

Factors Associated With Pickup of Pediatric Discharge Prescriptions

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BACKGROUND AND OBJECTIVES: Lack of medication pickup is associated with worse clinical outcomes for select patients. Identification of risk factors for not picking up discharge medications or approaches to this problem have received little study. We sought to identify factors associated with medication pickup rates after hospitalization at a tertiary care children's hospital.

METHODS: We conducted a retrospective cohort study of 178 discharges from a children's hospital. We contacted pharmacies that received electronic prescriptions to ascertain whether patients and families picked up medications. The principal outcome was pickup of all medications within 48 hours of discharge. Covariates included demographic data, insurance type, discharge diagnosis, home zip code median income, medication number and/or class, and pharmacy type (on-site versus off-site). We performed a multivariable logistic regression analysis.

RESULTS: Overall, 142 of 178 (80%) discharges involved medication pickup. Patient age and sex, diagnosis, discharge day, primary language, and hospitalization length had no statistically significant association with medication pickup. On the multivariable analysis, a higher home zip code median income ($P = .045$; highest versus lowest groups) had a statistically significant association with increased medication pickup. Private insurance had a statistically significant association with higher pickup rate on the univariable analysis ($P = .01$) but not on the multivariable analysis, which included zip code income ($P = .072$). On-site pharmacy use ($P = .048$) and prescription of an anti-infective ($P = .003$) had statistically significant associations with higher medication pickup rates.

CONCLUSIONS: Certain factors are associated with rates of medication pickup after discharge. Use of an on-site hospital pharmacy may represent a strategy to improve medication pickup rates in children who are hospitalized.

ABSTRACT

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Patients discharged after hospitalization often require continuation of medications initiated during their hospital stay, but these medications are often not picked up. One large study of outpatients of all ages found that ~22% of prescriptions went unfilled.¹ Another study of primary care adult patients revealed that 5.2% of prescriptions were not filled.² In a large study of pediatric outpatients, 12% of prescriptions went unfilled.³ A study of adults after myocardial infarction revealed that ~20% of medications were not picked up, and patients who did not pick up prescriptions had an increased risk of mortality.⁴

Studies of medication pickup among pediatric patients are limited. Most studies of pediatric prescription filling involve outpatients^{3,5} or patients discharged from the emergency department.^{6–11} Most studies of medication pickup among pediatric patients discharged from a hospital have focused primarily on those hospitalized for asthma.^{12,13} These studies have revealed that children who do not pick up discharge medications have an increased rate of emergency department return visits and readmissions. The only study in which the authors examined medication pickup rates in children discharged from a general hospital with varied conditions revealed that ~25% did not pick up medications.¹⁴ This study did not consider insurance or income as factors and predated the widespread use of electronic prescriptions.

Studies describing approaches to addressing the issue of pediatric medication pickup are limited. In 1 study, the authors investigated bedside medication delivery to the families of children hospitalized for asthma.¹² This study found that this intervention was associated with a reduced rate of revisits to the emergency department. No research has evaluated rates of prescription pickup among children hospitalized for a variety of medical conditions at a tertiary care children's hospital. In addition, no research has investigated the use of an on-site pharmacy as an approach to improving medication pickup rates among children who are

hospitalized. We hypothesized that certain variables, such as Medicaid insurance status and lower home zip code median household income, would be associated with lower medication pickup rates and that use of an on-site pharmacy would mediate this risk by reducing issues related to pharmacy access and transportation. We performed a retrospective study of pediatric medical patients discharged from our institution to examine these questions. Our goal was for this study to serve as a baseline for a quality improvement intervention to improve discharge medication pickup rates.

METHODS

Design

We conducted a retrospective study using clinical data from the electronic health record (EHR) of a freestanding children's hospital in the northeastern United States combined with calling patients' pharmacies to inquire about medication pickup. The hospital's institutional review board approved all aspects of the study, including calling pharmacies, as a quality improvement project that did not require patient and parent consent.

Setting

Ours is a tertiary care teaching children's hospital with ~200 beds. There are 4 general pediatric inpatient teams, each carrying an average of ~12 patients. These teams include a pediatric hospitalist or academic general pediatrician, residents, and medical students. There are also several subspecialty teams supervised by pediatric specialists. Residents on all teams generally write orders for discharge prescriptions under supervision of an attending physician. The default is for prescriptions to be written electronically (except for controlled substances or patient and family request), and almost all medications are written this way. At the time of this study, controlled medications could not be prescribed electronically because of legal restrictions. Our EHR (Epic Systems, Verona, WI) allows electronic prescriptions to all pharmacies in a nationwide database. The patient's preferred pharmacy is identified on admission by the hospital's administrative

admissions staff, indicated in the EHR, and is usually confirmed on discharge by the prescribing provider.

On-site Pharmacy

This pharmacy is located within the hospital building but outside of the inpatient unit (approximately a 5-minute walk away) near outpatient clinic areas. The pharmacy is hospital owned and staffed by at least 1 pharmacist and 1 technician when open (9:00 AM–5:30 PM weekdays and 8:00 AM–1:00 PM on Saturdays). The on-site pharmacy accepts most local insurance plans, including all types of Delaware Medicaid, some types of Pennsylvania Medicaid, and essentially all local commercial insurance plans.

If the patient's family is unaware of the existence of the on-site pharmacy, the inpatient medical team often offers this pharmacy as an option for filling the patient's prescriptions. This offer may occur more frequently in circumstances when there is concern that the medications or formulations may be difficult to find at other pharmacies or when social concerns may complicate medication pickup. In cases in which the inpatient team uses the on-site pharmacy, there is no specific documentation of why the team chose to prescribe medications there for that particular patient.

Study Procedure

We collected inpatient discharge data from a consecutive 15-day period in November 2015. We excluded patients discharged from surgical subspecialties because many of these patients receive prescriptions for as-needed pain medications, including narcotics, which could not be prescribed electronically. We excluded patients who had no medications prescribed on discharge and those whose medications were intravenous or subcutaneous only (these are often delivered by home care companies), patients with prescriptions for controlled medications only (these were written by using paper scripts), and patients whose medications were used as needed or were available over the counter. We excluded medications prescribed on an as-needed basis because nonpickup may have indicated that the medication was not

required rather than that the medication was required but not picked up. One notable exception was albuterol in patients with asthma when it was prescribed for scheduled dosing for several days followed by as-needed dosing.

Data Collection

Of the 526 discharges initially considered, 178 were included in our analysis. We obtained the following data for each patient: age, sex, insurance type, zip code, and primary language as noted in the EHR. We also recorded the following clinical data: primary diagnosis associated with medication prescription (based on physician discharge summary), length of hospitalization (based on time of admission order and discharge order), class of medications prescribed, number of discharge medications, whether discharge occurred on a weekend or weekday, and name and type of pharmacy used. Regarding primary diagnosis, we included the diagnosis associated with medication prescription(s). For example, if a patient was hospitalized with bronchiolitis (not requiring prescriptions) and otitis media (requiring a prescription), the patient was classified as having otitis media. If the patient was hospitalized with asthma (requiring prescriptions) and otitis media (requiring a prescription), the patient was classified as having both asthma and otitis media. We included discharges characterized as observation as well as inpatient stays. An investigator (A.L.) called the pharmacy in late November 2015 for each discharge to establish whether and when patients or families picked up their medications.

Outcome Measure: Medication Pickup

We considered medications picked up if patients or families picked up all prescribed medications within 48 hours of discharge. However, if the EHR or the pharmacy indicated that these medications had been prescribed previously and 2 investigators agreed that the patient likely still had the medication available, that medication was excluded from the analysis. For example, if a child with known asthma was discharged with albuterol, prednisone, and a new prescription for an inhaled steroid, and

the prednisone and inhaled steroid were picked up, but the albuterol was not, we assumed that the patient had albuterol available from previous prescriptions.

Data Analysis

We used data from the US Census Bureau¹⁵ for median annual household income in the patient's home zip code. We recoded the zip code annual median income into 3 groups: <\$50 000, \$50 000–79 000, and >\$79 000. We coded the patient's age and length of stay each into 4 groups, which were determined a priori.

Data were summarized by number and percentages. We used χ^2 or Fisher's exact test as appropriate to compare the proportion of medication pickup across study variables. We used univariable logistic regression to examine the association of study variables with medication pickup rates. We report the odds ratio (OR) and the corresponding 95% confidence interval (CI). We used

the backward stepwise method of multivariable logistic regression to select variables that substantially influence the outcome (medications being picked up). We used a cutoff significance point of .1 to retain a variable in this model. All tests were 2-tailed at the level of significance of .05. We used statistical software SPSS version 25 (IBM SPSS Statistics, IBM Corporation, Armonk, NY) and R version 3.4.3 for data analysis.

RESULTS

In Fig 1, we outline how patients' charts were assessed for study inclusion. All pharmacies called were reachable and forthcoming with the requested information after the investigator provided patient identifiers. In Table 1, we summarize the clinical data of the 178 discharges studied. These patients represented a mix of ages, sources of medical insurance, zip code median household annual incomes, and lengths of stay. Notably, 44% of the patients

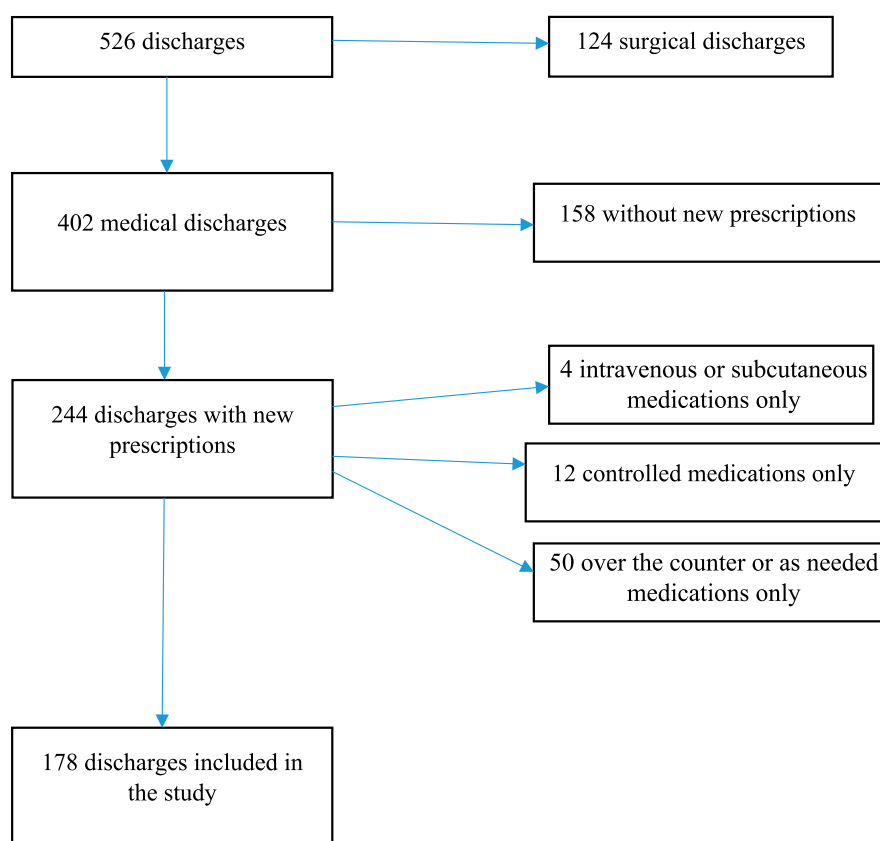


FIGURE 1 Chart selection process for study inclusion.

TABLE 1 Clinical Variables of the Discharges Studied (*N* = 178) and Association With Medication Pickup

Variable	<i>n</i> (%)	Pickup Rate, %	Unadjusted OR of Medication Pickup (95% CI)	<i>P</i>
Total patients studied	178 (100)	80	—	—
Patient variables				
Age, y				
0–1	29 (16)	76	Reference	.87
2–5	47 (31)	79	1.17 (0.39–3.33)	
6–10	54 (25)	80	1.27 (0.40–3.91)	
11–20	48 (27)	83	1.59 (0.50–5.02)	
Sex				
Female	95 (53)	79	Reference	.91
Male	83 (47)	81	1.12 (0.54–2.35)	
Insurance				
Private	99 (56)	87	2.71 (1.23–5.8)	.01
Medicaid	79 (44)	71	Reference	
Family variables				
Home zip code median Household income, \$				
<50 000	46 (26)	70	Reference	<.01 ^a
50 000–79 000	85 (48)	78	1.52 (0.67–3.41)	
>79 000	47 (26)	94	6.42 (1.90–29.53)	
Primary language				
English	169 (95)	80	Reference	>0.99 ^a
Non-English	9 (5)	78	0.88 (0.20–6.09)	
Clinical variables				
Discharge day				
Weekend	50 (28)	78	Reference	.87
Weekday	128 (72)	80	1.16 (0.51–2.54)	
Length of hospitalization, h				
<24	39 (22)	82	Reference	.98 ^a
24–48	83 (47)	80	0.85 (0.30–2.19)	
48–72	19 (11)	79	0.82 (0.21–3.53)	
>72	37 (21)	78	0.79 (0.25–2.48)	
Patient's medical service				
General pediatrics	135 (76)	79	Reference	.93
Nonsurgical subspecialty	43 (24)	81	1.14 (0.49–2.90)	
Discharge diagnosis ^b				
Asthma	50 (26)	72	0.53 (0.25–1.15)	.11
Respiratory (nonasthma)	40 (21)	85	1.25 (0.5–3.12)	.63
Skin or soft-tissue infection	17 (9)	94	4.44 (0.57–34.69)	.81
Seizures or headache	13 (7)	77	0.83 (0.22–3.2)	.79
Others	44 (25)	75	0.69 (0.31–1.55)	.37
No. medications				
1	94 (53)	83	Reference	.34 ^a
2	48 (27)	79	0.78 (0.33–1.93)	
3	23 (13)	78	0.74 (0.25–2.49)	
≥4	13 (7)	62	0.33 (0.10–1.20)	

had Medicaid, and almost all patients identified English as their primary language. Three patients fell into the category of picking up all medications except albuterol, 2 of whom had filled albuterol within the last 3 weeks.

Medication pickup rates in the groups of patients studied are also summarized in Table 1. Eighty percent of patients (142 of 178) picked up all prescribed medications as defined above. Certain clinical factors had statistically significant associations with pickup rates. In Table 2, we summarize the multivariable analysis of selected characteristics with adjusted ORs for medication pickup. To assess effect size, we found that the area under the receiver operating characteristic curve for these characteristics was 0.78 (SE of 0.04), indicating a good prediction capability of the model.

Insurance Type

Public insurance was associated with lower rates of medication pickup. Whereas 86 of 99 (87%) patients with private insurance picked up medications as prescribed, 56 of 79 (71%) patients with Medicaid did so (OR 2.71; CI 1.23–5.80; *P* = .01). The multivariable analysis (Table 2) revealed an adjusted OR of medication pickup of 2.17 for patients with private insurance compared with those with Medicaid (CI 0.93–5.26; *P* = .072).

Zip Code Median Household Income

Patients with a primary address in a zip code among the lowest median annual household income group had the lowest rates of medication pickup (32 of 46; 70%), whereas those whose address was in a zip code in the highest median income group had the highest rates (44 of 47; 94%; OR 6.42; CI 1.90–29.53; *P* < .01). The multivariable analysis revealed an OR of 4.38 (CI 1.03–18.60; *P* = .045) for medication pickup for those who lived in zip codes with a median annual household income >\$79 000 compared with those who lived in zip codes with a median annual household income <\$50 000.

Pharmacy Location

Patients whose discharge prescriptions were filled by the on-site pharmacy had

TABLE 1 Continued

Variable	n (%)	Pickup Rate, %	Unadjusted OR of Medication Pickup (95% CI)	P
Pharmacy location				.08 ^a
On-site	21 (12)	95	5.74 (0.74–44.27)	
Off-site	157 (88)	78	Reference	

For discharge diagnosis, 13 discharges were assigned >1, so the total number of discharge diagnoses equals 191. —, not applicable.

^a Generated by Fisher's exact test (otherwise generated by χ^2 test).

^b For these categories, each diagnosis was compared with all others (asthma versus nonasthma, etc).

with pickup rates of discharge medications. Health care disparities have received significant recent attention in the medical literature,^{16–19} and authors of previous studies of children after emergency department visits have reported similar findings.^{7,8} We are the first to report an association between median zip code annual income and medication pickup rates after hospital discharge, although a previous study revealed similar results among outpatients.³ In the multivariable analysis, home zip code annual income remained in statistically significant association with medication pickup rates, whereas, interestingly, Medicaid status did not. We surmise that several factors may explain these findings. Poorer areas may have fewer pharmacies; such areas have been described as “pharmacy deserts.”²⁰ Transportation to off-site pharmacies may be difficult to access for many families, especially those without regular access to a vehicle.³ Certain Medicaid policies may also require co-pays for certain medications that may be cost-prohibitive for some families. A British study of pickup rates in primary care patients revealed that patients exempt from prescription charges had higher pickup rates compared with patients not exempt from such charges.² Even relatively small co-pays may significantly affect parental behavior in seeking care for their children.²¹

We found that medication class was associated with medication filling rates. Specifically, we found that prescriptions for anti-infectives were more likely to be filled, whereas asthma prescriptions were less likely to be filled. This finding reveals that families’ beliefs about medications may contribute to whether families pick up medications on discharge. Previous research also revealed that anti-infectives prescribed for children in outpatient settings are more likely to be picked up than other types of medications.^{3,5} Inclusion of an oral anti-infective prescription might signal to a caregiver that this medication is required acutely with less concern for long-term side effects. Other studies have also revealed a reduced rate of medication pickup for asthma medications.¹⁰ The authors of these studies have offered several possible explanations for this

higher pickup rates (20 of 21; 95%) compared with those whose medications were sent to off-site pharmacies (122 of 157; 78%; OR 5.74; CI 0.74–44.27; $P = .08$). The multivariable analysis revealed an OR of 8.36 for pickup of prescriptions sent to the on-site pharmacy compared with off-site pharmacies (CI 1.01–68.8; $P = .048$).

Medication Type

In Table 3, we outline unadjusted ORs for medication pickup on the basis of type of medication prescribed. Patients prescribed oral anti-infective medications picked up their medications at higher rates than those with other medication types prescribed (65 of 71; 92%; OR 4.22; CI 1.65–10.77; $P < .01$). This variable remained in the multivariable analysis with an OR of 4.51 (CI 1.7–12.0; $P = .003$). In contrast, patients with asthma medications picked up their medications less frequently than those prescribed other medication types (47 of 66; 71%; OR 0.44; CI 0.21–0.93; $P = .03$), although this variable did not remain in the

multivariable analysis. We observed no significant association between other medication types and medication pickup rates.

Other Factors

Other factors listed in Table 1 had no statistically significant associations with pickup rates.

DISCUSSION

This study is the first to examine prescription pickup rates among children with diverse medical diagnoses after an inpatient stay at a children’s hospital. We found overall medication pickup rates similar to those reported in pediatric outpatients^{3,5} and in children discharged from a community hospital.¹⁴ Our most noteworthy findings involve association of pickup rates with socioeconomic factors, medication type, and pharmacy location.

We were not surprised that socioeconomic factors, such as home zip code median annual household income, were associated

TABLE 2 Multivariable Analysis of Selected Characteristics With Adjusted ORs for Medication Pickup

Characteristic	Adjusted OR (95% CI) of Medication Pickup	P
Insurance		.072
Private	2.17 (0.93–5.26)	
Medicaid	Reference	
Home zip code median household income, \$		
<50 000	Reference	—
50 000–79 000	1.53 (0.63–3.72)	.35
>79 000	4.38 (1.03–18.60)	.045
Pharmacy location		.048
On-site	8.36 (1.01–68.8)	
Off-site	Reference	
Oral anti-infective medication	4.51 (1.70–12.0)	.003

—, not applicable.

TABLE 3 Pickup Rates by Medication Category With Unadjusted ORs

Medication Category	Prescriptions Picked up/No. Patients With This Medication Type Prescribed (%)	Prescriptions Picked up/No. Patients Without This Medication Type Prescribed (%)	Unadjusted OR (95% CI)	P
Oral anti-infective	65/71 (92)	77/107 (72)	4.22 (1.65–10.77)	<.01
Asthma	47/66 (71)	95/112 (85)	0.44 (0.21–0.93)	.03
Acid suppression	13/15 (87)	129/163 (79)	1.71 (0.44–11.29)	.49 ^a
Topical	11/15 (73)	131/164 (80)	0.67 (0.21–2.55)	.52 ^a
Others	22/26 (85)	120/152 (79)	1.47 (0.52–5.28)	.69

^a Generated by Fisher's exact test (otherwise generated by χ^2 test).

finding, including caregivers' concerns about side effects and a hesitancy to treat patients who are asymptomatic or clinically improving.²²

We were not surprised that pickup rates were higher when medications were filled at the on-site pharmacy compared with an off-site pharmacy. The preferential practice of sending medications to the on-site pharmacy for patients and families who providers feel are most at risk for not picking up medications may further strengthen this finding. The improved pickup rate by using the on-site pharmacy may be due to a number of factors. First, although the on-site pharmacy is not adjacent to the inpatient area, it is relatively easy to locate with assistance from hospital personnel. This simplifies pickup, especially for those who rely on public transportation to reach their home pharmacy. Second, while still in the hospital, the impact of the child's hospitalization may remain at the forefront of a caregiver's mind, whereas once reaching home, caregivers may become preoccupied with other responsibilities. Finally, in certain circumstances, the medical team might insist that the medications be picked up at the on-site pharmacy before placing the patient's discharge order, although we have no data about how often this scenario might occur. Further studies should be used to investigate why providers choose to use an in-house pharmacy for the prescription of certain medications for certain patients.

Our study revealed no association between primary language and pickup rates. We also did not observe an association between patient age or sex and pickup rates,

although authors of several larger studies have reported increased pickup in younger patients.^{7,10} Data regarding pickup rates by patient sex have been mixed.^{1–3,5} We expected that pickup rates would be lower on weekends compared with weekdays because of shorter pharmacy hours but did not find this to be the case.

This study had a number of limitations. Our results may have limited generalizability by the fact that the study involved a single institution. Also, the design of the study may have favored recording apparent pickup of short-term medications as opposed to chronic medications. For example, if a patient did not pick up an inhaled steroid, it is possible that the patient had an available supply at home prescribed previously by an outside provider. However, patients are unlikely to have medications required for acute treatment, such as an anti-infective, at home. We also note that the decision to use the on-site pharmacy was not a random one; we cannot quantify how often the on-site pharmacy was chosen because of the family being at high risk for not picking up medications. Another limitation includes using zip codes as a proxy for household income or socioeconomic status. We do not mean to imply that using zip codes in this way is extremely precise in estimating patients' household income, but we do note that home zip code is generally easy for a hospital medical team to obtain, so it may be useful on a practical level. Home zip code might be used as a way to identify at-risk families and offer them an opportunity to use the in-house pharmacy. Another limitation involves the fact that our study involved patients at a certain time of year

(November). This time of year may affect our data somewhat because it is a particularly busy time for many families. Future studies should include data from other times of year as well.

CONCLUSIONS

A substantial number of pediatric patients do not fill prescriptions after hospitalization. Certain demographic and medical characteristics are associated with reduced rates of medication pickup. Use of an on-site hospital pharmacy may represent a strategy to improve discharge medication pickup rates in children who are hospitalized.

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