Preventability of Early Readmissions at a Children’s Hospital

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KEY WORDS
children’s hospitals, preventable readmissions, pediatric population

ABBREVIATIONS
APR-DRGs—All Patient-Refined Diagnosis-Related Groups
CRG—Clinical Risk Group
MCJCHV—Monroe Carell, Jr, Children’s Hospital at Vanderbilt

Drs Hain and G ay had full access to all the data in the study, take responsibility for the integrity of the data, the accuracy of the data analysis, and were responsible for drafting of the manuscript; Drs Hain, Gay, Whitney, and Berutti were responsible for the study concept and design and acquisition of data; Drs Hain, Gay, Saville, and Ms Wang were responsible for the analysis and interpretation of data; Drs Hain, Gay, Whitney, Berutti, and Saville and Ms Wang were responsible for critical revision of the manuscript for important intellectual content; and Ms Wang and Dr Saville were responsible for the statistical analysis.

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WHAT’S KNOWN ON THIS SUBJECT: There is widespread belief that many hospital readmissions in adults are avoidable by improvements in care and discharge planning processes, resulting in significant cost savings; however, current studies have not examined the preventability of such readmissions in children’s hospitals.

WHAT THIS STUDY ADDS: The overall rate of pediatric 15-day readmissions considered to be preventable was low, less than 2% of total hospital admissions. Pediatric readmissions are unlikely to serve as a highly productive focus for cost savings or quality measurement.

abstract

OBJECTIVE: To determine whether pediatric readmissions within 15 days of discharge were considered preventable.

METHODS: Retrospective chart review of 200 randomly selected readmissions (8% of all readmissions) occurring within 15 days of discharge from a freestanding children’s hospital between January 1, 2007, and December 31, 2008. The degree of preventability was assessed independently for each case by 4 pediatricians using a 5-point Likert scale and was correlated with chronic conditions and reason for index admission with 3M’s Clinical Risk Groups and All Patient-Refined Diagnostic-Related Groups, respectively.

RESULTS: The rate of 15-day readmissions considered more likely preventable by the discharging hospital was 20.0% (1.7% of total admissions, 95% confidence interval 14.8%–26.4%). Reviewers failed to reach initial consensus in 62.5% of cases, although final consensus was achieved after the panel reviewed cases together. Consensus ratings served as the standard for the remainder of the study. Readmissions in children with malignancies were considered less preventable than those in children with other chronic illnesses (5.8% vs 25.8%, P = .003). Readmissions following surgical admissions were considered more likely preventable than those following medical admissions (38.9% vs 15.9%, P = .002). Central venous catheter infec tions and ventricular shunt malfunctions accounted for 8.5% of all readmissions reviewed.

CONCLUSIONS: Although initial consensus about which readmissions were more likely preventable was difficult to achieve, the overall rate of preventable pediatric 15-day readmissions was low. Pediatric readmissions are unlikely to serve as a highly productive focus for cost savings or quality measurement. Pediatrics 2013;131:e171–e181
Reducing hospital readmissions has become a major focus of efforts to increase the quality of medical care while reducing costs. All-cause 30-day readmission rates of approximately 20% have been reported for Medicare beneficiaries1 and some researchers and policymakers believe that many readmissions are avoidable by improvements in care and discharge planning during the previous hospitalization.2–4 Consequently, readmissions are considered a reflection of quality of care and Medicare will reduce reimbursement to hospitals for readmissions considered potentially preventable.5,6 Yet, the impact of attempts to reduce avoidable readmissions, such as public reporting of hospital readmission rates by Medicare and diligent assurance of outpatient follow-up care after discharge, is unclear7–9 and many readmissions may be affected by events outside the control of the hospital, such as primary care access and outpatient management.7,10

A smaller but growing body of literature addresses readmissions in the pediatric population. Whereas previous studies focused on specific conditions,11–14 Feudtner et al15 evaluated all discharges from 38 children’s hospitals in 2004 and found that 16.7% of patients 2 to 18 years of age were readmitted within 365 days of the initial hospitalization. Berry et al16 also found that patients with more hospitalizations in a single year were more likely to require technology assistance and to have public insurance. These studies did not examine preventability or earlier readmissions.

To date, there has been less emphasis on early readmissions in children, defined here as readmissions within 15 days of a previous discharge. Although there may be many reasons why readmissions occur, including lack of socioeconomic resources and access to primary care,10 the discharging hospital is currently held most responsible for preventing readmissions.5,6 and intuitively, early readmissions may have a more direct relationship to care or discharge planning in the previous hospitalization than later readmissions. Thus, early readmissions might provide a better framework to study how readmissions might be prevented by the discharging hospital. Recent data from our institution showed that 15-day readmissions accounted for 8.4% of all admissions and that most of the patients had significant chronic diseases,17 suggesting that characteristics of pediatric patients and their illnesses may have a significant influence on early readmissions. Although the extent to which early readmissions to children’s hospitals are preventable has not been reported, children’s hospitals may also see reduced reimbursement for readmissions in the future.

If readmissions are to be used to measure quality and affect reimbursement to children’s hospitals, then understanding the preventability of readmissions is critical. The objective of the current study was to determine the extent to which readmissions within 15 days of discharge were deemed preventable in our children’s hospital population.

**METHODS**

**Study Setting**

For this study, patients admitted to inpatient units within the Monroe Carell, Jr, Children’s Hospital at Vanderbilt (MCJCHV), a tertiary children’s medical center associated with Vanderbilt University Medical Center (Nashville, TN),17 or its associated NICUs and newborn nursery (which admits healthy and high-risk patients directly from the labor and delivery suite from Vanderbilt University Medical Center) were included as admissions to MCJCHV, but those admitted to other hospitals at Vanderbilt University Medical Center were not. Our purpose was to examine the preventability of readmissions under the direct control of MCJCHV policies and personnel. This study was approved by the institutional review board of Vanderbilt University.

Internal administrative data for all MCJCHV patients <30 years of age were available, including admission and discharge dates, and diagnostic and procedure codes. Each admission was assigned to 1 of 316 mutually exclusive categories of the All Patient–Refined Diagnostic-Related Groups (APR-DRGs) Version 24.0 (3M Health Information Systems, Wallingford, CT).18,19

**Study Population**

The study population included all patients readmitted to MCJCHV for all causes up to and including 15 days after a previous discharge, initially admitted between January 1, 2007, and December 31, 2008. A total of 2546 pairs of initial admissions and 15-day readmissions were identified out of 50 188 total admissions (8.4% of all admissions, including newborns, as previously reported17). From this dataset, 200 pairs of index admissions and associated readmissions were randomly selected for chart review by using the randomization scheme generated by the Web site Randomization.com (http://www.randomization.com). The subset of readmissions selected for chart review was compared with the remainder of the group of 15-day readmissions for demographic characteristics, including age, sex, race/ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, all other), and insurance type (government, commercial, and all other). Race/ethnicity was classified by patients or their parents or legal guardians with predefined options within the data set. Race/ethnicity was assessed because it may contribute to readmission...
risk, as demonstrated by Feudtner et al. Clinical Risk Group (CRG) software, developed by 3M Health Information Systems (Salt Lake City, UT) and the National Association of Children’s Hospitals and Related Institutions (NACHRI) assigns individual patients to a single, mutually exclusive hierarchical chronic condition status group. We used CRGs to categorize patients from hospital discharge data as previously described and stratified this population as follows: (1) non-chronic condition (eg, appendicitis), (2) episodic chronic conditions (eg, asthma), (3) single lifelong chronic conditions (eg, diabetes type 1), (4) chronic conditions in more than 1 body system (eg, cerebral palsy with quadriplegia and asthma) and complex conditions (eg, muscular dystrophy), and (5) malignancies.

Readmission Preventability Review

In a previous report, one of the authors (J.C.G.) reviewed medical records for all 2546 pairs of index and readmissions and developed an initial manual for assigning preventability scores based on that review. Three additional experienced pediatric physicians were then recruited (1 general pediatric hospitalist [P.D.H.] and 2 specialists in pediatric critical care [G.M.W. and T.W.B.]) to form the review panel. The 4 panel members had a mean of 12.3 years of experience on the academic faculty (range 5–26 years). Before reviewing medical records for the current study, panel members further refined the original guidelines for each rating in the scale that follows and reviewed cases outside of the 200 randomly selected charts to develop conventions for the use of specific ratings for various clinical situations (see Appendix 1).

The following readmission preventability scale was established by the panel:

1. Readmission not preventable in most circumstances (including readmissions that were planned)
2. Readmission more likely not preventable
3. Readmission of uncertain preventability
4. Readmission more likely preventable
5. Readmission preventable in most circumstances

Then, panel members were charged to rate the degree to which readmissions in the 200 chart review set were preventable by changes in the inpatient care or discharge planning provided during the preceding (“index”) hospitalization. For example, panel members were instructed to look for medical errors during the index admission, evidence that the patient was not an appropriate discharge candidate, or communication issues at discharge that affected the readmission. Reviewers also were able to access information from the readmission to look for possible preventable causes (such as failure to fill a crucial medication prescription after the previous discharge) and to judge whether and how the readmission was related to the index admission.

The study chart review was then conducted in 2 parts: first, each panel member independently reviewed the same set of 100 records and assigned ratings. Panel members had access to the entire electronic medical record, including, but not limited to, history and physical, daily progress notes, discharge summaries, laboratory data, and notes from emergency department and outpatient encounters at MCJCHV. Panel members were not blinded to the identity of physicians and other staff members caring for the patients under review. The independent ratings were collated and analyzed. The panel then met together and in cases in which the 4 reviewers did not give exactly the same rating, the group reviewed the medical record together, and discussed the reasoning behind the rating of each reviewer. Through that discussion, the reviewers ultimately agreed on a final consensus rating for each readmission. This process was repeated with a second different subset of 100 randomly selected early readmissions.

Statistical Considerations

Because the ratings were on a 1 to 5 Likert scale, Kendall’s coefficient of concordance, W, was calculated to assess the level of agreement among 4 raters (correcting for ties) after each reviewer assigned ratings independently. Kendall’s W ranges from 0 (no agreement) to 1 (complete agreement) with a corresponding P value based on Friedman’s test, which tests the null hypothesis that there is no agreement among 4 raters with respect to readmission preventability. Wilcoxon rank-sum tests and Pearson χ² tests were used for comparisons between the reviewed and not reviewed readmissions. A P value <.05 was considered statistically significant.

RESULTS

Demographics of the Reviewed Readmissions Sample

Table 1 shows the comparison of the reviewed readmissions sample to other readmissions within the study period. The patients in the sample had an average age of 5.3 ± 6.1 years at the time of the index admission and 57.5% were boys. The average length of stay of the index admissions was 9.0 ± 21.2 days and the mean time between discharge and readmission was 6.7 ± 40.0 days. A significant chronic illness (defined as stratified CRG groups 3, 4, and 5) was present in 74% of patients in the sample and 82% of admissions were for primarily medical conditions. The patients...
TABLE 1 Demographic Characteristics in Selected and Unselected Readmissions

<table>
<thead>
<tr>
<th></th>
<th>Readmissions Not Selected for Review (n = 2346)</th>
<th>Readmissions Randomly Selected For Review (n = 200)</th>
<th>95% CI*</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Age (SD)b</td>
<td>6.6 (6.7)</td>
<td>5.3 (6.1)</td>
<td>0.42 to 2.22</td>
<td>.004</td>
</tr>
<tr>
<td>Age range, y, n (% total)</td>
<td>&lt;1 778 (33.2)</td>
<td>75 (57.5)</td>
<td>.21</td>
<td>.69</td>
</tr>
<tr>
<td>1–12 325 (13.9)</td>
<td>38 (19.0)</td>
<td>.06</td>
<td>.81</td>
<td>.006</td>
</tr>
<tr>
<td>13–20 492 (21.0)</td>
<td>26 (13.0)</td>
<td>.006</td>
<td>&gt;.99</td>
<td></td>
</tr>
<tr>
<td>&gt;20 34 (1.4)</td>
<td>2 (1.0)</td>
<td>.047 to 0.71</td>
<td>.69</td>
<td>.004</td>
</tr>
<tr>
<td>Male, % (95% CI)</td>
<td>54.4 (52.4 to 56.4)</td>
<td>57.5 (50.6 to 64.4)</td>
<td>.39</td>
<td></td>
</tr>
<tr>
<td>Mean LOS (SD)c</td>
<td>7.4 (13.2)</td>
<td>9.0 (21.2)</td>
<td>−4.58 to 1.43</td>
<td>.001</td>
</tr>
<tr>
<td>Median LOS (IQR)</td>
<td>3.0 (2.0–7.0)</td>
<td>3.0 (2.0–7.0)</td>
<td>.00</td>
<td>.90</td>
</tr>
<tr>
<td>Mean Days Between (SD)d</td>
<td>6.8 (4.2)</td>
<td>6.7 (4.0)</td>
<td>−0.47 to 0.71</td>
<td>.89</td>
</tr>
<tr>
<td>Primary Payer, % (95% CI)</td>
<td>Government</td>
<td>51.6 (49.6 to 53.7)</td>
<td>.99</td>
<td>.90</td>
</tr>
<tr>
<td></td>
<td>Commercial</td>
<td>45.2 (43.2 to 47.2)</td>
<td>.99</td>
<td>.90</td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td>3.2 (2.9 to 4.0)</td>
<td>.99</td>
<td>.90</td>
</tr>
<tr>
<td>Race, % (95% CI)</td>
<td>Non-Hispanic white</td>
<td>73.3 (71.5 to 75.0)</td>
<td>.99</td>
<td>.90</td>
</tr>
<tr>
<td></td>
<td>Non-Hispanic black</td>
<td>14.1 (12.9 to 15.8)</td>
<td>.99</td>
<td>.90</td>
</tr>
<tr>
<td></td>
<td>Hispanic</td>
<td>8.5 (7.4 to 9.7)</td>
<td>.99</td>
<td>.90</td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td>4.1 (3.4 to 5.0)</td>
<td>.99</td>
<td>.90</td>
</tr>
<tr>
<td>APR-DRG Medicalf</td>
<td>78 (75.8 to 87.0)</td>
<td>82 (76.1 to 79.5)</td>
<td>.99</td>
<td>.90</td>
</tr>
</tbody>
</table>

Aggregated Clinical Risk Groupf, %

- 1. Nonchronic
  - 14.6
  - 14.0
- 2. Episodic chronic
  - 9.4
  - 12.0
- 3. Single lifelong chronic
  - 6.6
  - 7.5
- 4. Multiple and complex
  - 46.5
  - 40.5
- 5. Malignancies
  - 22.9
  - 26

CI, confidence interval; IQR, interquartile range; LOS, length of stay.
* A 95% CI for the difference between means was used in comparisons among continuous variables.
+ Mean age in years at the time of the index admission.
# Mean LOS for the index admission in days.
$ Mean time in days between discharge from the index admission and readmission.
° Proportion of medical index hospitalizations as determined by APR-DRG category.
+ CRGs (3M) were used to assign individual patients to a single, mutually exclusive aggregated hierarchical chronic condition status group based on the presence and complexity of single or multiple chronic conditions.
1 Example: asthma.
2 Examples: sickle cell disease, bronchopulmonary dysplasia, pulmonary atresia (corrected), type 1 diabetes.
3 Examples: type 1 diabetes and juvenile idiopathic arthritis, Down syndrome with short bowel syndrome and congenital heart disease, spina bifida, Fanconi anemia, spinal muscular atrophy, cystic fibrosis.

in the reviewed sample were younger at the time of admission (5.3 years vs 6.6 years) and were more often covered by government insurance (63.0% vs 51.6%) than the remainder of the readmissions.

Consensus Ratings

Table 2 shows the final consensus ratings for all 200 reviewed readmissions. The panel found that 20.0% (95% confidence interval, 14.8% to 26.4%) of the 15-day readmissions reviewed (1.7% of total admissions) were more likely preventable (rating categories 4 and 5 together) by changing care or discharge planning during the index admission. A subset of these readmissions (8.5% of readmissions in the reviewed sample) was for 2 distinct types of clinical problems: central venous catheter infections and ventriculoperitoneal shunt malfunctions; moreover, among the 68.5% of cases rated as 1 (not preventable in most circumstances), 50% of the overall reviewed sample were planned. These final ratings then served as the standard by which initial interrater agreement was assessed.

Independent Review

When applying the rating scale to the first 100 sample readmissions in-dependently, all reviewers gave the same rating in 39% of cases (39/100); thus, at least 1 of the 4 reviewers disagreed 61% of the time. Reviewers were more likely to agree with ratings in planned readmissions than unplanned (94.0% vs 18.7% agreement, P < .001). Three of the 4 panel members agreed exactly in an additional 37% of cases (37/100), bringing the total agreement among at least 3 of the reviewers to 78%. Panel members then met and reviewed rating discrepancies while consulting the medical record and determined the consensus rating for the first 100 sample readmissions. This also allowed reviewers to discuss cases relating to the guidelines for rating assignment and confirm or revise previous rules and conventions.

In the second randomly selected set of 100 readmissions, the reviewers independently graded readmissions with the same rating in 36% of cases, and 3 of 4 reviewers agreed exactly in another 27%. Panel members then met again and reviewed rating discrepancies and determined a final consensus rating for the second 100 cases. Thus, after independent review of the entire 200 readmissions sample, at least 1 reviewer was in disagreement for 62.5% of cases; moreover, the discussion after review of the first 100 cases did not significantly bias the review of the second 100 cases, as the percentage agreement was similar. Figure 1 shows the percentage of all 200 cases in which 0, 1, 2, 3, or 4 panel members agreed with the final consensus rating in their initial independent review. Disagreement was particularly evident for readmissions rated as preventable in most circumstances (rating 5), in which no more than 2 of 4 reviewers agreed in any instance.

We next evaluated the extent of the change in reviewer ratings from initial independent review to consensus. Overall, reviewers changed their initial
ratings in 26.6% of the reviewed readmissions (range 18.0% to 30.5%). Most changes (67.6%) were in the direction of less likely to be preventable (range 54.1% to 84.2% among the 4 reviewers).

Statistical Analysis of Independent Interrater Agreement

Among the 4 raters on 200 readmissions (using the 5-level scale), the concordance coefficient was 0.713 (Friedman’s P < .001), reflecting good interrater agreement. Thus, even though reviewers did not agree exactly after independent review in 62.5% of cases, they were more likely to have independent ratings that were similar if not identical.

Preventability by CRG Grouping

The extent to which reviewers felt readmissions were likely preventable was similar for aggregated CRG groups for nonchronic, episodic chronic, single lifelong chronic, and complex patients (25.0% to 26.7%, Table 3). Patients with malignancies had fewer readmissions considered more likely preventable (3/52, 5.8%) than all other CRG groups and all were central venous catheter infections.

Preventability by APR-DRG Category

We next examined the correlation between consensus preventability ratings and clinical patient categories by APR-DRG assignments. By using the APR-DRG category designations of medical or surgical conditions, we found that 15.9% of readmissions after medical index admissions were felt to be more likely preventable compared with 38.9% of readmissions after surgery (P = .002). In the reviewed sample, two-thirds of the patients with planned readmissions were patients with malignancies with readmissions for scheduled chemotherapy. However, the remainder of planned readmissions occurred in 14 other APR-DRGs, including those for seizures, bone marrow transplantation; ventricular shunt procedures; major cardiothoracic, gastrointestinal, and musculoskeletal surgery; and malnutrition/failure to thrive.

Of the 25 most frequent index admissions APR-DRGs (accounting for 67.5% of all readmissions in the sample), only 3 were surgical categories (Table 4). In these categories, most readmissions (9/13) were deemed more likely preventable by the panel. The remaining APR-DRGs were medical, and most (82.6%) were considered less likely preventable.

Representative detailed clinical examples of cases and ratings can be found in Appendix 2.

DISCUSSION

This study raises 2 important issues for readmissions in pediatric patients. First, the overall rate of readmissions to our hospital was low (∼8%) and with only 20% of those considered more likely preventable, the all-cause 15-day preventable readmission rate was <2%. Second, consensus about which readmissions are more likely preventable was hard to reach. Initially at least 1 of 4 experienced hospital-based pediatricians differed 62.5% of the time, and agreement was lowest for readmissions deemed preventable in most circumstances (Fig 1); however, when the discrepant cases were discussed as a group, it became clear that different reviewers had alternative interpretations of the same information and when the clinical reasoning of each reviewer was expressed, the group could examine the “shades of gray” and reach consensus. This suggests that group rather than individual evaluations are the preferred method of assessing preventability. Both of these issues have important health policy implications.

TABLE 2 Consensus Preventability Ratings for Readmissions

<table>
<thead>
<tr>
<th>Consensus Rating</th>
<th>No. Cases</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1: Readmission not preventable in most circumstances</td>
<td>87</td>
<td>45.5</td>
</tr>
<tr>
<td>1P: Planned readmission</td>
<td>50</td>
<td>25.0</td>
</tr>
<tr>
<td>2: Readmission more likely not preventable</td>
<td>23</td>
<td>11.5</td>
</tr>
<tr>
<td>3: Readmission of uncertain preventability</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td>4: Readmission more likely preventable</td>
<td>35</td>
<td>17.5</td>
</tr>
<tr>
<td>5: Readmission preventable in most circumstances</td>
<td>5</td>
<td>2.5</td>
</tr>
<tr>
<td>Total</td>
<td>200</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Of early readmissions, 20% were felt to be more likely preventable (ratings 4 and 5). Nearly half of these were central venous catheter infections or ventriculoperitoneal shunt malfunctions (17 cases, 8.5% of the total sample).

FIGURE 1

Percentage of cases where 0, 1, 2, 3, or 4 panel members agreed with the final consensus rating in their initial independent review of all 200 cases using the full 5-point Likert scale. Exact agreement among all reviewers for all ratings was achieved in 37.5% of cases overall.
Studies focused on adults have reported higher rates of readmissions and preventable readmissions than we found.\(^1\)\(^6\) The low rate of preventable readmissions in our children’s hospital should give pause to payers looking to reduce costs by denying payment for readmissions. The findings should also concern quality groups looking to compare and ascribe accountability to hospitals based on pediatric readmission rates. With a preventable 15-day readmission rate of <2% of all admissions, the comparison of rates may reflect random variation more than the quality of care at an institution.

The primary goal of this study was to have a group of experienced inpatient pediatricians determine the degree to which they considered 15-day readmissions in our hospital to be preventable. As a novel undertaking in pediatrics, the group had to develop the approach, the rating scale, and the guidelines for determining and assigning preventability. We felt that addressing the process and the discrepancies among reviewers after independent review was instructive both for the panel in developing and applying guidelines and to those who may try to apply and refine the approach at other institutions. This became the secondary goal of the study. The lack of initial consensus regarding preventability is concerning when viewed in light of the possible financial and reputational consequences to hospitals. If experienced pediatricians are unable to view the same case and come to the same conclusion, then the potential for single reviewers at payers and hospitals to disagree about preventability is high. This situation would heighten tensions between payers and providers, and cause quality metrics using estimates in the United States. One might argue to exclude the large population of healthy newborns from the calculation, but even when these infants and their ratings were not considered, the rate of more likely preventable readmissions to our hospital was 20.8%.

### TABLE 3: Readmission Preventability by CRG

<table>
<thead>
<tr>
<th>CRG</th>
<th>Less Likely Preventable (%)</th>
<th>Planned (%)</th>
<th>More Likely Preventable (%)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1: Nonchronic</td>
<td>20 (71.4)</td>
<td>1 (5.6)</td>
<td>7 (25.0)</td>
<td>28</td>
</tr>
<tr>
<td>2: Episodic chronic</td>
<td>16 (66.7)</td>
<td>2 (8.3)</td>
<td>6 (25.0)</td>
<td>24</td>
</tr>
<tr>
<td>3: Single lifelong</td>
<td>6 (40.0)</td>
<td>5 (33.3)</td>
<td>4 (26.7)</td>
<td>15</td>
</tr>
<tr>
<td>4: Multiple and complex</td>
<td>52 (64.2)</td>
<td>9 (11.1)</td>
<td>21 (24.7)</td>
<td>81</td>
</tr>
<tr>
<td>5: Malignancies</td>
<td>16 (50.8)</td>
<td>33 (65.5)</td>
<td>3 (5.8)</td>
<td>52</td>
</tr>
<tr>
<td>Total</td>
<td>110 (55.0)</td>
<td>50 (25.0)</td>
<td>40 (20.0)</td>
<td>200</td>
</tr>
</tbody>
</table>

CRG software was used to assign 5 tiers of chronicity and complexity. Readmissions for malignancies were less likely to be considered preventable compared with other tiers. \(P < .02\) for individual comparisons. \(P = .003\) for tier 5 versus other chronic conditions.

### TABLE 4: Readmission Preventability in the Top 25 Index Admission APR-DRGs

<table>
<thead>
<tr>
<th>APR-DRG IA(a)</th>
<th>APR-DRG Description</th>
<th>Medical/Surgical(b)</th>
<th>More Likely Preventable(c)</th>
</tr>
</thead>
<tbody>
<tr>
<td>603</td>
<td>Chemotherapy</td>
<td>M</td>
<td>1/37</td>
</tr>
<tr>
<td>138</td>
<td>Bronchiolitis &amp; Respiratory syncytial virus Pneumonia</td>
<td>M</td>
<td>2/12</td>
</tr>
<tr>
<td>640</td>
<td>Neonate Birth Weight &gt;=2499 g, Normal Newborn or Neonate with Other Problem</td>
<td>M</td>
<td>0/8</td>
</tr>
<tr>
<td>22</td>
<td>Ventricular Shunt Procedures</td>
<td>S</td>
<td>6/7</td>
</tr>
<tr>
<td>254</td>
<td>Other Digestive System Diagnoses</td>
<td>M</td>
<td>1/7</td>
</tr>
<tr>
<td>680</td>
<td>Major Hematologic/Immunologic Diagnoses Except Sickle Cell Crisis &amp; Coagulation Disorders</td>
<td>M</td>
<td>1/7</td>
</tr>
<tr>
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<td>Postoperative, Posttraumatic, Other Device Infections</td>
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<td>Cranioamy Excep for Trauma</td>
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<td>113</td>
<td>Infections of Upper Respiratory Tract</td>
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<td>Asthma</td>
<td>M</td>
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<td>Other Respiratory Diagnoses Except Signs, Symptoms, &amp; Minor Diagnoses</td>
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<td>2/3</td>
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<td>144</td>
<td>Respiratory Signs, Symptoms, &amp; Minor Diagnoses</td>
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<td>1/3</td>
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<td>Other Stomach, Esophageal, &amp; Duodenal Procedures</td>
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<td>Other Esophageal Disorders</td>
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<td>Peripheral, Cranial &amp; Autonomic Nerve Disorders</td>
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<tr>
<td>51</td>
<td>Viral Meningitis</td>
<td>M</td>
<td>1/2</td>
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</table>

\(a\) APR-DRG assignment for the index admission.  
\(b\) Medical (M) or surgical (S) designation for the index admission by APR-DRG.  
\(c\) Numbers represent consensus ratings of 4+5 over the total number of remissions for the APR-DRG category of the index admission. Shown are the 25 most frequent index admission APR-DRGs representing 67.5% of the sample.
of preventability to be called into question.10,24

This study also introduces a concept for preventability of specific complications of central venous catheter infections and ventriculoperitoneal shunt malfunctions (8.5% of readmissions reviewed). Although the panel generally considered these potentially preventable, the extent to which they can be prevented is unclear. In the case of central venous catheter infections, recent experience in inpatient settings has shown that their incidence can be reduced significantly with diligent sterile technique and maintenance care.25,26 Although there are barriers to similar compliance in the home setting, theoretically external contamination of central venous catheters can be decreased to a significant degree rendering the readmissions that result from these infections potentially avoidable. In the case of ventriculoperitoneal shunt malfunctions, it is less clear how surgical technique affects the potential for shunt malfunction, although there are suggestions in the literature that risk factors, such as the location of the intracranial end of the shunt, have a bearing on shunt failure.27,28 Given that these 2 clinical problems are likely not always preventable, the actual preventable readmission rate may be <20%.

Finally, although the rate of preventable readmissions to our hospital was <2% of all admissions, it still represented ~250 hospitalizations per year. Furthermore, although the focus of this study was to determine whether changes in care or discharge planning during the index admission could have prevented the readmission, some readmissions may be influenced by factors beyond the control of the hospital, which, nevertheless, if altered, might obviate the need for readmission.

The contributions of outpatient providers and ambulatory care after discharge, more intensive home nurse visiting programs, and family situations and dynamics warrant further study.7

On the other hand, Feudtner and colleagues29 showed that pediatric readmission rates were actually higher in states receiving the highest ratings in child health system performance as assessed by the Commonwealth fund. This suggests that at least some readmissions may be a marker of an efficient, effective, timely, patient-centered, and equitable health system.

This study has several limitations. First, the randomly selected sample of readmissions differed from the rest of the readmissions in that the patients were somewhat younger and were more often covered by government health insurance programs. Younger patients may be more likely to have acute illnesses, readmission for which can be affected by an unpredictable disease course or be subject to clinical judgment as to when discharge is appropriate. Older children have more time to develop chronic illnesses, although the incidence of chronic illness was not different between the 2 groups. Government insurance programs, most likely to be Medicaid managed care in the patient population of our institution, tend to cover populations with greater socioeconomic disadvantages and more chronic illnesses. Again, the latter was not different between the 2 patient groups, but the reviewed group may have had more psychosocial factors affecting readmissions.

Another limitation of the current study is that it was conducted in a single freestanding children’s hospital that is part of an academic medical center. The generalizability of the findings to other types of institutions, or to other academic medical centers in different regions, is unknown. Also, reviewers considered readmissions in the context of hospital care and discharge planning. Taking other factors into consideration, such as ambulatory follow-up visits and discharge care plan execution, might have changed the results. Next, because the reviewers knew that each chart reviewed was from a readmitted patient, there may have been a retrospective bias. This may have biased reviewers to overstate the number of patients in the preventable categories. Alternatively, because the reviewers were not blinded to any information in the medical records (including the responsible attending physician), panel members may have been less likely to determine that care given by them or their colleagues may have resulted in a preventable readmission. Last, this study was based on medical chart review and accuracy and completeness of documentation is a key element in any review of medical records. In this study, we interpreted a lack of documentation about discharge planning, for example, as if such planning was not done. Clearly, the possibility exists that follow-up plans were made and the caring physicians simply omitted this information from the medical record. This approach had the potential to overestimate the extent to which the readmission was preventable.

CONCLUSIONS

The overall rate of pediatric 15-day readmissions likely to be preventable was low and initial consensus about which readmissions were more likely preventable was difficult to achieve. Pediatric readmissions are unlikely to serve as a highly productive focus for cost savings or quality measurement.

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REFERENCES


17. Gay JC, Hain PD, Grantham J, Saville BR. Epidemiology of 15 day readmissions to a children’s hospital. Pediatrics. 2011;127(6). Available at: www.pediatrics.org/cgi/content/full/127/6/e1505


APPENDIX 1

Criteria for Categories of Readmission Preventability

Preventability rating (PR) scale:
1: Readmission not preventable in a large majority of similar circumstances.
Subset 1P: Planned readmission.
2: Readmission likely not preventable in most similar circumstances but there are some mitigating circumstances of the first admission that might have an influence (though probably slight) on the need for readmission.
3: Uncertain: events in the previous hospitalization possibly could influence the need for readmission but even with chart review it is unclear the extent to which this is likely.
4: Readmission clearly related to the initial admission and events in the initial admission may directly influence the need for readmission, although there are mitigating circumstances that make preventability less certain or outpatient follow-up, treatments, or services are not clearly documented and the lack of such may be involved in the reason for readmission.
5: Readmission directly related to the initial admission, influenced by events during the initial admission and very likely preventable with different care during the initial admission.

Examples: Initial Guidelines for Reviewers
1: Readmission not preventable.
Readmission is unrelated to the initial admission and for the most part, was not present during the initial admission, eg, respiratory syncytial virus bronchiolitis after an initial admission for elective surgery; readmission for appendectomy after an initial admission for pneumonia (with no symptoms related to appendicitis during initial admission).
Disease process itself is unpredictable despite appropriate medical care; eg, former premature infant with bronchopulmonary dysplasia on O2 at home with acute respiratory distress with fever, wheezing, increased secretions diagnosed with pneumonia, is discharged from the hospital when back to baseline on antibiotics but readmitted with same symptoms 1 wk later;
Disease process, palliative care: the decision to admit for nontherapeutic, comfort-only end-of-life care is clearly delineated.
Malignancy: readmissions for complications of the malignant disease itself or the immunocompromised/myelosuppressed state brought on by chemotherapy necessary to treat the underlying disease; eg, readmission for febrile neutropenia 7 d after an admission for chemotherapy with negative cultures (for readmissions associated with central venous line infections, see category 4 below).
Trauma occurring after an initial admission totally unrelated to the initial admission and unexpected, eg, admission for surgery for a ruptured spleen from an auto accident after an initial admission for pneumonia.
Readmission for mental health/substance abuse (including suicides, overdoses).
Readmission for concern about complication of underlying disease but on testing, complication not detected, eg, fever after previous diagnosis of endocarditis but recurrence/persistence not found; postoperative fever but etiology not related to surgery.
Subset of Category 1 (designated 1P) is for Planned Readmissions as an intentional or expected part of the management of the patient's condition; eg, scheduled chemotherapy readmission after an initial admission for febrile neutropenia; staged or elective surgical procedures, initiation of ketogenic diet in a patient with intractable seizures.

2: Readmission usually not preventable.
Respiratory syncytial virus with improvement after 2 d of hospital observation (room air; eating at discharge) but with worsening symptoms after discharge but no clearly predictable reason for worsening;
Readmission within 3 d after discharge for similar symptoms, would not be considered preventable if farther out but raises the possibility that a longer initial hospital might have prevented the need for readmission;
Complication of a chemotherapy drug besides myelosuppression, eg, readmission for constipation from Vincristine;
Initial cellulitis, improving on antibiotics, home on appropriate oral antibiotics but develops abscess at the site. Readmitted despite apparent appropriate care;
Initial admission for evaluation of new or recurrent, more-frequent seizures, medications added or changed. If seizures controlled in the initial admission, readmission within 15 d for more seizures may be the result of the disease process rather than care. However, a subsequent second readmission strongly suggests that longer observation in the previous admission might have decreased the likelihood of readmission, and is thus might be considered a 4 (below), ie, 1 readmission for seizures may not be preventable but subsequent readmissions may be.
Readmission because of purely family circumstances; eg, appropriate prescriptions written and family education accomplished during the index admission but family fails to fill prescription; readmission for family concern that is not medically justified, decision by emergency department staff or primary care physician to admit anyway; recurrent abdominal pain 15 d after appendectomy for perforation. No etiology found. Uncertain relationship to initial admission.

3: Uncertain.
4: Readmission more likely preventable.
Readmissions for complications from drugs prescribed during the first admission, eg, reaction to intravenous vancomycin at home to complete treatment of osteomyelitis.
Readmission for a surgical complication that may not be entirely preventable but would not have occurred if surgery had not been performed; eg, subglottic edema and stridor after laryngeal laser surgery.
A second or subsequent readmission for seizure control in a patient with a seizure disorder.
Many readmissions for the same problem may be level 4 especially if within a week of the previous admission, suggesting that a longer previous admission may have prevented.
Plural or pericardial effusion after cardiac surgery; pneumonia with readmission for empyema, readmission for the same diagnosis within a very short time frame (1–2 d), ie, rate-relevant complication.
Intubation for respiratory failure in the initial admission and readmission for stridor from subglottic stenosis;
Central venous catheter infection as a readmission: premise is that catheter care is the responsibility of the original hospital that inserted it, better instruction to the family for home usage may prevent some but not all infections, home health agency performance is the responsibility of the hospital that set it up initially.
Readmission for ventriculoperitoneal shunt occlusion after an initial admission in which the ventriculoperitoneal shunt was placed (note: does not include ventriculoperitoneal shunt infections, see 5 below);
5: Readmission directly related to the initial admission, influenced by events during the initial admission and very likely preventable most of the time.
Postoperative infections.
Need for removal and/or revision of an infected, recently placed ventriculoperitoneal shunt.
Incorrect Lovenox dose on discharge prescription leading to a bleeding complication requiring readmission.
### APPENDIX 2

Representative Case Scenarios for Preventability Rating Assignments.

<table>
<thead>
<tr>
<th>LOS IA</th>
<th>LOS RA</th>
<th>Final Rating</th>
<th>Case Scenario</th>
<th>Reason for Rating</th>
</tr>
</thead>
</table>
| 1      | 1      | 1: Readmission not preventable in most circumstances | 5-y-old, sickle cell disease (Stratified CRG Level 3).  
Index admission: sickle pain crisis, afebrile. Pain improved, off intravenous pain medications.  
Readmission: 3 d after discharge for acute left leg pain, fever to 103°F, concern for osteomyelitis.  
Discharged on oral antibiotics as osteomyelitis could not be ruled out. | Standard of care to admit patients with sickle cell disease with fever and concern for significant infection, in this case, osteomyelitis. New illness not clearly related to the previous admission. |
| 6      | 2      | 1: Readmission not preventable in most circumstances | 4-mo-old former premature with chronic lung disease, tracheostomy (Stratified CRG Level 4).  
Index admission: acute hypoxia, increased secretions, possible aspiration. At baseline at discharge.  
Readmission: 15 d after discharge for respiratory distress, likely chronic aspiration. | Unpredictable and unpreventable manifestation of underlying disease process. |
| 4      | 4      | 1: Readmission not preventable in most circumstances (Planned) | 9-y-old with osteosarcoma (Stratified CRG Level 5).  
Index admission: scheduled chemotherapy.  
Readmission: scheduled chemotherapy 3 d after discharge. | Planned |
| 4      | 1      | 1: Readmission not preventable in most circumstances (Planned) | 2.5-mo-old with chronic renal insufficiency due to renal dysplasia and complete UPJ obstruction (Stratified CRG Level 4).  
Index admission: pyelonephritis.  
Readmission: scheduled pyeloplasty 4 d after discharge. | Planned |
| 1      | 1      | 2: Readmission more likely not preventable | 5 y old with chronic constipation (Stratified CRG Level 1).  
Index admission: bowel cleanout, successful.  
Readmission: 8 d after discharge reimpaction, repeat cleanout. Discharged with new home regimen. | Initial management appropriate but sent home from second admission on more aggressive bowel regimen. |
| 11     | 7      | 2: Readmission more likely not preventable | 13-mo-old with holoprosencephaly (Stratified CRG Level 4).  
Index admission: Pseudomonas pneumonia, respiratory failure. Discharged when improved on appropriate therapy.  
Readmission: 3 d after discharge with stridor, increased secretions, apnea. | Readmission within a short time of discharge, but discharge seemed appropriate on review and readmission due to disease process, not preventable by changes during initial admission. |
| 1      | 1      | 4: Readmission more likely preventable | 2.5-y-old with asthma (Stratified CRG Level 2).  
Index admission: status asthmaticus. Complex social situation, uncertain who had custody, follow-up not documented.  
Readmission: 14 d after discharge for recurrent status asthmaticus. | Did not have follow-up appointment after index admission. Better education and follow-up arrangements may have impacted the need for readmission. |
| 2      | 1      | 4: Readmission more likely preventable | 2-mo-old with laryngomalacia (Stratified CRG Level 3).  
Index admission: laryngeal laser surgery.  
Readmission: 2 d after discharge for postop stridor after failing to fill prescription for steroids. | Ensuring prescription availability at discharge may have affected need for readmission. |
| 9      | 6      | 4: Readmission more likely preventable | 10-y-old with acute myelocytic leukemia, stem cell transplantation (Stratified CRG Level 4).  
Index admission: fever, respiratory syncytial virus positive.  
Readmission: 13 d after discharge for fever, central venous catheter infection with coagulase negative Staphylococcus at readmission. | Improved teaching for home catheter care may have reduced the potential for a central venous catheter infection. |
### Representative Case Scenarios for Preventability Rating Assignments.

<table>
<thead>
<tr>
<th>LOS IA&lt;sup&gt;a&lt;/sup&gt;</th>
<th>LOS RA&lt;sup&gt;b&lt;/sup&gt;</th>
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<th>Case Scenario</th>
<th>Reason for Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>9</td>
<td>4- Readmission more likely preventable</td>
<td>18-mo-old with history of prematurity, hydrocephalus (Stratified CRG Level 4). Index admission: symptomatic ventriculoperitoneal shunt malfunction requiring externalization and shunt revision. Readmission: 2 d after discharge for symptomatic shunt malfunction and revision.</td>
<td>Surgical complications in general felt to be potentially influenced by the choice of materials used or the surgical technique.</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>5: Readmission preventable in most circumstances</td>
<td>15-y-old with long history of constipation (Stratified CRG Level 3). Index admission: scheduled appendicostomy. Readmission: abdominal pain, fever, elevated white blood cell count, superficial surgical site infection.</td>
<td>Potentially preventable surgical infection.</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>5: Readmission preventable in most circumstances</td>
<td>Healthy 2-y-old (Stratified CRG Level 1). Index admission: incision and drainage of methicillin-resistant <em>Staphylococcus aureus</em> thigh abscess. On intravenous Clindamycin in the hospital and prescription given for oral Clindamycin at home. Follow-up scheduled for 2 wk. Refused to take oral Clindamycin at home. Readmission: 3 d after discharge with arm cellulitis.</td>
<td>The patient was not given a trial of oral antibiotics before discharge from the index admission, which might have prompted a longer index admission or other approach to outpatient therapy.</td>
</tr>
</tbody>
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<sup>a</sup> Length of stay during the index admission.

<sup>b</sup> Length of stay during the readmission.
Preventability of Early Readmissions at a Children's Hospital

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