Rehospitalization of Children With Asthma

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Background: Although some children with asthma experience multiple admissions, asthma is considered a preventable cause of hospitalization.

Objective: To assess whether components of medical histories, ambulatory care prior to hospitalization, or ambulatory care after discharge are associated with repeated hospitalizations for children admitted with asthma.

Design: Nested case-control study of a cohort of children hospitalized for asthma, comparing those who were rehospitalized within 1 year with those not rehospitalized.

Setting: Urban pediatric primary care clinic.

Participants and Methods: Subjects were 119 children, aged 0 to 14 years, who had an inpatient admission with a diagnosis of asthma between July 1, 1993, and June 30, 1995 (index hospitalization). Data sources included medical charts, computerized patient records, and administrative data. Use of health care services was compared among children who were rehospitalized within 1 year with those who were not.

Main Outcome Measure: Repeated hospitalizations.

Results: The proportions of children who received general pediatric, allergy, or pulmonary care in the year prior to the index hospitalization were 86%, 7%, and 8%, respectively. By report, half of all children did not receive prescribed therapies, more than half were exposed to cigarette smoke at home, and one fourth were not up-to-date with immunizations at the time of admission. Thirty-five of the 119 children hospitalized with asthma were subsequently readmitted with asthma within 1 year of the index hospitalization. Children readmitted did not differ from those with a single admission in terms of the above characteristics. However, significantly more children subsequently readmitted had a pulmonary consultation during the index admission (23% vs 4%; P = .001) or in the year following discharge (37% vs 12%; P = .002). In addition, children readmitted were more likely to have other chronic conditions (69% vs 49%; P = .048).

Conclusion: Among low-income urban children, readmission for asthma is not associated with receipt of prescribed therapies or pediatric care.


Editor's Note: Looks like we need to keep looking for preventable reasons for rehospitalization.

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Asthma is the most prevalent chronic condition in children. It affects 4.8 million children in the United States and accounts for 200,000 childhood hospitalizations per year. Hospitalizations for asthma impair child and family functioning, are measures of asthma morbidity, and consume significant quantities of health care resources. Asthma accounts for $3.6 billion in medical costs each year in the United States. These medical expenditures include physician and clinic outpatient visits, emergency department use, home health services, prescription drugs, and hospitalizations. Weiss et al found that inpatient hospitalizations accounted for 54% of the direct expenditures for medical care related to asthma for children 17 years and younger.

Although hospitalizations for many pediatric conditions are declining, researchers have demonstrated increasing rates of hospital admissions for asthma. Various explanations have been proposed to account for increased hospital admissions for asthma. These include increases in disease severity, environmental exposures, and prevalence; changes in admission criteria; and different patterns of health care utilization. Limited access
PARTICIPANTS AND METHODS

PARTICIPANTS

Eligibility requirements included patients aged 0 to 14 years who (1) experienced 1 or more admissions during fiscal years 1994 and 1995 with a discharge diagnosis of asthma (International Classification of Diseases, Ninth Revision [ICD-9] 493.XX excluding 493.2) and (2) identified the Harriet Lane Primary Care Clinic (HLPC) at Johns Hopkins Children’s Center, Baltimore, Md, as the primary care provider at discharge.

The study was approved by the Joint Committee on Clinical Investigation at Johns Hopkins University School of Medicine.

SAMPLE

A case-mix management file identified all children with a discharge diagnosis of asthma admitted to the Johns Hopkins Children’s Center during the entirety of fiscal years 1994 and 1995. This file was cross-linked to a hospital administrative file to identify the 178 children for whom HLPC was the primary care provider. Upon hospital and outpatient chart reviews, 36 children were excluded because HLPC was not the primary care provider (n = 37) and/or because they were admitted for conditions other than asthma (n = 22). Each of the 7 children admitted for diagnoses other than asthma or related conditions (such as pneumonia) wheezed during the admission and required a change in their medication regimen; they were retained in the sample. The final sample included 119 children. Regardless of the time of the index hospitalization, the records of all children were examined for 12 months from the time of an index hospitalization to identify those who were rehospitalized within 1 year. Thirty-five children (29%) were rehospitalized within 1 year of the index hospitalization.

DATA SOURCES

For each study participant, the HLPC chart and computerized patient record was reviewed for a period extending from 1 year before through 1 year after the index hospitalization. Immunization histories for 8 children with incomplete immunization histories in the computerized patient record or in the medical chart were obtained from the Baltimore City Health Department Immunization Registry.

SELECTED DEFINITIONS

General pediatric care included well-child or acute care services provided in HLPC, it excluded visits for prescription refills or paperwork that did not include patient encounters. Allergy and pulmonary care included visits to the respective hospital outpatient specialty clinics as identified by hospital administrative records.

Consultations from allergy and pulmonary specialists were identified by presence of a consultation order or consultation note in the hospital medical chart.

Immunizations up-to-date was based on having received appropriate immunizations for the child’s given age on the day of the index admission. This included receipt of diphtheria and tetanus toxoid and pertussis vaccine by 2, 4, 6, and 18 months and 6 years of age; polio vaccine by 2, 4, and 18 months and 6 years; and measles-mumps-rubella vaccine by 18 months and 6 years. Subjects were classified as up-to-date or not up-to-date. The proportion of children up-to-date was calculated for all children with at least 1 valid immunization date. Only immunizations with associated dates rather than notations of being “up-to-date” were counted.

Other chronic conditions were identified by hospital admission, emergency department, or HLPC encounters. These conditions included eczema (n = 20), developmental delay or cerebral palsy (n = 9), hydrocephalus or ventriculoperitoneal shunt (n = 5), allergies (n = 5), sickle cell disease (n = 4), short gut syndrome (n = 3), seizures (n = 3), chronic pulmonary disease (n = 3), and chronic otitis media (n = 5). Among 1 or 2 children, an additional 42 chronic conditions were identified; these included ventricular septal defect, laryngomalacia, umbilical hernia, and cortical blindness.

Run out of medications was identified by hospital admission notes or emergency department or HLPC encounters that provided information on whether the child had run out of medications prior to the index admission. This information was based on parent or patient report as documented in medical records.

DATA ANALYSIS

Differences between children hospitalized once vs those readmitted for asthma within 1 year of the index hospitalization were compared using the x² test for proportions and the t test for means (SPSS for Windows, version 6.1.3; SPSS, Chicago, Ill). Means and medians are reported as value ± SD.
should influence disease morbidity and subsequent health care utilization.16,17

The purpose of this study was to determine whether components of medical histories, ambulatory care prior to hospitalization, or ambulatory care after discharge are associated with repeat hospitalizations for children admitted with asthma. We hypothesized that children who received prescribed medications and who received ambulatory care would be less likely to be readmitted with asthma in the following year. Knowledge of factors contributing to hospital readmission for children with asthma is critical to developing appropriate interventions targeted at those at greatest risk of repeat hospitalizations.

## RESULTS

Among the 119 children hospitalized with asthma, 93% were African American and 82% received medical assistance. The mean age was 4.0 ± 3.1 years and the mean length of hospital stay was 3.6 ± 6.2 days (median, 2 days). Thirty-five (29%) of the 119 children hospitalized with asthma were readmitted with asthma within 1 year of an index admission. Among low-income urban children, readmissions within 1 year preceding the index admission were comparable for children with single and multiple admis-

<table>
<thead>
<tr>
<th>Table 1. Patient Characteristics at the Time of Index Admission*</th>
<th>Single-Admission Patients (n = 84)</th>
<th>Multiple-Admission Patients (n = 35)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Receipt of ambulatory care in the year preceding the index admission</td>
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<td></td>
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<tr>
<td>General pediatric</td>
<td>71 (86)</td>
<td>29 (85)</td>
<td>.97</td>
</tr>
<tr>
<td>Allergy</td>
<td>6 (7)</td>
<td>2 (6)</td>
<td>.78</td>
</tr>
<tr>
<td>Pulmonary</td>
<td>4 (5)</td>
<td>5 (14)</td>
<td>.07</td>
</tr>
<tr>
<td>Prescribed routine asthma medications</td>
<td>65 (77)</td>
<td>32 (91)</td>
<td>.07</td>
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<tr>
<td>Receiving all daily medications</td>
<td>21 (25)</td>
<td>7 (20)</td>
<td>&gt;.99</td>
</tr>
<tr>
<td>Usual home medications</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Albuterol sulfate</td>
<td>58 (69)</td>
<td>31 (89)</td>
<td>.02†</td>
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<tr>
<td>Oral corticosteroids</td>
<td>17 (20)</td>
<td>9 (26)</td>
<td>.51</td>
</tr>
<tr>
<td>Cromolyn sodium</td>
<td>18 (21)</td>
<td>17 (49)</td>
<td>.003†</td>
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<tr>
<td>Inhaled corticosteroids</td>
<td>4 (5)</td>
<td>6 (17)</td>
<td>.03†</td>
</tr>
<tr>
<td>Cigarette exposure at home</td>
<td>46 (62)</td>
<td>16 (49)</td>
<td>.19</td>
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<td>Pets with fur or feathers at home</td>
<td>14 (28)</td>
<td>6 (20)</td>
<td>.86</td>
</tr>
<tr>
<td>Other chronic conditions</td>
<td>41 (49)</td>
<td>24 (69)</td>
<td>.049†</td>
</tr>
<tr>
<td>Immunizations up-to-date</td>
<td>55 (77)</td>
<td>25 (78)</td>
<td>.047†</td>
</tr>
<tr>
<td>Ever intubated or in an intensive care unit</td>
<td>24 (29)</td>
<td>16 (46)</td>
<td>.07</td>
</tr>
</tbody>
</table>

*Data are given as number (percentage). n = 119 except for receiving all daily medications (n = 48), cigarette exposure at home (n = 107), pets with fur or feathers at home (n = 73), and immunizations up-to-date (n = 109).

†P < .05.

In this study of low-income children, 29% of children were readmitted for asthma within 1 year of an index admission. Among low-income urban children, readmission for asthma was associated with female gender, being prescribed albuterol and cromolyn as usual home medications, the presence of other chronic conditions, and receipt of pulmonary consultation during the index admission.

## Table 2. Index Admission Characteristics* | Single-Admission Patients (n = 84) | Multiple-Admission Patients (n = 35) | P |
<table>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>First asthma admission</td>
<td>40 (49)</td>
<td>18 (55)</td>
<td>.62</td>
</tr>
<tr>
<td>Ran out of medications prior to admission</td>
<td>15 (54)</td>
<td>5 (42)</td>
<td>.49</td>
</tr>
<tr>
<td>Allergy consultation during admission</td>
<td>1 (1)</td>
<td>0 (0)</td>
<td>.52</td>
</tr>
<tr>
<td>Pulmonary consultation during admission</td>
<td>3 (4)</td>
<td>8 (23)</td>
<td>.001†</td>
</tr>
<tr>
<td>Medications at discharge</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Albuterol sulfate</td>
<td>82 (98)</td>
<td>34 (97)</td>
<td>.88</td>
</tr>
<tr>
<td>Oral corticosteroids</td>
<td>65 (77)</td>
<td>27 (77)</td>
<td>.98</td>
</tr>
<tr>
<td>Cromolyn sodium</td>
<td>45 (54)</td>
<td>20 (57)</td>
<td>.72</td>
</tr>
<tr>
<td>Inhaled corticosteroids</td>
<td>6 (7)</td>
<td>6 (17)</td>
<td>.10</td>
</tr>
<tr>
<td>General pediatrics visit within 2 wk of discharge</td>
<td>42 (50)</td>
<td>15 (43)</td>
<td>.48</td>
</tr>
<tr>
<td>1 mo of discharge</td>
<td>55 (71)</td>
<td>21 (62)</td>
<td>.31</td>
</tr>
</tbody>
</table>

*Data are given as number (percentage). n = 119 except for ran out of medications prior to admission (n = 40).

†P < .05.

In this study of low-income children, 29% of children were readmitted for asthma within 1 year of an index admission. Among low-income urban children, readmission for asthma was associated with female gender, being prescribed albuterol and cromolyn as usual home medications, the presence of other chronic conditions, and receipt of pulmonary consultation during the index admission.
admission. In addition, children readmitted for asthma tended to be prescribed daily asthma medications or to have ever been intubated or in an intensive care unit. Although our sample is small and drawn from a single urban hospital-based teaching clinic, our findings suggest that disease severity rather than receipt of prescribed therapies or ambulatory care is associated with readmission for asthma.

This study uses a combination of institutional case-mix data and medical chart review to evaluate associations between health care utilization and medical histories. As such, several limitations should be noted. First, patients were selected from a single urban institution. This controls for access to care, but sample size is small and the population homogeneous. Results may not be generalizable to populations of different socioeconomic status and ethnic composition. A large proportion of children in this study had chronic conditions in addition to asthma; these conditions ranged in severity, functional limitation, and duration. Second, this retrospective analysis is subject to coding limitations of case-mix data. Asthma diagnoses were based on discharge diagnoses and confirmed through medical chart review. Third, medical chart review does not enable us to measure the comprehensiveness or quality of ambulatory care. While differences in visit content may exist, there is no reason to suspect differential recording among the 2 groups of children. Fourth, our reporting of pulmonary and allergy specialist involvement is limited to information available in chart review. As such, it excludes informal consultations and therefore may underestimate specialist participation in care. The small percentage of children receiving pulmonary or allergy consultation does not reflect an unwillingness of these providers to participate in the care of children with asthma at this institution.

As with receipt of ambulatory care, immunization levels are comparable among children with single admissions and those readmitted with asthma. We used strict immunization criteria for identifying which children were up-to-date. Children with medical record notations of being "up-to-date" or having received immunizations elsewhere but lacking immunization dates were not considered to be up-to-date. Only the 10 children with no immunization documentation were excluded from the immunization analysis.

We also observed high proportions of children running out of medications and children not receiving currently agreed-upon therapies for asthma at the time of hospital discharge. Our methods preclude commenting on whether personal, family, and/or systems factors contribute to these findings. Moreover, there were no differences between children who were rehospitalized and those who were not in terms of these characteristics.

Despite these limitations, our findings suggest that readmission occurs among a subset of children with greater disease severity and is therefore predictable. Thus, receipt of a pulmonary consultation, presence of other chronic conditions, history of prior intubation or intensive care unit admission, and prescribing of daily asthma medications may identify children who are more likely to be readmitted. Targeted case management for these children may enhance discharge planning and outpatient management.

Our study precedes the adoption and implementation of critical pathways for asthma management. In our institution, it is possible that standardized forms and protocols contribute to improved medical documentation and discharge planning. In addition, all Medicaid children have been enrolled in managed care plans. By state law, the plans are held accountable for providing acute and well-child care. The plans’ emphasis on preventive care and decreased costs as well as their staffing of case managers and outreach workers provide a unique opportunity for jointly working to reduce asthma readmissions.

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REFERENCES