

The objective of this 2-part study was to identify associations between characteristics of ambulatory care and ACS hospitalizations among children with varying underlying levels of health. We hypothesized that ambulatory care characteristics would have weaker relationships to ACS hospitalizations for CMC than for children with less complex chronic conditions. In the first phase, administrative data was used to examine predictors of ACS hospitalization; and in the second phase, chart review data among a smaller subset of discharges was used to examine ambulatory care predictors of ACS hospitalization frequently unavailable in administrative data.

Methods

This retrospective cohort study included pediatric discharges from a tertiary children's hospital between July 2007 and July 2014. We used the pediatric medical complexity algorithm to categorize patients into 3 mutually exclusive groups: (1) nonchronic, (2) noncomplex chronic, or (3) complex chronic disease.¹⁵ We included encounters for patients with noncomplex chronic disease (NC-CD) or complex chronic diseases (ie, CMC). NC-CDs typically involve only a single body system, are nonprogressive, and are variable in severity (eg, asthma, depression); CMCs involve multiple body systems and are progressive, frequently requiring technology assistance (eg, cerebral palsy, tracheostomy with ventilator dependence).

This study was conducted with 2 samples. The administrative sample represented all inpatient and observation hospital discharge encounters for patients ≤ 21 years old during the study period, excluding only neonatal and labor/delivery encounters. This administrative sample, therefore, included patients from all hospital services, including hospital medicine, subspecialty or surgical services, and intensive care.

The chart review sample was a random subset of the administrative sample chosen to facilitate collecting ambulatory care details beyond what is routinely available in administrative data. We restricted this sample to encounters of patients admitted only to the hospital medicine service who had a primary care provider within our health system, to ensure complete access to pertinent ambulatory care information. Therefore, the chart review dataset was comprised of a 20% stratified random sample of the 1370 encounters for NC-CD and CMC on the hospital medicine service who received primary care within our health system. A structured data abstraction protocol was developed after piloting on 5 encounters of NC-CD and CMC not included in our study.

All discharge encounters were categorized as ACS or non-ACS hospitalizations. We used pediatric ACSC definitions available from the Agency for Healthcare Research and Quality Pediatric Quality Indicators Technical Specifications, v 5.0¹⁶—diabetes complications, perforated appendix, gastroenteritis, urinary tract infection, and asthma. As in previous studies,⁴ we also included bacterial pneumonia, which is within the general prevention quality indicator set of the Agency for Healthcare Research and Quality.

We adapted existing pediatric measures of quality and access to care^{6,17-20} for this study, and assessed each up to 2 years prior

to hospitalization. Measures were limited to those that were able to be abstracted from administrative or chart review sources; and not disease-specific, such that they could be applied to all encounters. Measures and data sources included the following: (1) having a primary care provider at the time of hospitalization (administrative); (2) having health insurance at the time of hospitalization (administrative); (3) timely well checks (chart review); (4) primary care provider continuity (chart review); (5) childhood vaccination status (chart review); (6) anthropometric measurement (weight, length/height, body mass index; chart review); and (7) outpatient visits—primary and specialty care (administrative and chart review).

Timely well checks were defined as the proportion of recommended well checks that were attended on time (based on American Academy of Pediatrics recommendations²¹), using an approach described previously.⁵ Primary care provider continuity was assessed using a continuity of care index, K, described by Ejlertsson.^{22,23} We calculated the K index by dividing the difference in the number of well care visits and the number of different providers by the number of well care visits minus 1. Continuity was dichotomized as above or below the median because we observed bimodal peaks at 0 and 1. Continuity scores could only be calculated when patients had >1 well care visit in the 2 years prior to hospitalization. Vaccination status was categorized as up to date or not, based on Centers for Disease Control and Prevention recommendations at the time the child was 2 years old. Children less than 2 years of age were considered vaccinated if they were up to date based on their age at the time of assessment.

In addition, we sought to characterize ambulatory encounters in the 30 days leading up to each hospitalization. Ambulatory encounters were defined as patient-provider interactions documented in the electronic health record, whether by phone, electronic (eg, email, in basket), or in-person. Measures included (1) total encounters—phone, electronic, or in-person (chart review); and (2) encounters for the same problem as hospitalization, phone, electronic, or in-person (chart review).

We included covariates consistent with previous pediatric ACS and CMC utilization studies,^{4,24,25} including age, sex, child's race/ethnicity, and primary language. Severity of illness was assessed using all-patient refined diagnosis-related group severity, hospitalization length of stay, and past-year hospitalizations. We also included passive smoke exposure, which has been associated with increased pediatric hospital use in general²⁶ and among children with asthma²⁷ and is also associated with more severe pneumonia.²⁸ Smoke exposure was assessed routinely on admission using a nursing intake form. Although nearly 33% of responses were missing, there was no difference in the presence of missing data between children with NC-CD or complex chronic disease. We coded smoke exposure into three categories: yes, no, or missing.

Statistical Analyses

Descriptive statistics compared differences between ACS and non-ACS hospitalizations for NC-CD and CMC. The first phase analyzed the administrative sample, testing associations among ACS hospitalization, patient characteristics, and ambulatory

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