

# Medication Discrepancies at Pediatric Hospital Discharge

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## ABSTRACT

**BACKGROUND:** The pediatric hospital discharge process presents significant challenges, and medication discrepancies remain an unsolved problem. The purpose of this study was to determine the discrepancy rates at the time of discharge when multiple sources of medication documentation exist, and to characterize the medication discrepancies into error type, medication category, and discharge summary authorship.

**METHODS:** A prospective study was performed on pediatric patients admitted to a general inpatient floor for >24 hours. After discharge, medication lists were obtained from the patients' parent/guardian, discharge summary, and Patient Summary List, a medication list that is part of the electronic medical record. These 3 medication lists were then compared with the pharmacy record to identify discrepancies, defined as any difference in medication name, dose, route, or frequency. Medication discrepancies were analyzed in terms of error type (dosage or addition/omission), category of medication, and final signers of the discharge summary.

**RESULTS:** Sixty-nine patient charts were analyzed, and 8% of medications contained a documentation discrepancy between sources. Overall, 26% (18 of 69) of the charts contained  $\geq 1$  discrepant medication; the Patient Summary List had the highest rate of discrepancy at 29%. Allergy (27%) and seizure medications (25%) were the categories with the highest rates of discrepancy. Addition/omission errors were much more common than dosage errors.

**CONCLUSIONS:** Medication discrepancies exist in inpatient documentation at the time of pediatric hospital discharge when multiple sources of documentation exist.

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Medication errors are 1 of the most common causes of adverse events.<sup>1</sup> Children are at exceptionally high risk for adverse drug events,<sup>2</sup> and several studies demonstrate that pediatric patients discharged from an academic medical center are at risk for receiving erroneous prescriptions.<sup>3</sup> In an analysis of 200 consecutive prescribing errors in a tertiary care teaching hospital, Lesar reported that "errors most commonly involved pediatric services (65%), compared with adult services (31%)."<sup>4</sup> Pediatric patients are more susceptible to medication errors for a variety of reasons, including the need for patient-specific dosing.<sup>5</sup>

The Joint Commission has noted the significance of medication errors in the hospital setting and has mandated medication reconciliation as a requirement for hospital accreditation.<sup>6</sup> As defined by the Institute for Healthcare Improvement, medication reconciliation is "the process of obtaining and maintaining an accurate and detailed list of all prescribed and non-prescribed drugs a patient is taking, including dosage and frequency, through all healthcare encounters and comparing the physician's admission, transfer, and/ or discharge orders to that list, recognizing any discrepancies, and documenting any changes, thus resulting in a complete list of medications, accurately communicated."<sup>7</sup> Rozich et al demonstrated that ~60% of all medication errors in the hospital occur at admission, transfer, or discharge.<sup>8</sup> According to a cross-sectional observational study in adults, patients with more discrepancies in their medication history and inpatient therapy tended to have more clinically important medication errors at discharge.<sup>9</sup> Furthermore, their study showed that 60% of the errors caused harm.<sup>9</sup>

Current literature on medication documentation errors at the time of discharge is well studied in the adult population but less so in the pediatric population. One potential source of medication error in the pediatric population is having multiple sources of documentation for an individual patient. When multiple sources exist, there is the potential not only

for prescription medication error (drug name, dosage, concentration, frequency or route) but also that there will be a discrepancy between different sources, leaving the intended medication unclear. Perhaps there is an argument that 1 documented medication list would be preferable to multiple sources. The purpose of this study was to determine the discrepancy rates at the time of discharge when multiple sources of medication documentation exist and to characterize the medication discrepancies into error type, medication subcategory, and discharge summary authorship.

## METHODS

This Health Insurance Portability and Accountability Act-compliant study was approved by the Institutional Review Board at the University of Michigan Medical School (HUM00064570). The prospective study collected data from June 20, 2012, to August 15, 2012, at the University of Michigan, C.S. Mott Children's Hospital in Ann Arbor, Michigan. Inclusion criteria were defined as any inpatient admitted to a defined general pediatric inpatient floor with a length of stay >24 hours. All pediatric patients admitted to a general inpatient floor were assessed for eligibility, and the only exclusion criterion was previous inclusion in the study. Informed consent was obtained from all participants who agreed to be part of the study, which included a phone survey after hospital discharge and permission to access patients' medical record and inpatient or outpatient pharmacy records.

## Medication Documentation Sources

1. Pharmacy records. The pharmacy records reflect the medications that were reviewed and dispensed by a pharmacist. As such, we used these records as the "gold standard" to compare with the other 3 written sources that follow.
2. Patient Summary List (PSL). This is a component of the electronic medical record that contains medications, diagnoses, procedures, allergies, and health maintenance. It is the responsibility of the attending

physicians, fellows, and resident physicians to ensure that these data are entered and updated during every inpatient encounter. The medication data in the PSL is also used and updated by outpatient providers if they make any changes. Clinical pharmacists do not have access to the PSL and therefore do not update any medication discrepancies noted on review at admission. The PSL is not distributed to the patient or patient's family.

3. Physician discharge summary. This document is either dictated or typed into the electronic medical record by resident physicians as a distinct entity from the PSL, and it includes the hospital course as well as a list of discharge medications. The attending physician is required to edit and sign this document. The prescriptions that are given to the family at the time of discharge should be equivalent to the list on the discharge summary and the PSL. The discharge summary does not autopopulate the PSL; any medication changes must be updated manually.
4. Parental medication report. This list was generated by calling the patient's parent or guardian within 24 hours of discharge.

## Reconciliation Process

The admitting physician takes a history and elicits a medication list, which is documented in a note titled "Admission History and Physical." At this time, the admitting physician should reconcile the medication list obtained from the parent to the existing list in the PSL, verify any discrepancies, and update the PSL as indicated. In addition, as hospital policy, a clinical pharmacist completes medication reconciliation within 72 hours of admission and enters the medication information elicited into the medical record under a separate document titled "Medication Reconciliation." The pharmacist does not have privileges to update the PSL in this system; therefore, any discrepant medications would need to be updated by a physician after referring to the pharmacist's "Medication Reconciliation" note.

At the time of discharge, a document titled "Discharge Summary" is created that contains a summary of the hospital course, a discharge day physical examination, any pertinent laboratories/imaging, a list of discharge medications, and scheduled follow-up. Discharge medication prescriptions sent to the hospital pharmacy or outpatient pharmacy should be identical to the list in the discharge summary because medication instructions are provided to patients and families based on that documentation. At the time of patient discharge from the hospital, the PSL should be accurately updated to reflect that which is documented in the discharge summary and the paper prescriptions that have been written and sent to the patients' pharmacy.

### Study Design

A member of the study team called the patients' parent or guardian at home within 24 hours of discharge and specifically asked the parent or guardian to report the name, dose, frequency and route of administration of all medications the recently discharged patient was taking. We did not ask the parent or guardian what source they were referring to when providing this information; we only asked them to report what the patient was receiving since hospital discharge. We made a maximum of 3 attempts to reach the family by telephone after discharge. Subsequently, the patients' pharmacy was contacted and the medication names, dosages, frequency and route of administration were obtained from pharmacy records. This information was entered into an Excel spreadsheet in addition to the medication list from the PSL and the discharge summary. The PSL, physician discharge summary, and the parent/guardian report of medications were compared with the pharmacy record to ascertain if there were any discrepancies. For the purposes of this study, we defined a discrepancy as any difference in medication name, dose, route, or frequency between any source (family, PSL, or discharge summary) compared with the pharmacy record.

In the second part of the study, we categorized medication discrepancies in terms of error type: either dose error or

addition/omission. We then further characterized the discrepant medications by categorizing them into 14 arbitrary classes of medications: allergy, seizure, antimicrobial, psychiatric, endocrine, topical, opioid, asthma, symptomatic care, benzodiazepine, supplementation, blood pressure, hematologic, and immunosuppressants. Benzodiazepines that were not prescribed for seizures (ie, muscle spasm or anxiety) were placed in the "benzodiazepine" category; all benzodiazepines prescribed for seizures were maintained in the "seizure" category. All nonnarcotic pain medication was categorized under "symptomatic care." Other symptomatic care medications included laxatives (senna, docusate sodium, polyethylene glycol), gastric acid pump inhibitors (omeprazole, lansoprazole), antiemetics (ondansetron), histamine-2 receptor antagonists (famotidine, ranitidine), and muscle relaxants/antispasmodics (oxybutynin chloride, baclofen). Supplemental medications included calcitriol, ferrous sulfate, multivitamins, vitamin B, potassium citrate, sodium citrate, and 0.9% normal saline. Topicals included acetic acid, bacitracin, and ciprofloxacin/dexamethasone drops.

Lastly, we documented who signed the final discharge summary. The final reviewers were in one of the following 5 categories: attending with resident, attending with fellow, attending with nurse practitioner/physician assistant, attending with special purpose trainee (a resident from an outside institution), or attending alone. Discrepancy rates and percentage of charts signed by each group was recorded.

Descriptive and statistical analyses were performed using SPSS version 2020 and SAS 9.2. A power analysis was not performed before beginning this study, and we used post hoc data analysis. Compared with pharmacy records, the percent of charts from the 3 sources (discharge summary, PSL, and the parental report of the medication list) with discrepancies were reported. Zero percent discrepancy with the pharmacy record was preset as the goal, and binomial tests were conducted to test statistical significance of the percent of

discrepancy. Cochran's *Q* test was used to test the differences in percent of discrepancy among the 3 sources. Because of the small sample size, descriptive results were provided for the nature of the discrepancies and type of medication found to be discrepant.

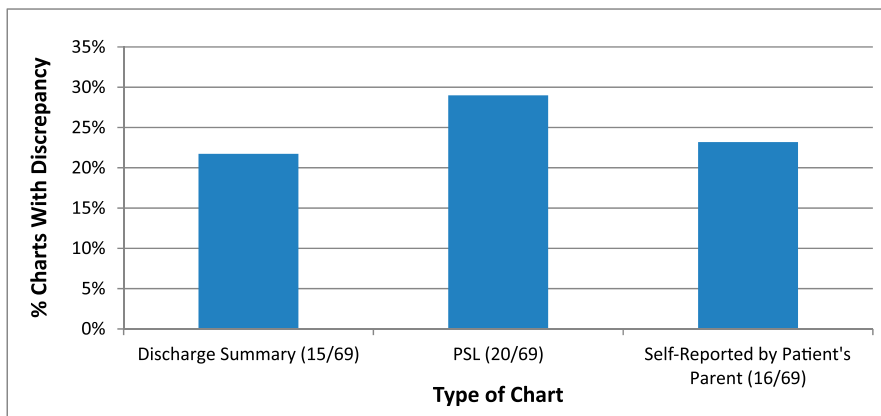
### RESULTS

During the study period, 122 pediatric patients were eligible, and informed consent was obtained from the parent or legal guardian for all patients. Fifty-three patients were lost to follow-up because their parent or guardian could not be reached by telephone after 3 attempts. Therefore, 69 patients were included in the analysis.

In total, there were 430 medications among the 69 charts; of these, 34 medications (8%) contained a documentation discrepancy between sources. Of the total number of discrepancies, 31 were addition/omission errors (91%), and 3 were prescriber dose errors (9%). Overall, 26% (18 of 69) of the charts contained  $\geq 1$  medication that had a discrepancy in documentation.

Using the pharmacy record as the gold standard for the purposes of this study, we compared the medications recorded as filled and dispensed to the 3 other documentation sources (Fig 1). Of the 3 medication documentation sources, the PSL was the most inconsistent with the pharmacy records, containing a discrepancy rate of 29% ( $P < .001$ ). There was a 23% discrepancy rate between the pharmacy record and the parent/guardian report ( $P < .001$ ) and a 22% discrepancy rate between the pharmacy record and the physician discharge summary ( $P < .001$ ). Nevertheless, the differences in the discrepancy rates among the 3 sources were not statistically significant ( $P = .65$ ).

Analyses of the medication discrepancies identified 11 arbitrary categories of discrepant medications: allergy ( $n = 11$ ), seizure ( $n = 44$ ), antimicrobial ( $n = 27$ ), psychiatric ( $n = 9$ ), endocrine ( $n = 37$ ), topical ( $n = 10$ ), opioid ( $n = 39$ ), asthma ( $n = 20$ ), symptomatic care ( $n = 124$ ), benzodiazepine ( $n = 25$ ), and supplemental ( $n = 48$ ) medications. The subcategories of



**FIGURE 1** Percent of charts with discrepancy in discharge medication, by type of charts.

allergy (27%) and seizure (25%) medications had the highest rates of discrepancies, followed by antimicrobial agents 11% (3 of 27). The following 3 categories had the lowest discrepant rates: symptomatic care 4% (5 of 124), benzodiazepines 4% (1 of 25), and supplementation 2% (1 of 48) (Fig 2). There were no medication documentation discrepancies in the immunosuppressant, blood pressure, or hematologic categories in this study.

The patient charts that contained medication documentation discrepancies were analyzed to identify the final signers of the discharge summary. The attending with resident signed 52 (75%) of the discharge

summaries. Within those 52 discharge summaries, 12 (23%) of the signed discharge summaries that went home with the patient contained discrepancies from the pharmacy records. Because a small number of cases were signed by the remaining 3 categories of providers (attending with fellow, attending with nurse practitioner or physician assistant, and attending with rotating resident), the differences in discrepancy between provider categories were not statistically significant.

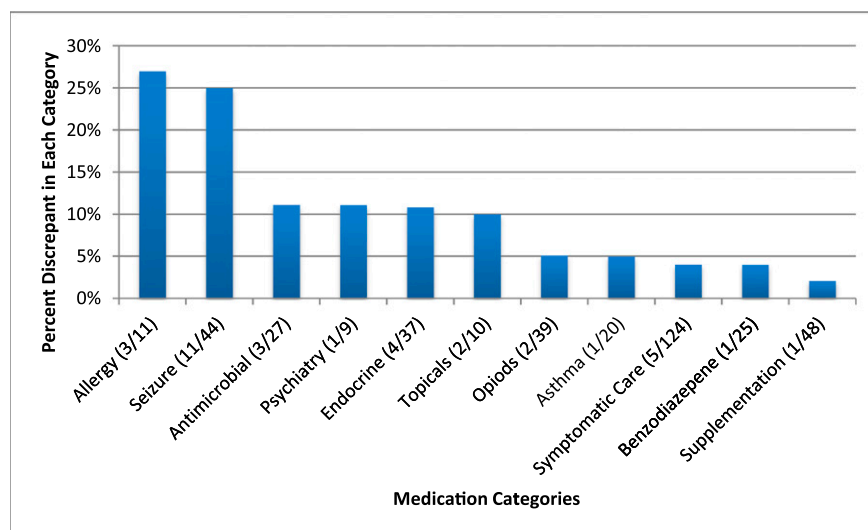
## DISCUSSION

It has been estimated that 7000 deaths occur annually across all patient

populations due to medication errors.<sup>10</sup> Furthermore, medication errors are potentially more harmful and have a higher incidence rate in the pediatric population than in the adult population.<sup>11</sup> Some studies report medication errors to be 3 times higher in pediatrics than in adult populations.<sup>2</sup> For these reasons, it is valuable to evaluate current systems of prescribing medications in pediatrics to understand the current state. The purpose of this study was to determine discrepancies between 4 sources of medication at the time of discharge from an inpatient pediatric unit; we did not measure the clinical outcomes of any medication documentation discrepancy. We found that 8% of medications contained a documentation discrepancy between sources, and overall, 26% of the charts contained  $\geq 1$  discrepant medication. We then looked at the types of errors that caused discrepancies to help determine appropriate next steps for further study.

The primary goal of our study was to evaluate the patients' medical record for discrepancies in medication documentation between different sources at the time of hospital discharge. Data suggest that interventions aimed to improve the safety of medication at transitions in care should focus first and foremost on preventing reconciliation errors at the time of discharge.<sup>12</sup> This study cannot conclude that these discrepancies directly affected the safety of our patients, but it does suggest that there is a need to focus on preventing documentation errors at the time of discharge. Johnson et al studied discrepancies among written prescriptions, medication regimens transcribed onto patient discharge instruction sheets, and labels on medications dispensed by community pharmacies after discharge of pediatric patients from an academic medical center. Their study reported the differences among the 3 sources to be 12%.<sup>3</sup> Similar to our study, they demonstrated that there is potential for error when there are multiple documentation sources for prescription discharge medications.

The definition of an error is important because it can markedly affect the number



**FIGURE 2** Discrepant medications by category.

of errors discovered.<sup>1</sup> Unfortunately, there is no generally agreed on definition of what constitutes an error, so studies often use different criteria.<sup>13</sup> In our study, the vast majority of errors were addition/omission errors, and we limited our analysis to addition/omission and dosage errors. A study performed by Johnson et al found a 6% error rate in medications and reported the most common types of errors in their study were wrong (or no) duration on prescription (21%) or wrong route (21%).<sup>3</sup> Lastly, Kaushal et al reported their results after reviewing 10,778 medication orders in a pediatric inpatient setting and found 6% medication errors, with the most frequent type of medication error being dosing error (28%).<sup>14</sup> Although our study was not designed to address the consequences of medication discrepancy, our analysis provides information regarding what types of errors occurred most frequently at the time of pediatric hospital discharge, which may be important in future studies and process improvement projects.

Allergy and seizure medications had the highest discrepancy rates in our study. However, the number of allergy medications was small ( $n = 11$ ) making it difficult to draw strong conclusions about this category. Seizure medications had a larger number of prescriptions ( $n = 44$ ). Potential reasons for increased discrepancies in seizure medications may include that the Neurology Service tends to admit its patients to the unit where this study was conducted, and seizure medications tend to be titrated when a patient is hospitalized with seizures.

In a study of medication discrepancies at pediatric hospital admission, Coffey et al found that severe discrepancies were most common with seizure medications. They speculated that patients requiring seizure medications are frequently hospitalized, often treated by generalists, and have numerous dosing adjustments leading to potential errors.<sup>15</sup> Previous studies have documented different findings. Kaushal et al reported the most common drugs involved in medication errors and potential adverse drug events were anti-

infective agents, analgesics and sedatives, electrolytes and fluids, and bronchodilators.<sup>14</sup> Lesar studied medication prescribing errors over 13 months in a tertiary care teaching hospital and also reported antimicrobial agents as having the highest rate of error (54%), followed by narcotics and benzodiazepines (21%).<sup>4</sup> As Lesar pointed out, the high rate of error with antimicrobial medications is likely due to the variability in equation expression for calculating the dose of these medications. In our study, we looked at discrepancies at the time of discharge, and earlier dosing errors for antimicrobial medications may have already been corrected by the pharmacy staff. Ferranti evaluated medication-related events detected by computerized surveillance and safety reporting systems over a 1-year period for Duke University Hospital pediatric inpatients and reported the most frequent adverse drug event category were nephrotoxins (21%), followed by narcotics and benzodiazepines (19.3%) and hypoglycemic agents (11.5%).<sup>2</sup> Further studies are needed to elucidate the predilection for prescribing errors in certain drug categories, as well as the variation in findings among institutions.

Prescribing medications is a complex task with many possibilities for error. In most academic teaching hospitals, residents write the majority of prescriptions. However, relatively few studies have specifically investigated house staff prescribing.<sup>16</sup> Conroy et al analyzed 319 centers in the United Kingdom and found only 34 described any teaching methods, and of these only 3 had actually tested prescribing competency.<sup>17</sup> Callen, McIntosh, and Lee reported that medication errors in hospital discharge summaries have the potential to cause serious harm to patients and that house staff are more likely to contribute to discharge medication error rates.<sup>18</sup> Johnson et al obtained data from 192 patients discharged from the infant, child, and adolescent units of the Johns Hopkins Hospital. The patients were discharged with 335 prescriptions, all written by house staff, and contained an error rate of 6%.<sup>3</sup> Walson, Hammel, and Martin reported the results of an

examination to evaluate prescription writing administered to pediatric house officers; their data indicate that proper prescription writing (especially the use of controlled substances) should be taught to house officers and that the therapeutic knowledge of beginning pediatric interns cannot be assumed to be adequate.<sup>19</sup> A systematic review of the literature on educational interventions to improve prescribing by medical students and junior doctors found 11 controlled trials on educational interventions to improve prescribing skills.<sup>20</sup> Only 1 intervention (the WHO Good Prescribing Guide, with 6 trials) has been tested in a wide variety of international settings and across a range of students at different levels, and has been shown to have some beneficial effects.<sup>20</sup> In our study, when the attending and resident signed a discharge summary, 23% of charts had an identifiable medication documentation discrepancy. At our institution, it is the responsibility of the resident to reconcile the medication lists at the time of discharge, sign the discharge summary, and electronically forward the discharge summary to the attending physician for review and final signature. Limited conclusions can be drawn from this observation. However, the rate of discrepancy in the reconciliation process could provide an opportunity to analyze both the etiology and the outcome of these discrepancies.

This study has several limitations. First, we were only able to include 69 patients in our analysis primarily because of the inability to reach the parents or guardians of patients by telephone after hospital discharge. Our small sample size with a dropout rate of 43% might introduce selection bias. Furthermore, the cohort was not powered to detect statistical differences between the rates of discrepancies in the various groups. However, our numbers represent a convenience sample of patients enrolled over a 3-month period and had sufficient power to detect a difference in discrepancy when compared with zero discrepancy. We recognize that our findings are preliminary and descriptive. Our use of post hoc analysis has inherent limitations, particularly in the subgroup analyses.<sup>21</sup>

Second, the results of this study were generated from a pediatric general care patient population on a single patient care floor, limiting the generalizability to all pediatric patient populations. It is also unknown what effect the timing of this study had on the discrepancy rates found when the attending and resident signed discharge summaries; this study was conducted in the months of June, July, and August when there are both new interns and residents that have recently transitioned to a senior role. For the purposes of our study, we assumed the pharmacy contained the most accurate list of medications because these were the medications dispensed to the patient. Although there are risks associated with any assumptions, there is a precedent in the literature for using pharmacy information for medication lists<sup>22,23</sup> because they have been identified as being most available and most accurate.<sup>24</sup> The accuracy of the pharmacy list was less important than the value of comparing different sources to 1 reference source to reveal discrepancies. We also recognize that this study was limited to identifying medication discrepancies among multiple sources that can lead to prescribing errors. This study would not identify that a prescription contained a dose, route, or frequency error (ie, incorrectly prescribed) but was consistently documented among multiple sources. Lastly, this study was designed to look at discrepancy rates, and we cannot make any causal connection with adverse patient outcomes.

Further studies are required to determine how to decrease discrepancies when multiple sources of documentation exist. In addition, the relationship between medication discrepancy and patient outcome needs to be examined.

## CONCLUSIONS

This study revealed that medication discrepancies exist in inpatient documentation at the time of pediatric hospital discharge when multiple sources of documentation exist. In our sample, 26% of the patient charts analyzed contained at least 1 medication documentation discrepancy. Allergy and seizure medications had the highest rates of

discrepancy, with seizure medications being prescribed fourfold more frequently. In this study, addition/omission errors were much more common than dosage errors. These data may inform future studies and strategies to facilitate medication reconciliation and documentation at pediatric hospital discharge.

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