Impact of Discharge Components on Readmission Rates for Children Hospitalized with Asthma

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Objectives To describe hospital-based asthma-specific discharge components at children's hospitals and determine the association of these discharge components with pediatric asthma readmission rates.

Study design This is a multicenter retrospective cohort study of pediatric asthma hospitalizations in 2015 at children's hospitals participating in the Pediatric Health Information System. Children ages 5 to 17 years were included. An electronic survey assessing 13 asthma-specific discharge components was sent to quality leaders at all 49 hospitals. Correlations of combinations of asthma-specific discharge components and adjusted readmission rates were calculated.

Results The survey response rate was 92% (45 of 49 hospitals). Thirty-day and 3-month adjusted readmission rates varied across hospitals, ranging from 1.9% to 3.9% for 30-day readmissions and 5.7% to 9.1% for 3-month readmissions. No individual or combination discharge components were associated with lower 30-day adjusted readmission rates. The only single-component significantly associated with a lower rate of readmission at 3 months was having comprehensive content of education ($P < .029$). Increasing intensity of discharge components in bundles was associated with reduced adjusted 3-month readmission rates, but this did not reach statistical significance. This was seen in a 2-discharge component bundle including content of education and communication with the primary medical doctor, as well as a 3-discharge component bundle, which included content of education, medications in-hand, and home-based environmental mitigation.

Conclusions Children's hospitals demonstrate a range of asthma-specific discharge components. Although we found no significant associations for specific hospital-level discharge components and asthma readmission rates at 30 days, certain combinations of discharge components may support hospitals to reduce healthcare utilization at 3 months. *(J Pediatr 2017;■■:■■-■■).*

Asthma exacerbations are a leading cause of hospitalization in children and a leading cause of potentially preventable pediatric admissions.[1-3] Despite reductions in the rates of potentially preventable pediatric asthma admissions between 2003 and 2012,[4] asthma hospitalizations remain high in certain populations and account for almost one-third of childhood asthma costs, resulting in $1.5 billion in hospital charges annually in the US.[5] As hospitals and health systems take on increasing risk in their contracts with insurance companies, they face increasing financial pressure to reduce rates of readmissions.

Children hospitalized for asthma have approximately a 20% chance of repeat hospitalization in the subsequent year and 3-month readmission rates vary widely among hospitals, ranging from 3% to 14%.[6-8] With this increased risk and wide variation in outcomes, children hospitalized for asthma are an important population on which hospitals and health systems should focus. There is an ongoing debate regarding how much inpatient management and discharge planning influence asthma readmission rates and whether readmission rates are truly a measure of high inpatient quality care.[6,9] That said, ideal inpatient care for asthma results in a successful transition back to the community with sustained improvement in the child's underlying illness, reducing the need for future hospitalization.

APR-DRG	*All Patient Refined Diagnosis Related Group*
ICU	Intensive care unit
NIH	National Institutes of Health
PHIS	Pediatric Health Information System
PMD	Primary medical doctor

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Currently, there is no standardized asthma discharge process across children's hospitals. Evidence-based guidelines published by the National Institutes of Health (NIH) recommend asthma education, medication education, environmental mitigation, and coordination of care with the primary provider as part of the discharge planning process.[10] The objectives of the present study were to describe current hospital-based asthma-specific discharge components at children's hospitals across the US, and to study the association of specific discharge components with asthma readmission rates to identify and better understand the discharge practices that may reduce readmissions.

Methods

This is a retrospective cohort study of children 5-17 years of age hospitalized with an acute asthma exacerbation in a US children's hospital from January 1, 2015 to December 31, 2015. We used data from the Pediatric Health Information System (PHIS) database, which is an administrative database containing clinical and billing data from tertiary care children's hospitals in the US. Data quality is ensured through a joint effort between the Children's Hospital Association (Lenexa, Kansas) and participating hospitals, as previously described.[11] For this study, PHIS data were supplemented with data collected from an electronic survey distributed to quality leaders at each participating PHIS hospital.

Among the PHIS hospitals, children who were hospitalized with an asthma exacerbation (inpatient or observation) were eligible for inclusion if they were between 5 and 17 years of age, and were discharged between January 1, 2015 to December 31, 2015 with an *All Patient Refined Diagnosis Related Group* (APR-DRG) diagnosis of asthma (APR-DRG 141). We excluded children with complex chronic conditions using a previously reported classification scheme.[12]

An electronic survey (**Appendix 1**; available at www.jpeds.com) was distributed to quality leaders at each of the PHIS hospitals. The survey focused on 13 different asthma-specific discharge components adapted from previously identified interventions to reduce rehospitalization,[13,14] and key components as identified by the National Heart Lung Blood Institute asthma expert guidelines.[10] The survey asked respondents to report the frequency (never, rarely, sometimes, often, and always) by which their hospital group performed each discharge practice. The survey highlighted 4 broad discharge practice categories: (1) Inpatient asthma education (specifically, dedicated individual to conduct education, multiple formats of education (group class, one-to-one teaching, videos, written materials, etc), and content areas of asthma education); (2) Medications and devices in-hand at discharge (specifically, spacer, beta-agonist, controller medication, and oral steroids for current or future exacerbation); (3) Contact with the primary medical doctor (PMD) (specifically, communication with the PMD, and scheduled follow-up PMD appointment); and (4) Postdischarge components (specifically, postdischarge phone call to caregivers, home visit referrals, and environmental mitigation program referrals).

Through group consensus, each hospital's provision of a discharge component was classified by intensity and given a score of 1 (low), 2 (middle), and 3 (high) (**Appendix 2**; available at www.jpeds.com). For example, in the content of education discharge component, the survey asked about 7 specific topic areas that the educator discussed with the patient and/or caregiver based on the NIH asthma guidelines, including asthma pathophysiology, symptom identification, trigger assessment/avoidance strategies, role of medications, inhaler/spacer technique demonstration, inhaled corticosteroid adherence, and home-asthma management plan.[10] There was also an option to write-in additional education components. A hospital was classified as low (score 1) for content of education if they reported less than the 7 content areas, middle (score 2) if they reported 7 of 7 content areas, and high (score 3) if they reported all 7 content areas plus additional content; a high score for this discharge component was considered comprehensive content of education. As another example, for the communication with PMD at discharge component, the hospital was classified as low (score 1) if the reported frequency was never/rarely, middle (score 2) if the reported frequency was sometimes/often, and high (score 3) if the reported frequency was always.

The primary outcomes were the adjusted same-cause readmission rates at 30 days and 3 months. We counted readmissions (inpatient or observation) if the patient returned for asthma (APR-DRG 141) or other respiratory APR-DRGs.[15] The additional respiratory APR-DRGs were included as outcomes to capture readmissions that may have been related to asthma, but not coded specifically as asthma. Readmission rates were adjusted for patient characteristics (age, sex, race, and payer status), severity of asthma illness (number of hospitalizations for asthma in prior year [2014]), severity of exacerbation (any encounter in the intensive care unit [ICU]), length of stay, disposition, seasonal variation, and hospital characteristics (case-mix index and hospitals' percentage of admissions that are for asthma).

Statistical Analyses

Categorical variables were summarized with frequencies and percentages, and comparisons were made across groups using χ^2 statistics. Continuous variables were summarized with median and IQRs, and compared across groups with Wilcoxon rank-sum statistics. We risk-adjusted hospital readmission rates using generalized linear mixed effects models with a random hospital effect and the following covariates: age, ARP-DRG severity of illness, sex, race, payor, disposition, length of stay, receipt of ICU care, and the hospital-level percentage of asthma discharges to total discharges. From these models, we performed a covariance test to determine if there was significant variation in risk-adjusted readmission rates across hospitals. Hospital-level 30-day and 3-month readmissions rates were compared across levels of the discharges components using Kruskal-Wallis tests. Because of the number of discharge components relative to the number of observations, we employed a data reduction technique using Classification and Regression Trees. This suggested several possible combina-

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