abstract

BACKGROUND AND OBJECTIVES: Filling a prescription is the important first step in medication adherence, but has not been studied in pediatric primary care. The objective of this study was to use claims data to determine the rate of unfilled prescriptions in pediatric primary care and examine factors associated with prescription filling.

METHODS: This retrospective observational study of pediatric primary care patients compares prescription data from an electronic medical record with insurance claims data. Illinois Medicaid provided claims data for 4833 patients who received 16,953 prescriptions during visits at 2 primary care sites over 26 months. Prescriptions were compared with claims to determine filling within 1 day and 60 days. Clinical and demographic variables significant in univariate analysis were included in logistic regression models.

RESULTS: Patients were 51% male; most (84%) spoke English and were African American (38.7%) or Hispanic (39.1%). Seventy-eight percent of all prescriptions were filled. Among filled prescriptions, 69% were filled within 1 day. African American, Hispanic, and male patients were significantly more likely to have filled prescriptions. Younger age was associated with filling within 1 day but not with filling within 60 days. Prescriptions for antibiotics, from one of the clinic sites, from sick/follow-up visits, and electronic prescriptions were significantly more likely to be filled.

CONCLUSIONS: More than 20% of prescriptions in a pediatric primary care setting were never filled. The significant associations with clinical site, visit type, and electronic prescribing suggest system-level factors that affect prescription filling. Development of interventions to increase adherence should account for the factors that affect primary adherence. Pediatrics 2012;130:620–626

WHAT’S KNOWN ON THIS SUBJECT: Filling a prescription is the first step in medication adherence. Unfilled prescriptions are a documented component of nonadherence in adult and pediatric emergency departments and family practices. No one has reported the proportion of unfilled prescriptions in pediatric primary care.

WHAT THIS STUDY ADDS: This study identifies the proportion of unfilled prescriptions in a large sample of primary care pediatric patients. It describes clinical and demographic factors associated with prescription filling and suggests that electronic prescribing may improve adherence.

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KEY WORDS nonadherence, unfilled prescriptions, primary adherence, medication adherence

ABBREVIATIONS

ED—emergency department

EMR—electronic medical record

IDHFS—Illinois Department of Healthcare and Family Services

LR—logistic regression

PCP—primary care physician

Dr Zweigoron was responsible for study design, data collection, data analysis, and manuscript preparation; Dr Binns was responsible for study design, data analysis, and manuscript preparation; and Dr Tanz was responsible for study conception, study design, and manuscript preparation.

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Inadequate pharmaceutical treatment of illness can result in increased morbidity and mortality. Primary medication nonadherence is 1 cause of this and refers to the failure to fill a prescription written by a provider. It includes failure to take a prescription to a pharmacy, and failure to pick up a prescribed medication that was filled by a pharmacy. Primary adherence is a poorly quantified and poorly understood component of medication adherence, particularly for pediatric patients.

Published evidence demonstrates that children and adults struggle with primary medication adherence in an acute care setting. Up to 22% of adult patients do not fill their prescriptions after hospital discharge. When children are discharged from the hospital with a prescription, up to 25% of prescriptions are not filled. Prescription filling rates are similar or worse after emergency department (ED) visits. Claims data for adult ED prescriptions demonstrate that 16% to 25% of prescriptions are not filled.

Studies from pediatric EDs demonstrate rates of unfilled prescriptions from 7% based on survey data to 35% by using claims data. Primary medication nonadherence also occurs in a primary care setting. Beardon et al used claims data to demonstrate that 5.2% of all prescriptions, and 6.8% of prescriptions for children, were unfilled in a UK family practice. Seven percent of patients, including children and adults, had unfilled prescriptions in a British primary care practice. A study in adult primary care using claims data for antihypertensive medications demonstrated an unfilled prescription rate of 16%. A large study of electronic prescriptions in primary care showed that 24% of all prescriptions and 16% written by pediatricians were unfilled. A study of pediatric medication dosing errors found that 55% of patients had filled a prescription within 1 day. We did not find any studies designed exclusively to address the frequency of unfilled prescriptions in pediatric primary care, either in hospital-based outpatient clinics or community practices.

Identifying the degree of primary nonadherence is important to comprehensively address the problem of medication nonadherence in primary care. We sought to determine the rate of primary nonadherence in an outpatient pediatric setting. We analyzed electronic medical record (EMR) prescription data matched to claims data and we report the proportion of prescriptions written to pediatric primary care patients that were unfilled. We describe clinical and demographic factors that were associated with filling prescriptions.

**METHODS**

**Subjects**

This study includes all Medicaid-insured patients with a primary care encounter between October 1, 2008, and December 1, 2010, at either of 2 primary care sites that treat only children. The time period includes the date the electronic charting of prescriptions began until the time the data were downloaded, which resulted in a total of 26 months. Both clinic sites are affiliated with a large tertiary care children’s hospital in an urban setting. They provide primary care, including health maintenance visits, routine screening tests, and other preventive care, and acute care visits for nonemergent conditions. The clinics see patients age 0 to 24 years. One site (Clinic A) is staffed exclusively by resident physicians precepted by full-time academic and volunteer community pediatricians. The other site (Clinic B) is staffed by residents and full-time academic pediatricians. The academic pediatricians at Clinic B both supervise residents and see their own patients when not supervising residents.

Most patients (~95%) at each site are insured by Illinois Medicaid, which is a government-funded insurance provider for children whose parents or guardians do not have insurance through an employer and cannot afford private insurance. Medicaid pays pharmacies directly for all prescriptions listed on its published formula. These prescriptions do not require a copayment from patients. Within the system, there are a few managed care plans. The clinics serve patients only for whom they are a provider. Attending physicians are not required by Illinois Medicaid to cosign resident prescriptions.

Data were obtained after review and approval from the Children’s Memorial Hospital Institutional Review Board and an administrative board of the Illinois Department of Healthcare and Family Services (IDHFS).

**Data Sources**

**EMR**

Prescription data and associated clinical and demographic data were obtained through a query of the EMR, which is used by both clinics and the affiliated hospital. The query included any prescription written in the outpatient clinic during the 26-month study period. Additional patient data gathered included date of birth, Illinois Medicaid identification number, self/parent-identified primary language, self/parent-identified ethnicity, name of the medication prescribed, date of encounter, primary care physician (PCP), prescribing physician, visit type (based on International Classification of Diseases, Ninth Revision code), and the way that each prescription was provided (e-prescribed or printed and handed to patient). An e-prescribed prescription is one that is ordered in the EMR and sent electronically to a pharmacy designated by the patient, eliminating the need for
the patient to manually take a paper prescription to a pharmacy. This function became available at all sites midway through the study period (May 2010) and was encouraged, although it was an optional tool for physicians. Before this, all prescriptions were ordered in the EMR and then printed and handed to patients. The EMR includes very limited information on parents/guardians and so their characteristics may not have been available for inclusion in the study.

Residents are identified in the EMR as the PCP for their patients, families know when their PCP has clinic, and each resident’s clinic session is constant during all 3 years of training. Both clinics selectively schedule patients with the PCP for health maintenance and follow-up visits, and whenever possible for sick visits.

**IDHFS Pharmacy Claims Data**

IDHFS maintains records of health data for Medicaid-insured patients, including pharmacy claims. Claims are generated when a prescription is picked up at a pharmacy. IDHFS used the subjects’ Medicaid identification numbers to generate a list of prescription claims for each included patient for the study period plus an additional 60 days (October 1, 2008–February 1, 2011). Sixty days was selected to capture people getting refill prescriptions for medications they may have at home. As Medicaid allows prescriptions to be filled only monthly, this gives patients a month plus some additional time to obtain chronic medications for which they may already have a home supply. The claims data from Illinois Medicaid include the date and quantity of the prescription filled, but not the provider who wrote the prescription.

**Data Management and Analysis**

Each prescription generated from a primary care site was manually matched to a claim for that medication filed by a pharmacy within the 60 days after the order. For filled prescriptions, we calculated the number of days between when the doctor wrote the prescription and when the pharmacy filled the claim, which occurs when a prescription is picked up.

Analyses were conducted by using the Statistical Package for the Social Sciences 12.0 (SPSS Inc, Chicago, IL) and Stata 9.2 (Stata Corp, College Station, TX). The patients’ demographic and prescription data were summarized. We used \( \chi^2 \) tests to perform univariate analysis of filled and unfilled prescriptions versus demographic and clinical factors, including race/ethnicity, gender, age, primary language, prescription provider, and type of visit. We dichotomized prescribers as PCP or not PCP; type of visit was either a health maintenance visit or “other,” including sick and follow-up visits by using *International Classification of Diseases, Ninth Revision* codes.

The prescriptions were divided into 8 categories based on type of medication, allowing us to compare the rates of filling between groups. Each medication category was individually compared with a dummy variable that was composed of all other categories pooled. Demographic and clinical factors with associations of \( P < .1 \) were entered into a logistic regression (LR) model. The multivariate model included prescription status (filled or unfilled) as the dependent variable. The independent variables were ethnicity, gender, age, clinical site, visit type, and medication category. The LR model included individual subject as a random effect to account for clustering.

**RESULTS**

**Subjects**

This study included 4833 unique patients seen over 11,227 clinical encounters at which providers wrote 16,953 prescriptions. Table 1 shows the demographic data of patients. Most patients were African American or Hispanic. Most parents identified English as the patients’ primary language. Nearly 80% of subjects were younger than 11 years.

**Encounters**

Patients saw their PCP at 97.5% of encounters. They saw another provider from the same clinic at the other 2.5% of visits. This high rate of PCP-patient matching is likely because of how the clinics function and absence of encounters that did not generate a prescription (visits at which only reassurance was provided or an over-the-counter medication was recommended are not included). Health maintenance visits comprised 41.4% of encounters, with sick visits and follow-up visits making up the remaining 58.6% of encounters. More encounters occurred at Clinic B (61.5%) than at Clinic A (38.5%).

**Prescriptions**

Providers wrote 16,953 prescriptions for clinic patients during the 26-month period. Sixty days was selected to capture people getting refill prescriptions for medications they may have at home. As Medicaid allows prescriptions to be filled only monthly, this gives patients a month plus some additional time to obtain chronic medications for which they may already have a home supply. The claims data from Illinois Medicaid include the date and quantity of the prescription filled, but not the provider who wrote the prescription.

**TABLE 1 Demographics of Study Population (n = 4833)**

<table>
<thead>
<tr>
<th>Variable</th>
<th>( n )</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Race/Ethnicity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>468</td>
<td>9.7</td>
</tr>
<tr>
<td>African American</td>
<td>1868</td>
<td>38.7</td>
</tr>
<tr>
<td>Hispanic</td>
<td>1889</td>
<td>39.1</td>
</tr>
<tr>
<td>Other*</td>
<td>608</td>
<td>12.6</td>
</tr>
<tr>
<td>Primary language</td>
<td></td>
<td></td>
</tr>
<tr>
<td>English</td>
<td>4039</td>
<td>83.6</td>
</tr>
<tr>
<td>Spanish</td>
<td>667</td>
<td>13.8</td>
</tr>
<tr>
<td>Other</td>
<td>127</td>
<td>2.6</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>2464</td>
<td>51.0</td>
</tr>
<tr>
<td>Female</td>
<td>2369</td>
<td>49.0</td>
</tr>
<tr>
<td>Age, y</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0–1</td>
<td>1285</td>
<td>26.6</td>
</tr>
<tr>
<td>2–5</td>
<td>1510</td>
<td>27.1</td>
</tr>
<tr>
<td>6–10</td>
<td>1176</td>
<td>24.3</td>
</tr>
<tr>
<td>&gt;11</td>
<td>1062</td>
<td>22.0</td>
</tr>
</tbody>
</table>

*American Indian/Alaskan Native, Asian, Declined, Indian, Native Hawaiian/Pacific Islander, Unknown.

* Mean age: 6.1 y (SD 5.1). Median age: 5.0 y.
study period. Illinois Medicaid received claims for 13,232 of these prescriptions (78.1%) within 60 days. Of the filled prescriptions, 69% were filled within 1 day. There were 3,124 (18%) prescriptions that were electronically prescribed. The remaining 82% were computer-generated paper prescriptions handed directly to patients.

Table 2 shows the 8 categories of medications and the proportion of total and filled prescriptions by category. Subcategories of medication types are also presented in Table 2. There was a significant difference in the rate of filling among the 8 medication categories ($\chi^2, P < .001$). Oral anti-infective medications were filled at the highest rate and nutritional supplements at the lowest rate.

**Multivariate Regression for Filled Versus Unfilled Prescriptions**

The multivariate model of prescription filling within 60 days is displayed in Table 3. As shown, medication category had a strong influence on prescription filling; medications for infections, asthma/allergies, and dermatologic conditions were filled most often. African American or Hispanic patients were more likely than White patients to fill their prescriptions. Prescriptions written at Clinic B were more likely to be filled, as were prescriptions written at sick/follow-up visits. Prescriptions submitted electronically had higher odds of being filled than paper prescriptions. Age was not a predictor of prescription filling. Prescriptions provided to girls were filled significantly less frequently than prescriptions for boys.

**Multivariate Regression Model for Filling Within 1 Day**

The multivariate model of prescription filling within 1 day is displayed in Table 4. The category of medication prescribed influenced the likelihood that a prescription was filled within 1 day, with anti-infectives and antipyretics more likely than other categories. Prescriptions written at Clinic B, electronic prescriptions, and prescriptions written at sick/follow-up visits had greater odds of being filled within 1 day; however, in this model, neither patient race/ethnicity nor gender influenced prescription filling, and age was a significant factor. Patients younger than 1 year had significantly greater odds than older children of getting their prescriptions filled within 1 day.

**DISCUSSION**

To our knowledge, this is the first study to evaluate primary medication adherence exclusively among pediatric primary care patients. The results are consistent with studies from EDs and nonpediatric primary care, showing rates of unfilled prescriptions ranging from 16% to 35% and 16% to 24%, respectively.5–8,12,13 Our findings suggest that nondemographic factors, such as the method of prescribing (electronic versus paper), clinic site, medication
type, and visit type can influence primary adherence. It also highlights patient factors that may promote prescription filling.

This study did not show a significant association between child age and prescription filling. A previous study of 65 patients also found a lack of significant association, but it may have been too small to detect a difference. In larger studies, younger age has been associated with a higher likelihood of prescription filling, but it is possible that younger age alone contributes to parental sense of urgency. Similar to the study by Kajioka et al, we found that prescription filling was more likely for boys. We also identified a significant association with race/ethnicity. Research has not shown a consistent association between race or gender and adherence.

Nondemographic factors reproducibly influence adherence. Our study reinforces the importance of nondemographic factors on medication adherence. Specifically, electronic prescribing increased the likelihood that a prescription would be filled. Although electronic prescribing has been shown to reduce prescription errors and costs, this is the first study to demonstrate that it may also improve adherence to primary care prescription filling. This is consistent with studies in adults showing improved primary adherence with electronic prescribing. We speculate that electronic prescriptions are more often filled because of their convenience.

We also found a difference in primary adherence between the 2 clinic sites. It is possible that unmeasured patient-related variables (for example, distance between the clinic or home and the pharmacy) and/or factors associated with providers (resident versus attending physician) or delivery of care may have mediated this difference. In addition to differences in the types of providers, the 2 clinics differ in proximity to rapid transit, access to free parking, and neighborhood demographics. Visit type and medication type were other nondemographic factors that influenced prescription filling as well as filling within 1 day. That antimicrobial agents are more frequently prescribed as well as filled may not be unexpected. It is reassuring that parents seem to be more adherent to recommended pharmacotherapy for acute illnesses. The lower rate of filling for nutritional supplements and for prescriptions from health maintenance organizations may reflect “higher-urgency” prescriptions. It is also possible that younger age alone contributes to parental sense of urgency. Similar to the study by Kajioka et al, we found that prescription filling was more likely for boys. We also identified a significant association with race/ethnicity. Research has not shown a consistent association between race or gender and adherence.
of patients included. We believe that insurance claims data reliably indicate prescription filling. Additionally, the use of EMR allowed us to get complete and consistent demographic and clinical data regarding patients and visits.

There are several aspects of medication adherence not addressed by this study. We cannot draw conclusions about full medication adherence, as we do not know if patients took their medications once filled. Also, prescriptions may not have been intended for immediate use; for example, some pediatricians provide a “watch-and-wait” antibiotic prescription for acute otitis media. Watch-and-wait antibiotics may be unfulfilled because of patient improvement and not primary medication nonadherence; however, it is likely that these sorts of prescriptions constitute a small fraction of the total analyzed. Prescriptions for medications used as needed, such as an albuterol inhaler, may not be filled within 60 days. The claims data from Illinois Medicaid include the date and quantity of the prescription filled, but not the provider who wrote the prescription. Thus, a physician unaffiliated with our clinics may have prescribed the same medication before or after our prescribing date, and the claim filed could have been for that prescription. Finally, all of the patients in this study were insured by Illinois Medicaid and they received their primary care in academic clinics in an urban environment, which may limit generalizability.

**REFERENCES**


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**TABLE 4 Multivariate Model of Prescription Filling Within 1 Day (*n* = 16,953)**

<table>
<thead>
<tr>
<th>Predictors</th>
<th>Unadjusted*</th>
<th>Adjusteda</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Odds Ratio</td>
<td>(95% CI)</td>
</tr>
<tr>
<td>Race/Ethnicity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>White (referent)</td>
<td>1.0</td>
<td>(0.62–1.02)</td>
</tr>
<tr>
<td>African American</td>
<td>0.79</td>
<td>(0.62–1.02)</td>
</tr>
<tr>
<td>Hispanic</td>
<td>1.00</td>
<td>(0.78–1.28)</td>
</tr>
<tr>
<td>Other</td>
<td>0.87</td>
<td>(0.65–1.17)</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male (referent)</td>
<td>1.0</td>
<td>(0.82–1.07)</td>
</tr>
<tr>
<td>Female</td>
<td>0.94</td>
<td>(0.82–1.07)</td>
</tr>
<tr>
<td>Age, y</td>
<td></td>
<td></td>
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<tr>
<td>0–1 (referent)</td>
<td>1.0</td>
<td>(1.02–1.34)</td>
</tr>
<tr>
<td>2–5</td>
<td>0.83</td>
<td>(0.79–1.09)</td>
</tr>
<tr>
<td>6–10</td>
<td>0.70</td>
<td>(0.58–0.94)</td>
</tr>
<tr>
<td>≥11</td>
<td>0.58</td>
<td>(0.49–0.70)</td>
</tr>
<tr>
<td>Clinical Site</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clinic A (referent)</td>
<td>1.0</td>
<td>(1.02–1.34)</td>
</tr>
<tr>
<td>Clinic B (referent)</td>
<td>1.17</td>
<td>(1.02–1.34)</td>
</tr>
<tr>
<td>Visit type</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sick or follow-up visit (referent)</td>
<td>1.0</td>
<td>(1.02–1.34)</td>
</tr>
<tr>
<td>Well-child visit</td>
<td>0.41</td>
<td>(0.37–0.45)</td>
</tr>
<tr>
<td>Prescription type</td>
<td></td>
<td></td>
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<tr>
<td>Paper prescription (referent)</td>
<td>1.0</td>
<td>(1.02–1.34)</td>
</tr>
<tr>
<td>Electronic prescription</td>
<td>2.29</td>
<td>(2.01–2.62)</td>
</tr>
<tr>
<td>Prescription category (versus dummy variable)</td>
<td></td>
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</tr>
<tr>
<td>Oral anti-infectives</td>
<td>3.37</td>
<td>(2.82–4.03)</td>
</tr>
<tr>
<td>Asthma and allergy medications</td>
<td>0.81</td>
<td>(0.72–0.91)</td>
</tr>
<tr>
<td>Topical anti-infectives</td>
<td>3.03</td>
<td>(2.50–3.67)</td>
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<tr>
<td>Dermatologic medications</td>
<td>0.59</td>
<td>(0.56–0.85)</td>
</tr>
<tr>
<td>Antipyretics</td>
<td>1.57</td>
<td>(1.35–1.81)</td>
</tr>
<tr>
<td>Nutritional supplements</td>
<td>0.45</td>
<td>(0.38–0.53)</td>
</tr>
</tbody>
</table>

*CI, confidence interval.  aPatient included as a random effect to account for clustering.


LONELY IN THE PARK: My wife and I had been on the trail for about 30 minutes before we saw another hiker. Over the next six hours, we did not see another. Granted, it was really hot and we were not on the most popular trail in the Santa Rosa and San Jacinto Mountains National Monument, but the absence of other people was striking. Even on the ridge line, from which we could see for miles, we saw no evidence of other people. According to an article in USA Today (Travel: July 11, 2012), how people explore the National Park System has changed over the past 20 years. While the total number of visits to national parks has increased slightly over the years, the amount of time spent in the parks has dropped by approximately 15% system-wide. In some parks, the decrease in time spent in them is quite dramatic. For example, at Yosemite National Park, in the early 1990s the average visitor spent nearly 27 hours inside the park. However, in 2011, the average visitor spent less than 17 hours. In Grand Teton National Park, the average visitor spent 6.5 hours in 2011, compared to 10 hours in 1991. The reasons for the decline are most likely due to fewer overnight stays and a change in travel style. National Park Service data suggest that the number of overnight stays in the national parks in 2011 dropped almost 25% from their peak in 1994. Even in national parks where the number of overnight visitors increased, such as Joshua Tree National Park, visitors tend to spend fewer nights than in the past. Why people spend fewer nights camping is not known. One hypothesis is that an older population now prefers to sleep in a hotel rather than in a tent. Younger children and adults, brought up on video games and myriad electronic diversions, may not be as interested in a night under the stars. Finally, how visitors engage with the park has changed. More and more often, visitors drive through parks briefly stopping along the way to view some of the highlights. Although not mentioned by the park service, I wonder if airline baggage restrictions have a role in this. For us, checking enough camping equipment for a family of six is quite expensive. As for my wife and me, we spent the day reveling in the wide open spaces—and then, like so many others, spent the night in a hotel.

Note by WVR, MD
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Rachael T. Zweigoron, Helen J. Binns and Robert R. Tanz
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Updated Information & Services
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References
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/content/130/4/620.full.html