	Definition
Category A	Circumstances or events that have the capacity to cause error
Category B	An error occurred but did not reach the patient
Category C	An error reached the patient but did not cause patient harm
Category D	An error reached the patient and required monitoring to confirm no harm
Category E	An error may have contributed to or resulted in temporary harm, requiring intervention
Category F	An error may have contributed to or resulted in temporary harm and required initial or prolonged hospitalization
Category G	An error may have contributed to or resulted in permanent harm
Category H	An error required intervention necessary to sustain life
Category I	An error may have contributed to or resulted in patient death

by the ICU pharmacist and providers to determine if changes in current therapy were warranted.

Our secondary objective was to assess the safety of our standard medication history process in the study population. Each discrepancy identified was categorized using the National Coordinating Council for Medication Error Reporting and Prevention (NCC MERP) Index for Categorizing Medication Errors.[7] Through use of this tool, each discrepancy was assigned to a harm severity category by the project team member who completed the follow-up medication history interview. In instances of questionable categorization, a consensus decision was made by the project team member who performed the follow-up medication history and the project leader. NCC MERP index category A includes the least severe errors, which are defined as events with the capacity to cause error. Category I includes the most severe errors, which are defined as errors that may have contributed to or resulted in patient death.[7] A complete list of the NCC MERP Index for Categorizing Medication Errors is shown in Figure 1.

Data analysis included descriptive statistics using medians and interquartile ranges (IQRs) for continuous variables and proportions for categorical variables.

Figure 2. Flow diagram of patient inclusion and exclusion and application of medication history eligibility criteria.

115 Patients met inclusion criteria

44 Patients excluded prior to follow-up medication history:
    In-hospital mortality (*n* = 19)
    Continued delirium (*n* = 16)
    Comfort measures (*n* = 6)
    Transferred to other facility (*n* = 3)

71 Patients eligible for follow-medication history

31 Patients excluded from follow-up medication history:
    Poor historians (*n* = 16)
    Protocol violations (*n* = 15)

40 Patients completed follow-up medication history

Results

Among the 115 patients who met the inclusion criteria, a total of 40 patients received a follow-up medication history interview (Figure 2).

Common reasons for study exclusion included in-hospital mortality prior to the follow-up interview, continued delirium, and patients being deemed poor historians or unable to report home medications. Baseline characteristics of the study cohort are summarized in Table 1. The majority of patients

(57.5%) were male; the median age was 54 years (IQR, 36-59 years). The most common reason for ICU admission was respiratory failure (27.5% of patients). The median ICU length of stay (LOS) was 8 days (IQR, 5-12 days), and the median hospital LOS was 13 days (IQR, 7-20 days).

At the time of the initial medication history, 27 patients (67.5%) were mechanically ventilated and 13 patients (32.5%) were delirious. Twenty-three (57.5%) of the initial medication histories were collected from an outpatient pharmacy, 16 (40%) from family members, and 1 (2.5%) from both an outpatient pharmacy and family members.

After completion of the follow-up medication history, a total of 104 discrepancies were identified, with a median (IQR) of 2 (1–4) discrepancies per patient (Table 2). At least 1 discrepancy was observed in the histories of 80% of patients. The most common discrepancy was addition (51.9% of discrepancies). Of the patients for whom the initial medication history was obtained from an outpatient pharmacy, 20 of 23 (87%) had a discrepancy between histories. Of the patients for whom the initial medication history was obtained from a family member, 12 or 16 (75%) had a discrepancy between histories. The most common NCC MERP index category assigned was category A (51% of discrepancies overall), indicating that the identified discrepancies had the capacity to cause error. The next most common assignment was to category C (34%), indicating that an error occurred and reached the patient but did not cause harm; and the highest category assigned was category E, indicating that an error may have contributed to or resulted in temporary harm requiring intervention. Examples of identified discrepancies in each NCC MERP index category are provided in Table 3.

Alternative-source histories obtained from family members led to a higher percentage of category A errors than those obtained from outpatient pharmacies, as well as lower percentages of category B, C, or E errors (Figure 3). Lastly, there was a higher frequency of addition discrepancies in the outpatient pharmacy–provided histories compared to the family-provided histories (56.5% vs 42.9%), and a higher frequency of omission discrepancies in family-provided histories (40.0% vs 15.9%).

Discussion

Obtaining an accurate medication history is essential to avoid discrepancies and potential patient harm. Most medication reconciliation studies we reviewed excluded noncommunicative patients, making the results less applicable to critically ill patients who are delirious or mechanically ventilated.[2,4,8] We identified a high frequency of discrepancies when medication histories for delirious or mechanically ventilated patients were obtained from alternative sources, with addition discrepancies occurring most frequently. Although a high percentage of our population had at least 1 discrepancy identified, most discrepancies were classified into category A, indicating that the events had the capacity to cause error but did not reach the patient. Lastly,

Table 1. Demographic and Other Characteristics of Study Population

	Value (*n* = 40)[a]
Age, median (IQR), y	54 (36-59)
Male, No. (%)	23 (57)
Race/ethnicity, No. (%)	
Caucasian	27 (67)
African American	7 (17)
Hispanic	1 (2)
Other	5 (12)
Admission diagnosis, No. (%)	
Respiratory failure	11 (27)
Sepsis	10 (25)
Neurological disorder	6 (15)
Endocrine disorder	5 (12)
Overdose	4 (10)
Liver failure	3 (7)
Renal failure	1 (2)
ICU length of stay, median (IQR), d	8 (5-12)
Hospital length of stay, median (IQR), d	13 (7-20)
Inclusion criteria met, No. (%)	
Mechanical ventilation	27 (67)
Delirious	13 (32)
Initial medication history source, No. (%)	
Outpatient pharmacy	23 (57)
Family member	16 (40)
Both	1 (2)
Time to follow-up interview, median (IQR), d	6 (2-9)

Abbreviations: IQR, interquartile range; ICU, intensive care unit.
[a]Category percentages do not sum to 100% due to rounding.

Table 2. Types and Frequencies of Medication History Discrepancies in Study Cohort (n = 40)

Variable	Value
Total no. of discrepancies	104
Addition	54 (51.9)
Omission	25 (24.0)
Incorrect frequency	16 (15.4)
Incorrect dose	6 (5.8)
Incorrect drug	3 (2.9)
No. of discrepancies per patient, median (IQR)	2 (1-4)
Discrepancies per patient, No. (%) of patients[a]	
0	8 (20)
1	11 (27)
2	5 (12)
3	5 (12)
≥4	11 (27)
Fraction (%) of patients with discrepancies by initial history source	
Outpatient pharmacy	20/23 (87)
Family member	12/16 (75)
Both	0/1 (0)
NCC MERP index category, No. (%) of discrepancies	
Category A	53 (51)
Category B	15 (14)
Category C	35 (34)
Category D	0
Category E	1 (<1)
Categories F–I	0

Abbreviations: IQR, interquartile range; NCC MERP, National Coordinating Council for Medication Error Reporting and Prevention.
[a]Percentages do not sum to 100% due to rounding.

information obtained from family members resulted in a lower proportion of patients with identified discrepancies, and a higher percentage of these discrepancies were classified into category A. The project helped us better understand the accuracy and safety of medication histories obtained from alternative sources for delirious or mechanically ventilated ICU patients.

Our observations were similar to those reported in previous literature that described discrepancies in medication histories of ICU patients. Kram and colleagues[5] performed a single-center prospective evaluation examining the impact of pharmacist-led medication reconciliation for ICU patients. Those investigators excluded patients who were cognitively impaired or unable to participate and had no family members present. Thirty-four of the 46 patients (73.9%) were excluded due to cognitive impairment or inability to participate. The researchers identified that 78.2% of their population had at least 1 discrepancy, with a median of 3 discrepancies per patient. The majority (62.1%) of the identified discrepancies were categorized as being clinically insignificant. Similar to that study, our study found that a high percentage of the study population had at least 1 discrepancy identified, with most being categorized as clinically insignificant.
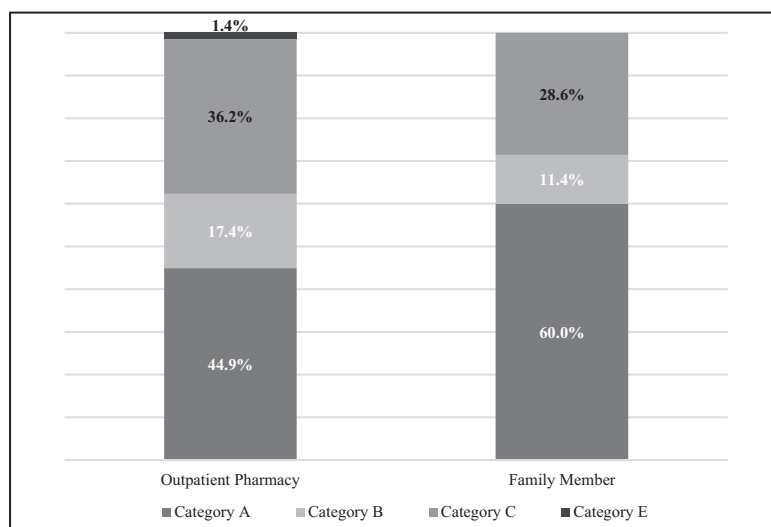
Bosma and colleagues[9] described their experience with implementing a pharmacist-driven medication reconciliation process at ICU admission and discharge. They were able to significantly reduce the proportion of patients with at least 1 medication discrepancy within 24 hours after ICU admission in the postintervention group relative to the preintervention group (45.1% vs 14.6%; adjusted odds ratio, 0.18 [95% confidence interval, 0.11-0.30]). Those investigators did not specifically exclude delirious or mechanically ventilated patients but used a multimodal approach to obtain a best possible medication history by reviewing 6-month pharmacy fill records and EHR information and by interviewing patients or caregivers. Bosma et al described obtaining a best possible medication history in 87.3% of patients, with only 60.8% of histories being considered of optimal quality. A medication history was reviewed directly with only 35.8% of included patients. Our study also demonstrated the challenges encountered in obtaining medication history information directly from critically ill patients, with only 35% of our population being directly interviewed after delirium improved or after extubation.

Our project had limitations to consider. First, we were unable to perform follow-up interviews of 75 patients who met the inclusion criteria. Although a large number of patients were excluded, we interviewed a cohort that we believe was representative of the standard medical ICU population. Larger studies are needed to confirm our results and determine the overall impact on patient safety. Second, our standard workflow for obtaining medication histories within our ICU population is to interview family members or obtain pharmacy fill records. Both information sources are used only if additional

Table 3. Examples of Medication History Discrepancies Identified in Study Cohort

NCC MERP Index Category	Discrepancy Type	Example
Category A (*n* = 53)	Incorrect dose	Outpatient pharmacy reported a recent fill for clonidine 0.1 mg by mouth twice daily. Dose was listed on home medication list but not ordered by medical team on admission. Patient reported taking clonidine 0.2 mg by mouth twice daily at home. Discrepancy did not reach the patient.
Category B (*n* = 15)	Addition	Outpatient pharmacy reported a recent prescription fill for cetirizine 10 mg by mouth once daily. Medication was listed on home medication list and ordered as needed by medical team on admission. No doses were administered to the patient. Patient reported not taking cetirizine at home.
Category C (*n* = 35)	Omission	Medication history completed using outpatient pharmacy fill records. Pregabalin 150 mg by mouth 3 times daily was not reported by the pharmacy and therefore not ordered on admission by the medical team. Patient reported taking pregabalin at home. No adverse events identified while pregabalin was held.
Category E (*n* = 1)	Incorrect dose	Outpatient pharmacy reported a recent fill of metoprolol tartrate 50 mg by mouth twice daily. Metoprolol tartrate 25 mg by mouth twice daily was resumed on admission. Patient experienced an episode of atrial fibrillation with rapid ventricular rate requiring a dose of IV metoprolol. Patient reported taking metoprolol tartrate 75 mg by mouth twice daily at home. Team may have initiated a higher dose on admission with correct home dose information.

Abbreviations: NCC MERP, National Coordinating Council for Medication Error Reporting and Prevention; IV, intravenous.

Figure 3. Distribution of NCC MERP index categorizations of discrepancies identified in the study population by initial medication history source.

classes may provide further insight into which medications may warrant further investigation once delirium resolves or upon extubation.

Conclusion

Discrepancies between initial and follow-up medication histories occurred at a frequent rate in a sample of delirious or mechanically ventilated patients; however, these discrepancies tended to be of low risk severity. When alternative sources must be used in obtaining medication histories, information provided by family members may be more reliable and result in fewer errors that reach the patient than information provided by outpatient pharmacies. Waiting for delirium to resolve or for extubation to occur may lead to delays in obtaining medication history information, but obtaining subsequent direct confirmation by the patient should occur when possible if alternate sources are used initially. Larger studies in this area are needed to overcome the limitations of our assessment and confirm the results.

Disclosures

The authors have declared no potential conflicts of interest.

clarity is required. We might have identified fewer discrepancies if both sources had been used in obtaining the initial medication history. Third, the process of categorizing error severity using the NCC MERP index is subjective in nature. While this tool clearly describes criteria for categorization, some discrepancies identified in our study required further discussion. Two project members participated in discussions to ensure consensus on categorization. Lastly, the project included both prescription and nonprescription medications and did not stratify medications by therapeutic class. Therefore, discrepancies involving herbal supplements carried the same weight as those involving prescription medications. Conducting data analysis with regards to medication

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