

Caregiver Medication Management and Understanding After Pediatric Hospital Discharge

Kaitlyn Philips, DO, MS,^{ab} Roy Zhou, MD,^a Diana S. Lee, MD,^{ab} Christine Marrese, MD,^c Joanne Nazif, MD,^{ab} Constance Browne, PharmD,^a Mark Sinnett, PharmD,^a Steven Tuckman, BS, Pharm, MBA,^a Kimberly Griffith, PA,^a Victoria Kiely, RN, MS,^a Marcia Lutz, RN, MSN,^a Anjali Modi, BA,^a Michael L. Rinke, MD, PhD^{ab}

OBJECTIVES: Caregivers frequently make mistakes when following instructions on discharge medications, and these instructions often contain discrepancies. Minimal literature reflects inpatient discharges. Our objective was to describe failures in caregiver management and understanding of inpatient discharge medications and to test the association of documentation discrepancies and sociodemographic factors with medication-related failures after an inpatient hospitalization.

METHODS: This study took place in an urban tertiary care children's hospital that serves a low-income, minority population. English-speaking caregivers of children discharged on an oral prescription medication were surveyed about discharge medication knowledge 48 to 96 hours after discharge. The primary outcome was the proportion of caregivers who failed questions on a 10-item questionnaire (analyzed as individual question responses and as a composite outcome of any discharge medication-related failure). Bivariate tests were used to compare documentation errors, complex dosing, and sociodemographic factors to having any discharge medication-related failure.

RESULTS: Of 157 caregivers surveyed, 70% had a discharge medication-related failure, most commonly because of lack of knowledge about side effects (52%), wrong duration (17%), and wrong start time (16%). Additionally, 80% of discharge instructions provided to caregivers lacked integral medication information, such as duration or when the next dose after discharge was due. Twenty five percent of prescriptions contained numerically complex doses. In bivariate testing, only race and/or ethnicity was significantly associated with having any failure ($P = .03$).

CONCLUSIONS: The majority of caregivers had a medication-related failure after discharge, and most discharge instructions lacked key medication information. Future work to optimize the discharge process to support caregiver management and understanding of medications is needed.

ABSTRACT

www.hospitalpediatrics.org

DOI: <https://doi.org/10.1542/hpeds.2019-0036>

Copyright © 2019 by the American Academy of Pediatrics

Address correspondence to Kaitlyn Philips, DO, MS, Children's Hospital at Montefiore, 3411 Wayne Ave, Room 802, Bronx, NY 10467. E-mail: kphilip@montefiore.org

HOSPITAL PEDIATRICS (ISSN Numbers: Print, 2154-1663; Online, 2154-1671).

FINANCIAL DISCLOSURE: The authors have indicated they have no financial relationships relevant to this article to disclose.

FUNDING: Supported by the National Institutes of Health, National Center for Advancing Translational Sciences through Einstein-Montefiore Clinical and Translational Science Awards (grants TL1TR001072 and UL1TR001073). The contents are solely the responsibility of the authors and do not necessarily represent the official views of the National Institutes of Health. Funded by the National Institutes of Health (NIH).

POTENTIAL CONFLICT OF INTEREST: The authors have indicated they have no potential conflicts of interest to disclose.

Dr Philips conceptualized and designed the study, designed the survey tool, collected data, conducted analyses, drafted the initial manuscript, and reviewed and revised the manuscript; Dr Zhou helped design the study and survey tool, drafted the initial manuscript, and reviewed and revised the manuscript; Dr Rinke conceptualized and designed the study, supervised data collection and analyses, and critically reviewed and revised the manuscript; Drs Lee, Marrese, Nazif, Browne, and Sinnett, Mr Tuckman, Ms Griffith, Ms Kiely, Ms Lutz, and Ms Modi helped design the study and survey tool and reviewed and revised the manuscript; and all authors approved the final manuscript as submitted.



^aChildren's Hospital at Montefiore, Bronx, New York; ^bDepartment of Pediatrics, Albert Einstein College of Medicine, Bronx, New York; and ^cBaystate Children's Hospital, Springfield, Massachusetts

Transition of care after pediatric hospitalization is complex and lacks quality standards.^{1,2} Discharge-related care failures occur in up to one-third of pediatric discharges, and pediatric adverse drug events are common in the outpatient setting.^{3,4} However, the discharge medication process remains an understudied area of research for children who are hospitalized.⁵ The aim of a 2018 Joint Commission national patient safety goal was to use medications safely by communicating “correct information about a patient’s medicines” and providing “written information on the medications... when discharged from the hospital.”⁶ Thus, confirming appropriate medication execution, adherence, and understanding by the patient’s caregiver and accuracy of discharge medication documentation are critical to ensuring a safe discharge.⁷

As the responsibility for medication administration shifts from hospital provider to home caregiver, children are vulnerable to failures in medication management and understanding. Studies from emergency departments (EDs) reveal that caregivers have difficulty managing all discharge instructions, especially those related to medications.⁵ Caregivers of children discharged from the ED frequently cannot recall medication name,^{8–11} frequency,^{8,9,11,12} duration,^{9,11,12} indications,^{8,12} and side effects.⁹ Additionally, up to 38% report medication nonadherence.^{5,8} More than 40% of caregivers make a mistake when dosing their child’s liquid medication, especially when health literacy rates are low.^{8,13,14} Furthermore, medication dose volumes are often rounded to several decimal places in electronic prescribing systems, making them difficult to understand and accurately administer and leaving children at risk for dosing errors.^{15,16} Because the majority of this work is focused on ED rather than inpatient discharge, the unique challenges related to caregiver medication management and understanding after pediatric hospital discharge remain understudied.^{5,9–13}

In addition, medication documentation discrepancies at care transitions are common, disadvantaging caregivers in correctly conducting discharge tasks.

Studies reveal that discrepancies in discharge documentation are found in 19% to 26% of pediatric charts, with medication duration being frequently omitted.^{17,18} A separate study with similar results revealed that one-third of unintentional discrepancies at the time of hospital admission had potential to cause adverse events.¹⁹ It is unknown if incomplete written discharge instructions are linked with worse caregiver medication management and understanding in an urban minority population with low health literacy.

Quantifying the frequency of discharge medication-related failures and identifying why caregivers mismanage and misunderstand medication instructions after inpatient hospitalization are a critical first step in designing future interventions to improve care transitions. It is also important to evaluate the quality of written discharge instructions in relation to medication management. Therefore, our primary objective was to describe the proportion of failures in caregiver management and understanding of inpatient discharge medications. We then tested the association of documentation discrepancies and sociodemographic factors with any medication-related failure. These data were used as a baseline for a subsequent improvement project.

METHODS

Design and Setting

This study took place in an urban tertiary care academic children’s hospital. The hospital serves a low-income and primarily African American and Hispanic population, with one-third of adults not completing high school and therefore at high risk for low health literacy.^{20,21} It was conducted on the hospital medicine services of 2 general inpatient units (36 beds each) from January 2017 to March 2017. One to 3 service teams per unit care for general medical patients (<13 years old) and complex care and surgical patients (≤21 years old). Each team is an attending-led teaching service, run by house staff (physician assistants, residents, and interns). At discharge, house staff complete a discharge summary and an after-visit summary (AVS). The discharge summary sent to the patient’s general

pediatrician includes hospital course, follow-up, and discharge medication information. The AVS provided to caregivers by the bedside nurse contains standardized section headers for anticipatory guidance and follow-up and medication information. The AVS automatically imports information contained in the electronic prescription (name, dose, route, and interval) during mandatory discharge medicine reconciliation. There is an optional dosing calendar completed by the bedside nurse as well as a free-text box for discharging providers to enter additional instructions if desired, although input is neither standardized nor mandatory. Verbal discharge medication counseling is not standardized and may be done by house staff, nursing, or the pharmacy. Four months before this study, a hospital-based outpatient pharmacy opened, dispensing discharge prescriptions on-site and performing bedside prescription delivery and medication counseling.

Subjects

The study subjects included English-speaking caregivers of patients <18 years old discharged from the pediatric inpatient unit on at least 1 new standing-prescription oral medication, including change in dose of a previous medication. Eligible caregivers had to be primarily responsible for managing medication administration after discharge.

Procedure for Identifying Eligible Caregivers

Eligible caregivers were identified via daily electronic medical record review of patients who were discharged. Each week a convenience sample of caregivers chosen via a quasi-randomized approach were called 48 to 96 hours after discharge and surveyed. Patients’ last names were alphabetized, and we started with a randomly chosen letter every week. Calls proceeded alphabetically for eligible caregivers during regular business hours, evening hours, and on weekends as the primary investigator’s (PI) schedule allowed. The number of completed calls per week ranged from 5 to 20 on the basis of the availability of eligible caregivers. For

consistency in data collection, all calls, determination of failed responses, and chart review for sociodemographic and medication information were performed by the PI (K.P.).

Measures and Survey Tool

The primary outcome measure was the proportions of caregivers who failed each individual question on a 10-item postdischarge questionnaire administered via phone call (Table 1). We also calculated the overall proportion of discharge medication-related failures, a composite outcome in which ≥ 1 incorrect response defined a failure.

To develop the questionnaire, the research team integrated questions related to medication name, dose, frequency, duration, adherence, desired effects, and expected side effects from previous studies⁹⁻¹⁴ with questions related to knowledge of new prescriptions and timing of the next dose due after discharge. Lastly, a question for assessing caregiver difficulty in obtaining medications from the pharmacy was asked to analyze adherence behaviors and in preparation for work to improve our institution's process. We pilot tested the questionnaire with 10 caregivers and modified the language on the basis of feedback.

Specific responses defined in Table 1 were required to determine if the question was correct or incorrect. For example, if the caregiver could not provide the exact name (eg, amoxicillin) or class of medication (eg, antibiotic), the answer to "What medication was it?" was incorrect. If the caregiver did not know why the child was taking the medication or did not know the desired signs that indicated improvement, the question "What are you watching for to know the medication is working?" was incorrect. If the caregiver was not told expected side effects, adjudicated from common resources for medication counseling, or could not list an appropriate one, the answer to "Are there any side effects of the medication you are looking for?" was incorrect.

Secondary measures included the proportion of charts with (1) incomplete medication information on the AVS, (2) discrepant medication information between the discharge summary and AVS, and (3) complex dosing. The AVS was considered incomplete if the information expected to be imported from the electronic prescription and/or completed on the dosing calendar was missing (name, dose, interval, duration, and next dose due). Medication desired

effects and expected side effects information was not imported and was rarely included in free text and so was not included in this outcome. The discharge summary and AVS were considered discrepant if the medication name, dose, interval, and duration were not identical. Given the complicated process of pediatric dosing and limits of the electronic prescribing system to round doses appropriately, a dose was complex if rounded to any decimal other than a whole number or 0.5 mL.²² We aimed to quantify how often our electronic prescribing system generated a dose difficult for caregivers to accurately administer, placing children at risk for dosing errors.

Procedure for Administering Survey

Caregivers gave verbal consent before the survey proceeded. If the patient was discharged on >1 medication, questions were asked of the first eligible medication listed by the caregiver. Question responses were compared to medication information in the chart at the time of the call and deemed either correct/passed or incorrect/failed (Table 1). If the response was unclear, we attempted to clarify. For example, if the duration question response was "a couple more days," we asked for a specific number.

TABLE 1 Survey Questions Used to Evaluate for a Discharge Medication-Related Failure

Question	Category of Failure	Definition of Incorrect Answer
Did you go home on any medications?	Unaware prescription exists	Unaware child was to continue taking medication after discharge
What medication was it?	Unaware of name and/or class	Unaware of or wrong medication name or class
Did you have any trouble getting it from the pharmacy?	Pharmacy trouble	Did not pick up medication or delay in obtaining medication
When did you start the medication?	Wrong start time	Missed dose between discharge and when next dose was due
How much medication are you giving?	Wrong dose	Unaware of dose or reported dose differs by $>10\%$ of prescription ²⁹
How many times a day are you giving the medication?	Wrong interval	Unaware of interval or reported interval does not match prescription
Was there ever a time you had to miss a dose?	Missed doses	Less than 80% reported adherence to dosing regimen ³⁰
How long will you give the medication for?	Wrong duration	Unaware of total duration; stopping medication early, leading to $<80\%$ adherence ³⁰ ; or unaware that medication is chronic and has no end date
What are you watching for to know the medication is working?	Unaware of desired effects	Unaware of child taking medication, never told why child is taking medication, or never told how to know child is improved
Are there any side effects of the medication you are looking for?	Unaware of expected side effects	Unaware of or never told about any side effects of medication

If the response was incorrect, we determined the danger of the response and either educated, referred the caregiver to his or her pediatrician, or provided the inpatient unit's phone number to rectify discrepancies.

Procedure for Collection of Secondary Outcomes and Independent Variables

After the survey, the PI reviewed the chart to collect secondary outcome and independent variable data, including use of a hospital-based pharmacy, number and class of eligible medications, and discharge date. The PI also queried the institution's medical database, Looking Glass Clinical Analytics (Streamline Health, Atlanta, GA), to collect length of stay, All Patient Refined Diagnosis Related Groups hospital code, and sociodemographic data (age, sex, race, ethnicity, and socioeconomic status [SES]).

Statistical Analysis

We describe the proportions of (1) failed question responses, (2) discharge medication-related failures, (3) incomplete AVS medication information, (4) discrepant medication information between the discharge summary and AVS, and (5) complex dosing. Regarding the primary outcome, if correct responses could not be verified because of lack of chart documentation or because caregiver responses revealed they had the information elsewhere (eg, printed on prescription), that question was excluded from the composite outcome results. As baseline data for an improvement project, this approach biases results toward the null hypothesis that there is no difference between the preintervention and postintervention periods. We also performed sensitivity analyses, and we either (1) considered unverifiable data as a failure or (2) excluded those caregivers with unverifiable data from the analysis. Given comparable sensitivity analyses results, caregivers with and without a discharge medication-related failure by using the primary analysis structure were compared on independent variables and secondary outcomes by using the Wilcoxon rank test for continuous variables and the χ^2 test or Fisher's exact test for categorical variables.

We also tested the relationship between a missing medication category on the AVS and failure on the associated survey question. All analyses were performed by using Stata 14.0 (StataCorp, College Station, TX). This study was approved by the Institutional Review Board at the Albert Einstein College of Medicine.

RESULTS

Analysis of Discharge Medication-Related Failures and Discharge Documentation

A total of 245 caregivers were called, and 157 were included in the final analysis (64% response rate). Of those not included, 80% did not answer, 7% requested a call back and were not subsequently reached, 5% were not interested in participating, and 8% were not able to complete the survey. The median patient age was 3 years (interquartile range: 1.6–6 years).

A total of 110 (70%) caregivers had a discharge medication-related failure (categorized in Fig 1). Of included caregivers, the most commonly failed question related to lack of awareness of expected side effects (52%), which was followed by wrong duration (17%), wrong start time (16%), and lack of awareness of desired effects (12%). In sensitivity analyses of unverifiable data ($n = 17$ caregivers), the failure rate was 81% if all unverified data were considered a failure and 77% if data were excluded. If "Are there any side effects of the medication you are looking for?" was eliminated from the primary analysis, the failure rate decreased to 46%.

Eighty percent of AVSs lacked key medication information, most commonly duration (41%) and/or when the next dose was due after discharge (74%) (Table 2). There was no statistically significant association between missing duration or next dose due documentation and failing the associated survey question.

Association Between Independent Variables, Secondary Outcomes, and Discharge Medication-Related Failures

In Table 3, we compare the sociodemographics, clinical variables, and

secondary outcomes of caregivers with and without a discharge medication-related failure. There was a statistically significant association for race and/or ethnicity ($P = .03$). Hispanic and non-Hispanic African American caregivers had the highest failure rates (37% and 39%, respectively). Of 110 caregivers with a discharge medication-related failure, 39% were non-Hispanic African American and 12% were non-Hispanic other race. For those without a failure, 23.4% were non-Hispanic African American and 29.8% were non-Hispanic other race (Table 3). There was no statistically significant association between secondary outcomes and a discharge medication-related failure.

DISCUSSION

To our knowledge, this is the first study in which failures in medication management, understanding, and documentation are integrated to describe specific reasons for caregiver medication challenges after pediatric hospital discharge. By analyzing caregiver management and understanding of discharge medications as well as associated medication documentation, we found that an overwhelming majority of caregivers had a discharge medication-related failure and that most documentation lacked key medication information.

Our discharge medication-related failure rate of 70% after inpatient discharge is similar to previously reported rates of caregiver medication administration knowledge after ED discharge. Grover et al¹⁰ found that only 38% of caregivers recalled the correct medication dose, frequency, and duration after ED discharge. Our results further reveal domains in which caregivers lack knowledge and report nonadherence after inpatient hospitalization, including when the next dose after discharge is due and medication desired effects and expected side effects. In a study in which the effectiveness of standardized ED discharge teaching was evaluated, Isaacman et al¹¹ determined that accurate parental recall of medication data (name, dose, frequency, and duration) can be improved to >90% with a standardized discharge medication education process. Future studies to

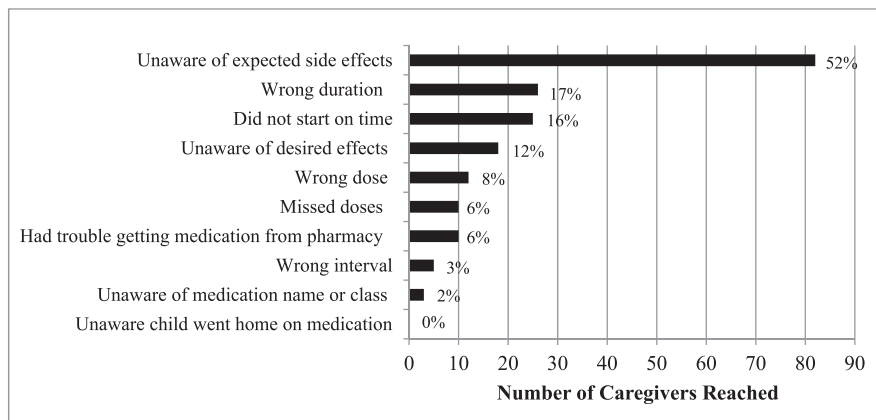


FIGURE 1 Categories of failures ($n = 157$). Percentages do not total 100% because caregivers may have >1 failure.

evaluate a thorough and standardized discharge medication process in the inpatient unit are warranted.

We found that more than half of caregivers were unaware of expected medication side effects. Knowledge of side effects is not well studied in pediatrics but is highlighted by the Agency for Healthcare Research and Quality as important for discharge planning.^{5,23} A pediatric ED study in the Kingdom of Saudi Arabia revealed that 47% of subjects recognized possible medication side effects.⁹ Our study revealed a similar frequency but expands these findings to an American and primarily minority population, filling an understudied research gap in the pediatric literature. Adult patients who recalled having side effects explained were significantly less likely to experience an adverse drug event.²⁴ More research is necessary to elucidate the importance of side-effect counseling during pediatric care transitions.

Additionally, 80% of documentation provided to caregivers lacked important medication information, most often related to duration

and when the next dose was due after discharge. An even higher percent lacked key information related to medication desired effects and side effects. Although caregivers frequently lacked knowledge in similar domains, there was no significant association between missing written information and failing the associated survey question. Medication discrepancies between various forms of documentation are common after pediatric discharge,^{17,18} although our study is 1 of the first to specifically describe the prevalence of medication domains frequently omitted from discharge instructions. This may be due to problems with physician prescription writing (by using free text), transfer of prescriptions to the pharmacy electronically, and/or automatic population of the prescription into the written AVS. Similarly, we report a 25% prevalence of unrounded, difficult-to-administer dosing volumes for pediatric discharge prescriptions, which has only previously been reported in inpatient order entry.¹⁶ This finding is critical to future studies for improving electronic prescribing system

pediatric dose rounding. Both discharge preparation and medication counseling are dynamic processes that involve multiple individuals and various modalities of education. More research is necessary for evaluating the role of written instructions and complex dosing as part of the entire process to enhance caregiver medication management and understanding.

In our study, a statistically significant association exists by race and/or ethnicity, with Hispanics and Non-Hispanic African Americans having the highest failure rate. Previous studies have revealed similar race-related disparities in areas such as worse asthma control, poorer diabetes management, and increased likelihood of readmission for non-Hispanic African American children, all possibly due to medication understanding.²⁵⁻²⁷ Minority race and/or ethnicity is a risk factor for caregiver discharge management errors and may be linked to low health literacy.⁵ In our study of inpatient discharge-medication failures, this finding may be related to low health literacy, cultural differences, or disparities in SES or education. More research is needed to better understand these disparities and identify solutions for improvement.²¹

Our study is limited by our outcome, which was based on caregiver self-report and recall. Although we confirmed the accuracy of reported medication information by comparing it to the chart, we could not confirm if caregivers were accurately executing instructions. Similarly, we did not direct caregivers on use of written instructions during the survey, so some may have referenced written instructions, which may have introduced bias against caregivers who were not in direct possession of the documents. The questionnaire we developed is not validated in the literature because this is an understudied area of pediatric research, but it was pilot tested with caregivers in our study and modified. Additionally, available resources limited our results to only English-speaking caregivers. Limited English proficiency has been linked to medication errors,²⁸ and it is likely that our failure rate would be higher if caregivers with limited

TABLE 2 Descriptive Statistics for Secondary Outcomes

	n (%)	Total ^a
AVS with missing information	124 (80)	155
Discrepant medication information between discharge summary and AVS	8 (5)	152
Prescriptions with complex medication dosing	39 (25)	157

^a Each secondary outcome has a different total because of 2 charts missing an AVS and 5 charts missing a discharge summary or AVS, making adjudication of these outcomes impossible.

TABLE 3 Comparison of Sociodemographics, Clinical Variables, and Secondary Outcomes for Caregivers With a Discharge Medication–Related Failure

	Failure (n = 110)	No Failure (n = 47)	P
Independent variables			
Age, y, median (IQR)	3 (1.8 to 5.0)	3 (1.2 to 7.0)	.93
SES z score, median (IQR) ^a	−3.5 (−7.0 to −1.6)	−3.0 (−5.8 to −1.0)	.26
LOS, d, median (IQR)	1.9 (1.2 to 3.1)	2.3 (1.7 to 3.2)	.06
Sex of child, female, n (%)	50 (46)	26 (55)	.26
Race and/or ethnicity, n (%)			
Hispanic	41 (37)	16 (34)	.03
Non-Hispanic African American	43 (39)	11 (23)	
Non-Hispanic other race	13 (12)	14 (30)	
Unavailable	13 (12)	6 (13)	
Used hospital's outpatient pharmacy, n (%)	60 (55)	28 (60)	.56
No. eligible medications, n (%) ^b			
1	80 (73)	38 (81)	.28
2	23 (21)	5 (11)	
≥3	7 (6)	4 (8)	
Class of medication, n (%) ^b			
Steroid	37 (34)	13 (28)	.79
Antibiotic or antifungal	44 (40)	23 (49)	
Antiviral	17 (15)	6 (13)	
Other	12 (11)	5 (10)	
APR-DRG of hospitalization, n (%) ^b			
Asthma	34 (31)	11 (23)	.47
Respiratory tract infection	38 (35)	13 (28)	
Gastrointestinal problem	7 (6)	3 (6)	
Genitourinary problem	3 (3)	4 (9)	
Skin and soft-tissue infection	6 (5)	3 (6)	
Other	22 (20)	13 (28)	
Weekend discharge, n (%)	41 (37)	14 (30)	
Secondary outcomes, n (%)			
AVS missing information	88 (82)	36 (77)	.49
Discrepant chart ^b	3 (3)	5 (11)	.06
Complex dosing	24 (22)	15 (32)	.18

Total sample size: SES: 106 failures and 45 no failure; discrepant chart: 106 failures and 46 no failure; AVS missing information: 108 failures and 47 no failure. APR-DRG, All Patient Refined Diagnosis Related Group; IQR, interquartile range; LOS, length of stay; —, not applicable.

^a SES was reported as a z score calculated from small census tract data based on the patient's home address; it reveals the deviation from the mean of the New York State population.⁵¹

^b Fisher's exact test was used.

may face different adherence challenges. Additionally, this study was not powered to detect differences in some of the independent variables we measured; thus, a type II error is possible. Finally, this is a study at a single institution in a primarily underserved minority population, and our findings may not represent the population at other institutions.

CONCLUSIONS

Our study provides important insight to caregiver medication challenges after inpatient hospitalization. More than two-thirds of caregivers mismanage and misunderstand discharge medications, particularly related to medication side effects, duration, and start time after hospital discharge. This finding, combined with poor medication documentation at the time of discharge, may place children at risk for medication errors. Future work to optimize the discharge process to support caregiver management and understanding of medications is needed.

REFERENCES

1. Auger KA, Simon TD, Cooperberg D, et al. Summary of STARNet: Seamless Transitions and (Re)admissions Network. *Pediatrics*. 2015;135(1):164–175
2. Berry JG, Blaine K, Rogers J, et al. A framework of pediatric hospital discharge care informed by legislation, research, and practice. *JAMA Pediatr*. 2014;168(10):955–962; quiz 965–966
3. Wu S, Tyler A, Logsdon T, et al. A quality improvement collaborative to improve the discharge process for hospitalized children. *Pediatrics*. 2016;138(2):e20143604
4. Bourgeois FT, Mandl KD, Valim C, Shannon MW. Pediatric adverse drug events in the outpatient setting: an 11-year national analysis. *Pediatrics*. 2009; 124(4). Available at: www.pediatrics.org/cgi/content/full/124/4/e744
5. Glick AF, Farkas JS, Nicholson J, et al. Parental management of discharge instructions: a systematic review. *Pediatrics*. 2017;140(2):e20164165
6. The Joint Commission. National patient safety goals effective January 2018.

English proficiency were evaluated. Likewise, we did not directly measure health literacy. Although we know our study took place in a population with low health literacy, and we know low health literacy is a risk factor for making medication errors, we cannot make conclusions about our findings in relation to the rates of caregiver health literacy on pediatric inpatient units.

Understanding medication challenges in this population is an important direction for future work.

Our results are limited to a young age range because our hospital medicine services tend to care for children <13 years old; therefore, our results cannot be generalized to teenagers who may be involved in administering their own medications or

- Available at: https://www.jointcommission.org/assets/1/6/NPSG_Chapter_HAP_Jan2018.pdf. Accessed July 18, 2018
7. Cua YM, Kripalani S. Medication use in the transition from hospital to home. *Ann Acad Med Singapore*. 2008;37(2):136–141
 8. Yin HS, Dreyer BP, van Schaick L, Foltin GL, Dinglas C, Mendelsohn AL. Randomized controlled trial of a pictogram-based intervention to reduce liquid medication dosing errors and improve adherence among caregivers of young children. *Arch Pediatr Adolesc Med*. 2008;162(9):814–822
 9. Al-Harthy N, Sudersanadas KM, Al-Mutairi M, et al. Efficacy of patient discharge instructions: a pointer toward caregiver friendly communication methods from pediatric emergency personnel. *J Family Community Med*. 2016;23(3):155–160
 10. Grover G, Berkowitz CD, Lewis RJ. Parental recall after a visit to the emergency department. *Clin Pediatr (Phila)*. 1994;33(4):194–201
 11. Isaacman DJ, Purvis K, Gyuro J, Anderson Y, Smith D. Standardized instructions: do they improve communication of discharge information from the emergency department? *Pediatrics*. 1992;89(6, pt 2):1204–1208
 12. Kaestli L, Noble S, Combesure C, et al. Drug information leaflets improve parental knowledge of their child's treatment at paediatric emergency department discharge. *Eur J Hosp Pharm Sci Pract*. 2016;23(3):151–155
 13. Yin HS, Dreyer BP, Moreira HA, et al. Liquid medication dosing errors in children: role of provider counseling strategies. *Acad Pediatr*. 2014;14(3):262–270
 14. Yin HS, Parker RM, Sanders LM, et al. Liquid medication errors and dosing tools: a randomized controlled experiment. *Pediatrics*. 2016;138(4):e20160357
 15. Morecroft CW, Gill A, Caldwell NA, Wood R, Crolla J, Antwi-Boasiako L. Are prescribed doses of medicine for children measurable? *Arch Dis Child*. 2012;97(5):e18
 16. Jones AN, Miller JL, Neely S, et al. Prevalence of unrounded medication doses and associated factors among hospitalized pediatric patients. *J Pediatr Pharmacol Ther*. 2017;22(4):286–292
 17. Gattari TB, Krieger LN, Hu HM, Mychaliska KP. Medication discrepancies at pediatric hospital discharge. *Hosp Pediatr*. 2015;5(8):439–445
 18. Johnson KB, Butta JK, Donohue PK, Glenn DJ, Holtzman NA. Discharging patients with prescriptions instead of medications: sequelae in a teaching hospital. *Pediatrics*. 1996;97(4):481–485
 19. Coffey M, Mack L, Streitenberger K, Bishara T, De Faveri L, Matlow A. Prevalence and clinical significance of medication discrepancies at pediatric hospital admission. *Acad Pediatr*. 2009;9(5):360–365.e1
 20. US Census Bureau. QuickFacts: Bronx County (Bronx Borough), New York. Available at: <https://www.census.gov/quickfacts/fact/map/bronxcountybronxboroughnewyork/EDU635216#viewtop>. Accessed July 18, 2018
 21. Yin HS, Johnson M, Mendelsohn AL, Abrams MA, Sanders LM, Dreyer BP. The health literacy of parents in the United States: a nationally representative study. *Pediatrics*. 2009;124(suppl 3):S289–S298
 22. Johnson KB, Lee CK, Spooner SA, Davison CL, Helmke JS, Weinberg ST. Automated dose-rounding recommendations for pediatric medications. *Pediatrics*. 2011;128(2). Available at: www.pediatrics.org/cgi/content/full/128/2/e422
 23. Agency for Healthcare Research and Quality. Strategy 4: care transitions from hospital to home: IDEAL discharge planning. Available at: www.ahrq.gov/professionals/systems/hospital/engagingfamilies/strategy4/index.html. Accessed October 2, 2018
 24. Forster AJ, Murff HJ, Peterson JF, Gandhi TK, Bates DW. Adverse drug events occurring following hospital discharge. *J Gen Intern Med*. 2005;20(4):317–323
 25. Mitchell SJ, Bilderback AL, Okelo SO. Racial disparities in asthma morbidity among pediatric patients seeking asthma specialist care. *Acad Pediatr*. 2016;16(1):64–67
 26. Auslander WF, Thompson S, Dreitzer D, White NH, Santiago JV. Disparity in glycemic control and adherence between African-American and Caucasian youths with diabetes. Family and community contexts. *Diabetes Care*. 1997;20(10):1569–1575
 27. Parikh K, Berry J, Hall M, et al. Racial and ethnic differences in pediatric readmissions for common chronic conditions. *J Pediatr*. 2017;186:158–164.e1
 28. Yin HS, Dreyer BP, Ugboaja DC, et al. Unit of measurement used and parent medication dosing errors. *Pediatrics*. 2014;134(2). Available at: www.pediatrics.org/cgi/content/full/134/2/e354
 29. Rinke ML, Moon M, Clark JS, Mudd S, Miller MR. Prescribing errors in a pediatric emergency department. *Pediatr Emerg Care*. 2008;24(1):1–8
 30. Osterberg L, Blaschke T. Adherence to medication. *N Engl J Med*. 2005;353(5):487–497
 31. Diez Roux AV, Merkin SS, Arnett D, et al. Neighborhood of residence and incidence of coronary heart disease. *N Engl J Med*. 2001;345(2):99–106

Caregiver Medication Management and Understanding After Pediatric Hospital Discharge

Kaitlyn Philips, Roy Zhou, Diana S. Lee, Christine Marrese, Joanne Nazif, Constance Browne, Mark Sinnott, Steven Tuckman, Kimberly Griffith, Victoria Kiely, Marcia Lutz, Anjali Modi and Michael L. Rinke

Hospital Pediatrics 2019;9;844

DOI: 10.1542/hpeds.2019-0036 originally published online October 3, 2019;

Updated Information & Services	including high resolution figures, can be found at: http://hosppeds.aappublications.org/content/9/11/844
Supplementary Material	Supplementary material can be found at:
References	This article cites 25 articles, 11 of which you can access for free at: http://hosppeds.aappublications.org/content/9/11/844#BIBL
Subspecialty Collections	This article, along with others on similar topics, appears in the following collection(s): Continuity of Care Transition & Discharge Planning http://www.hosppeds.aappublications.org/cgi/collection/continuity_of_care_transition_-_discharge_planning_sub Hospital Medicine http://www.hosppeds.aappublications.org/cgi/collection/hospital_medicine_sub Patient Education/Patient Safety/Public Education http://www.hosppeds.aappublications.org/cgi/collection/patient_education:patient_safety:public_education_sub
Permissions & Licensing	Information about reproducing this article in parts (figures, tables) or in its entirety can be found online at: http://www.hosppeds.aappublications.org/site/misc/Permissions.xhtml
Reprints	Information about ordering reprints can be found online: http://www.hosppeds.aappublications.org/site/misc/reprints.xhtml

Hospital Pediatrics®

AN OFFICIAL JOURNAL OF THE AMERICAN ACADEMY OF PEDIATRICS

Caregiver Medication Management and Understanding After Pediatric Hospital Discharge

Kaitlyn Philips, Roy Zhou, Diana S. Lee, Christine Marrese, Joanne Nazif, Constance Browne, Mark Sinnett, Steven Tuckman, Kimberly Griffith, Victoria Kiely, Marcia Lutz, Anjali Modi and Michael L. Rinke

Hospital Pediatrics 2019;9;844

DOI: 10.1542/hpeds.2019-0036 originally published online October 3, 2019;

The online version of this article, along with updated information and services, is located on the World Wide Web at:

<http://hosppeds.aappublications.org/content/9/11/844>

Hospital Pediatrics is an official journal of the American Academy of Pediatrics. Hospital Pediatrics is owned, published, and trademarked by the American Academy of Pediatrics, 345 Park Avenue, Itasca, Illinois, 60143. Copyright © 2019 by the American Academy of Pediatrics. All rights reserved. Print ISSN: 1073-0397.

American Academy of Pediatrics

DEDICATED TO THE HEALTH OF ALL CHILDREN®

