Association between Postdischarge Oral Corticosteroid Prescription Fills and Readmission in Children with Asthma

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Objectives To assess the relationships between postdischarge emergency department visits, oral corticosteroid (OCS) use, and 15- to 90-day asthma readmission in children.

Study design Retrospective study of 9288 children from 12 states in the Truven MarketScan Database, ages 2-18 years, hospitalized between January 1, 2009, and June 30, 2011, with asthma, and continuously enrolled in Medicaid for 6 months prior and 3 months after hospitalization. The primary outcome was 15- to 90-day readmission for asthma. Secondary outcomes were postdischarge emergency department visits (within 28 days) and outpatient OCS prescription fills (6-28 days postdischarge or earlier if coinciding with an outpatient asthma visit). Logistic regression was used to assess the relationship of hospital readmission with patient characteristics and asthma health services surrounding the index admission.

Results Median age at index admission was 6 years (IQR, 3-9); 62% were male and 49% were black; 2.8% had a 15- to 90-day readmission (median, 50 days; IQR, 32-70). After index discharge, 4% had an emergency department visit (median, 17 days; IQR, 12-24) and 11% had an outpatient OCS fill (median, 14 days; IQR, 6-21). In multivariable analysis, children with a postdischarge outpatient OCS fill (OR, 3.2; 95% CI, 2.4-4.6) or hospitalization within 6 months preceding the index admission (OR, 2.9; 95% CI, 2.0-4.0) had the greatest likelihood for hospital readmission.

Conclusions OCS fill within 28 days of hospital discharge was most strongly associated with 15- to 90-day hospital readmission. This finding may inform evolving strategies to reduce asthma readmissions in children. *(J Pediatr 2017;180:163-9).*

Asthma is a leading cause of pediatric morbidity, affecting almost 10% of children, and resulting annually in >130 000 hospitalizations and $1.5 billion in hospital charges.[1] Hospitalizations account for a substantial proportion of childhood asthma expenditures.[2] Readmission rates range from 3% to 8% within 90 days of discharge from a prior asthma hospitalization.[3-5] There is ongoing debate regarding how much hospital care and discharge planning vs outpatient follow-up care influences the likelihood of an asthma readmission in children.[6]

Postdischarge prescription fills for inhaled corticosteroids (ICS) and short-acting beta agonists occurring within 3 days of hospital discharge were associated with a lesser likelihood of 14-day readmission, and the association persisted for ICS and readmission from 15 to 90 days, suggesting that efforts to improve recommended discharge medication adherence may reduce readmissions.[7] In the study, oral corticosteroid (OCS) prescription fills within 3 days of discharge were not associated with lower likelihood of readmission up to 90 days.

To date, no study has examined the relationship between more distal postdischarge health care use and readmission in children with asthma. For ambulatory care sensitive conditions such as asthma, strategic use of outpatient preventive services after discharge (prescription of asthma controller medications or ambulatory visits) might prevent readmission. Conversely, use suggestive of symptom exacerbation (emergency department [ED] visit or outpatient OCS dispensing event) might herald readmission. However, such use might not allow for actionable intervention if occurring in close proximity to readmission.

We conducted the present study to help identify children with asthma who are at risk for readmission and to help inform strategies that might minimize readmission risk through optimized care transitions from hospital to home. To specifically examine the relationship between markers of symptom exacerbation in the postdischarge period and readmission, our primary objective was to assess how postdischarge ED visits and OCS prescription fills correlate with 15- to 90-day hospital readmission. We also assessed patient characteristics that are associated with the need for an OCS prescription or an ED visit for asthma within 1 month

ED	Emergency department	OCS	Oral corticosteroid
ICS	Inhaled corticosteroids		

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of hospital discharge, and described the timing of postdischarge ED visits and OCS prescription fills in relation to the timing of readmissions.

Methods

This retrospective cohort study included children ages 2-18 years hospitalized with asthma between July 1, 2009, and June 30, 2011, and continuously enrolled in Medicaid from 1 of 12 states for 6 months before and 3 months after the hospitalization with health care claims contained in the Truven Health MarketScan Database (Ann Arbor, Michigan). There were 2093 children excluded for insufficient duration of enrollment. The University of Colorado Institutional Review Board ruled this work exempt from human subjects review.

Asthma hospitalization was identified with an *International Classification of Diseases, 9th Revision, Clinical Modification* principal diagnosis code for asthma (493.xx). Hospitalizations with "observation" adminstrative status were included.[8] For children with >1 hospitalization in the study period, 1 hospital admission was randomly chosen for inclusion in the study cohort. Informed by prior research,[9] this method was used to achieve a "natural" balance of index and subsequent hospitalizations in the cohort, and to account for prior inpatient use, which is described as the strongest predictor of readmission.[10]

The primary outcome was hospital readmission with a primary diagnosis of asthma from 15 to 90 days after discharge from the index admission. Hospital readmissions 0-14 days (n = 30) were not measured. The secondary outcomes were ED visits for asthma and outpatient prescription fills for OCS within 28 days of discharge. Only ED visits not resulting in hospital readmission were counted. An OCS fill was identified from pharmaceutical claims in the Medicaid dataset using Healthcare Effectiveness Data and Information–defined National Drug Codes.[11]

Although information was absent from the database on the health care setting from which a prescription was created, we distinguished outpatient from inpatient OCS fills using their timing after discharge and corresponding health services encounters. OCS fills were labeled "outpatient" if they were filled ≥6 days after hospital discharge or they coincided with an ambulatory or ED health services visit. Because most systemic steroid prescriptions for asthma are 5 days (a portion of which would be completed in the hospital), we felt that regimens arising from the inpatient stay would likely be completed by postdischarge day 5, even if a parent waited for a 1-2 days to fill the prescription. Using these methods, inpatient OCS fills occurred a median of 0 days (IQR, 0-1) after hospital discharge. Outpatient OCS fills occurred a median of 14 days (IQR, 6-21) after hospital discharge. The shorter duration of time used to measure ED visits and OCS fills compared with hospital readmissions was used because we were most interested in (1) measuring ED visits and OCS fills that occurred soon after discharge and (2) assessing whether ED visits and OCS fills might correlate with subsequent hospital readmission within an extended timeframe. We assessed the relationship between patient demographic, clinical, and asthma health services characteristics with the outcome measures.

We assessed patients' age at admission, race, sex, type of Medicaid (fee-for-service or managed care), and reason for Medicaid enrollment (disability vs other, including family income). Age was assessed in categories recommended by the National Heart, Lung, and Blood Institute's Expert Panel recommendations (2-4, 5-11, and 12-18 years).

We assessed the presence of comorbid, complex chronic conditions in addition to the child's asthma using Feudter's diagnosis classification system, version 2.[12] Complex chronic conditions include neuromuscular, cardiovascular, digestive, and other conditions that are associated with high morbidity and high resource use, including hospital readmissions.

We measured the length of stay and season for each child's index asthma admission in the cohort. Season dates were December 21 to March 20 for winter, March 21 to June 20 for spring, June 21 to September 20 for summer, and September 21 to December 20 for fall. We also assessed asthma hospitalizations, ED visits, and asthma prescription fills in the 6 months preceeding the index hospitalizaion, and ambulatory visits in the 28 days after the asthma index admission. We assessed ambulatory visits using Healthcare Effectiveness Data and Information–defined Current Procedural Terminology and Uniform Billing Revenue codes.[13] Asthma prescription fills for short-acting beta agonists, ICS, and leukotriene receptor antagonists were identified via the Healthcare Effectiveness Data and Information–defined National Drug Codes.[11] ICS and leukotriene receptor antagonist prescription fills were combined into a "controller" medication category.

Statistical Analyses

Asthma health services use was treated dichotomously (ie, present or absent). We used χ^2 tests for bivariable comparisons of outcomes with patient categorical characteristics (eg, age) and the Wilcoxon rank sum test for comparisons of continuous variables (eg, index hospitalization duration of stay). One multivariable logistic regression model was used to assess the relationship between patient characteristics and the likelihood of 15- to 90-day hospital readmission. Three domains of cofactors were included when deriving the model: (1) preindex admission asthma health services, (2) patient demographic and clinical characteristics measured during the index admission, and (3) postdischarge ED visits and outpatient OCS fills. Data were analyzed using SAS 9.4 (SAS Institute, Cary, North Carolia). $P < .05$ were considered significant.

Results

The 9288 children hospitalized with asthma in the cohort had a median age of 6 years (IQR, 3-9). Sixty-two percent were male, 48.6% were black, 76.8% used Medicaid managed care, and 9.5% were enrolled in Medicaid because of a disability (**Table I**). Eighteen percent had a comorbid complex chronic condition. Median duration of stay of the index admission for asthma was 2 days (IQR, 1-3). Most admissions occurred in the fall (32.1%) or winter (20.4%).