

An Examination of Physician-, Caregiver-, and Disease-Related Factors Associated With Readmission From a Pediatric Hospital Medicine Service

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OBJECTIVES: The purpose of this study was to describe the characteristics and reasons for pediatric hospital medicine readmissions. We also aimed to describe characteristics of potentially preventable cases and the reliability of classification.

METHODS: Retrospective descriptive study from December 2008 through June 2010 in a large academic tertiary care children's hospital in Houston, Texas. Children were included if they were readmitted to the hospital within 30 days of discharge from the pediatric hospital medicine service. Reasons for readmission were grouped into three categories: physician-related, caretaker-related, and disease-related. Readmissions with physician- or caretaker-related reasons were considered potentially preventable.

RESULTS: The overall readmission rate was 3.1%, and a total of 204 subjects were included in the analysis. Lymphadenitis and failure to thrive had the highest readmission rates with 21%, and 13%, respectively. Twenty percent ($n = 41/204$) of readmissions were preventable with 24% ($n = 10/41$) being physician-related, 12% ($n = 5/41$) caregiver-related, and 63% ($n = 26/41$) for mixed reasons. When comparing classification of readmissions into preventable status, there was moderate agreement between 2 reviewers ($K = 0.44$, 95% confidence interval: 0.28–0.60). Among patients with preventable readmission, the probability of having had a readmission by 7 days and 15 days was 73% and 78%, respectively.

CONCLUSIONS: Reliable identification of preventable pediatric readmissions using individual reviewers remains a challenge. Additional studies are needed to develop a reliable approach to identify preventable readmissions and underlying modifiable factors. A focused review of 7-day readmissions and diagnoses with high readmission rates may allow use of fewer resources.

ABSTRACT

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Hospital readmissions are a complex and multifactorial entity in pediatrics, and it is uncertain whether they reflect suboptimal quality of care during initial hospitalization. Traditionally, adult studies have described readmissions as an indicator for poor quality of care during the index hospitalization with many readmissions being related to high morbidity and cost, especially among Medicare patients.¹⁻⁷ However, aspects of adult readmissions may not be generalizable to pediatric readmissions because a large proportion of adult readmissions involve chronic lifestyle-related conditions.^{4,5} Furthermore, pediatric readmission rates are lower compared with adult readmissions.⁸⁻¹⁰ Despite these differences, government agencies and third-party payers are starting to use readmission rates as a measure for quality of care in pediatrics and reducing reimbursements for pediatric readmissions deemed to be preventable.¹¹

Several pediatric studies have used administrative data from databases of large children's hospitals to characterize long-term pediatric readmissions occurring across a broad spectrum of childhood diseases.^{9,12} These studies have identified few predictors for readmission, with only black race and public insurance being cited consistently.^{4,9,12-15} Feudtner et al evaluated hospital performance in relation to readmission rates and found that high performance is associated with higher readmission rates. Given these findings, the authors questioned whether readmissions truly represent poor quality of care.¹⁶ Recently, a large, single-center, retrospective study analyzed the epidemiology of short-term pediatric readmissions to all hospital services within 15 days of discharge.¹⁷ In a follow-up study, Hain et al studied a random sample of these 15 day all-cause readmissions to determine preventability and found that only a small percentage were potentially preventable. The preventable readmissions constituted 20% of the readmissions they studied but only 1.7% of their total admissions.¹⁸ On the basis of these data, it remains debatable whether a focus on pediatric readmission rates as a quality measure will lead to improved quality of care for the hospitalized child.

Currently, few data exist to describe the preventability of pediatric readmissions to a pediatric hospital medicine service, and given the potential financial impact on hospital medicine programs, it is prudent to gain a better understanding of this phenomenon. Pediatric hospitalists often manage patients with conditions that are among the most frequently admitted to the hospital and thus incur great cost. These conditions tend to have a high turnover with short lengths of stay.¹⁹ These unique circumstances could make the study of readmissions to a pediatric hospital medicine service of particular importance and relevance to the field, especially given the potential financial impact. Once the characteristics of preventable readmissions are known, institutions can use the information to identify cases more readily and develop interventions to address precipitating factors for readmission.

The primary purpose of this study was to describe the reasons for readmission for patients discharged from a pediatric hospital medicine service. Secondly, we sought to describe the characteristics of readmissions that may have been potentially preventable and the reliability of this classification. We explored factors such as minority status, public insurance, short staffing, inexperienced physicians, and shorter length of index stay as potential characteristics for preventable readmission.

METHODS

Study Design, Data Source, and Data Collection

This retrospective, descriptive study used a preexisting database, which included readmissions data from December 2008 to June 2010, at Texas Children's Hospital (Houston, TX), a large single-site academic tertiary care children's hospital located in an urban setting. A large percentage of patients admitted to the hospital have public insurance and/or are of Hispanic ethnicity. At the time of this study, the Pediatric Hospital Medicine (PHM) service primarily managed medical patients, including patients with chronic complex conditions and technologic dependence (gastrostomy tube, tracheostomy without ventilator). The readmissions database was

created for quality monitoring purposes for the section of PHM. Each quarter, readmissions to our PHM service were identified using a report created through our electronic medical record (EPIC 2009, version 4). The report included the following information: age, ethnicity, admission and discharge dates, length of stay for both admissions, time between admissions, name of hospital unit, discharge diagnosis, and physician provider(s) at admission and discharge. All readmission cases were further analyzed via chart review to confirm information found on the report and to determine the reason for readmission. Standardized data collection forms were used to extract data for each subject. Additional dichotomous variables for the index admission were extracted from the database and included weekend discharge, fellowship training for discharging faculty member, and seniority of discharging physician (<5 years or >5 years of practice). This study was approved by the Baylor College of Medicine (Houston, TX) Institutional Review Board.

Study Population

Patients were included in this study if they were discharged from the hospital medicine service for the first admission and readmitted within a 30-day period to any service. Thirty days was selected because it was the suggested time interval for preventable readmissions in adult patients at the time the study commenced.^{1,3,7} Patients were excluded if they had a missing chart, left the hospital against medical advice on the first admission, or had a planned reason for readmission.

Classification System and Outcomes

Before developing a classification system, we searched for existing classification tools nationally via a query of the literature (PubMed and Embase), the American Academy of Pediatrics Hospital Medicine listserv, and health care agency websites (eg, Agency of Healthcare Research and Quality). No classification tools to identify preventable readmissions were found. The primary investigator (SW) then developed a classification system that grouped reasons for readmission into 4 categories: physician-related, caretaker-related,

disease-related, or unrelated reasons for readmission (Fig 1). Examples of these reasons include an incorrect diagnosis during the index admission as being physician-related, poor adherence to discharge medications as caretaker-related, and unforeseen worsening of a disease process after discharge as disease-related. An unrelated reason for readmission included patients being readmitted for a different diagnosis that was not related to the discharge diagnosis for the index admission, for example, a patient admitted for cellulitis during the index admission who is readmitted due to pneumonia. A preventable readmission was defined as one with either a caretaker- or physician-related reason for readmission. Subjects with only disease-related or unrelated reasons for readmission were deemed to have a nonpreventable readmission. The classification system was reviewed and approved to be suitable for use by 2 hospital medicine faculty members and 3 fellows, with no additional reasons for readmission identified.

Two of the investigators (SK, CF) underwent training on how to use the classification system during a 1-hour session during which they reviewed 5 readmission case

examples. These basic cases served as anchors to allow reviewers to understand the different reasons for readmission. For example, a young child was readmitted due to worsening cellulitis and was noted to have missed clindamycin doses at home. This child was considered to have caretaker-related reason of readmission due to noncompliance with discharge medication. Also, during this session, a suggested order of chart review (second discharge summary, first history, physical, etc) was discussed. The reviewers then practiced using the classification system independently while reviewing 20 readmission cases each to assess reliability. They met 2 times, after completion of 10 cases and again after 20 cases, to discuss each person's classification for the reason for readmission. The primary investigator (SW) explained verbally the intended meaning of each element of the classification system (Fig 1), and CF and SK then verbalized how they had interpreted the same elements. Throughout this process, several elements of the classification system were revised to increase the clarity of interpretation, but no additional reasons for readmission were identified.

As we began data collection, the principal investigator (SW) used the classification

system as all charts were reviewed. During each chart review, a primary reason for readmission was identified, and, if present, a secondary contributing reason. To assess the reliability of the patient readmission as preventable or nonpreventable, a second reviewer (SK) independently reviewed all charts, and a κ score was calculated. For cases with discrepant ratings between the first 2 reviewers, a third reviewer (CF) was used to determine the final rating, which was used for the analysis.

Statistical Analysis

Statistical analysis was performed by using SAS software for Windows, version 9.3 (SAS Institute, Cary, NC). Summary statistics were stratified by preventable status. Independent variables were compared across groups using the Fisher's exact test for categorical variables, and Wilcoxon's rank sum test was used for continuously measured variables. Statistical significance was assessed at the $\alpha = .05$ level of significance. Interrater reliability was assessed by using κ statistics with 95% confidence intervals (CIs). Strength of agreement was categorized by using Landis and Koch's scheme.²⁰ A survival analysis was conducted to compare time to readmission by preventability status of the readmission.

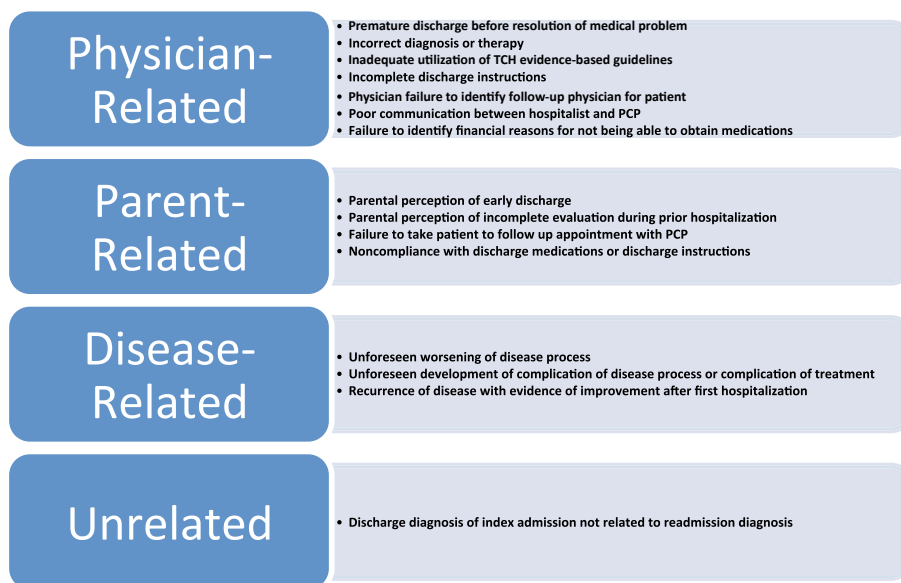


FIGURE 1 Classification system for etiology of readmission. Four main categories defined by bullet points on the right. Preventable readmissions had at least 1 of the criteria for a physician- or parent-related reason for readmission. Nonpreventable readmissions were purely disease-related or unrelated. PCP, primary care provider; TCH, Texas Children's Hospital.

RESULTS

A total of 251 readmissions were observed among 7983 discharges identified through the electronic medical records. The overall readmission rate was 3.1%. We excluded 47 readmissions with 15 being excluded because they were planned readmissions, 10 for missing charts and another 22 because they represented repeated admissions for subjects already included in the data set. The most common reasons for planned readmissions were surgical procedures ($n = 11$) or medical treatments such as chemotherapy ($n = 4$). A total of 204 readmissions of unique patients were included in this analysis. Patients were predominantly male (59%). Fifty-one percent of the patients were Hispanic and 66% had Medicaid insurance, which reflects the population seen at our institution (Table 1). Most patients were initially admitted to a hospitalist unit (60%) and were discharged on a weekday (72%). The discharging physicians were predominantly junior physicians (62%) and were not fellowship trained (81%). The median length of stay for the first admission was 3.0 days (range 0–83 days). The median time interval between admissions was 9.5 days (range 0–30 days) (Table 2). The percentage of patients readmitted to a critical care unit was 16.6% (95% CI: 12–23). Diseases with the highest number of readmissions, such as pneumonia, bronchiolitis, cellulitis, and urinary tract infection, also had the highest volume of discharges. The readmission rates were 3% (24 of 743) for pneumonia, 3% (25 of 765) for bronchiolitis, 6% (11 of 189) for UTI, and 2% (12 of 526) for cellulitis. The diseases with the highest readmission rates were lymphadenitis (21%, 9 of 42), failure to thrive (13%, 10 of 77), osteomyelitis (12%, 7 of 58), and neonatal fever (11%, 11 of 104). Of these diagnoses, lymphadenitis and failure to thrive had the most potentially preventable readmissions (Table 3).

The most common reasons for readmission were disease-related (87%) followed by physician-related (16%), unrelated (13%), and caretaker-related reasons (4%) (Table 4). Because 46 patients had >1 reason for readmission, the sum of percentages exceeds 100%. Twenty percent

TABLE 1 Demographic Characteristics With Comparison Between Preventability Status

Characteristic	All Readmissions ($n = 204$)	Not Preventable ($n = 163$)	Preventable ($n = 41$)	<i>P</i>
Age, y, median (range)	1.0 (0–18.6)	0.9 (0–18.6)	1.7 (0–17.9)	.20 ^a
Gender (%)				.03 ^b
Female	83 (41)	60 (37)	23 (68)	
Male	121 (59)	103 (63)	18 (44)	
Ethnicity (%)				.11 ^b
White	49 (24)	41 (25)	8 (20)	
Black	32 (16)	25 (15)	7 (17)	
Hispanic	103 (51)	85 (52)	18 (44)	
Other	19 (9)	11 (7)	8 (20)	
Insurance (%)				0.17 ^b
Private	57 (29)	44 (27)	13 (32)	
Public	129 (66)	106 (65)	23 (56)	
None	10 (5)	6 (4)	4 (10)	

^a Calculated by using Wilcoxon rank sum test.

^b Calculated by using Fisher's exact test.

(95% CI: 15–26) of the 204 patients were identified as having a preventable readmission. Of this group of 41 preventable readmissions, 24% ($n = 10/41$) were physician-related, 12% ($n = 5/41$) caregiver-related, and 63% ($n = 26/41$) had mixed reasons for readmission that included at least 1 caregiver- or physician-related reason for readmission.

Moderate agreement was observed between raters for preventable versus not preventable readmissions with agreement on 84% ($n = 171$ of 204) of cases ($K = 0.44$, 95% CI: 0.28–0.60). The remaining 33 cases were reviewed by the third reviewer. Interrater reliability was also moderate for category of readmission ($K = 0.59$, 95% CI: 0.47–0.70) but only fair for specific

TABLE 2 Physician and Hospital-Related Characteristics With Comparison by Preventability Status

Characteristic	All Readmissions ($n = 204$)	Not Preventable ($n = 163$)	Preventable ($n = 41$)	<i>P</i>
Admission unit				.03 ^a
Hospitalist only	123 (60)	92 (56)	31 (76)	
Mixed unit	81 (40)	71 (44)	10 (24)	
Weekend vs weekday				1.00 ^a
Weekend discharge	57 (28)	46 (28)	11 (27)	
Weekday discharge	147 (72)	117 (72)	30 (73)	
Physician experience				.85 ^a
Practicing <5 y	114 (62)	92 (62)	22 (59)	
Practicing >5 y	71 (38)	56 (38)	15 (51)	
Fellowship				.48 ^a
Fellowship trained	35 (19)	30 (20)	5 (14)	
No fellowship	151 (81)	119 (80)	32 (86)	
LOS median (range), d				
First hospital stay	3.0 (0–83)	3.0 (0–83)	2.0 (1–26)	.22 ^b
Median days between admissions (range)	9.5 (0–30)	12.0 (0–30)	6.0 (0–29)	.002 ^b

LOS, length of stay.

^a Calculated by using Fisher's exact test.

^b Calculated by using Wilcoxon rank sum test.

TABLE 3 Preventability Status of Readmission by Primary Diagnosis at First Admission

	All Readmissions (<i>n</i> = 204) ^a	Not Preventable (<i>n</i> = 163)	Preventable (<i>n</i> = 41)
Pneumonia (%)	24 (15)	20/24 (83)	4/24 (17)
Bronchiolitis (%)	25 (16)	23/25 (92)	2/25 (8)
Cellulitis (%)	12 (7)	9/12 (75)	3/12 (25)
Urinary tract infection (%)	11 (7)	10/11 (91)	1/11 (9)
Failure to thrive (%)	10 (5)	7/10 (70)	3/10 (30)
Lymphadenitis (%)	9 (4)	5/9 (56)	4/9 (44)
Neonatal fever (%)	11 (5)	9/11 (82)	2/11 (18)
Osteomyelitis (%)	7 (3)	7/7 (100)	0/7 (0)

^a Percentage values in this column have all readmissions in the denominator. Other percentages are row percentages.

insurance. The majority (68%, 15 of 22) of these patients had complex medical conditions including congenital heart disease, chronic lung disease, neurologic conditions, metabolic disorders, and conditions related to prematurity. Seven children had readmissions related to their gastrostomy tube or central nervous system shunt. All 22 readmissions were deemed to be nonpreventable with disease-related or unrelated reasons for readmission. Seven admissions for these particular patients were related to lower respiratory tract infections with at least 1 being a consequence of aspiration. Two of the 22 patients were readmitted due to influenza during the H1N1 epidemic. Acute gastroenteritis and dehydration was also common among the 22 affecting 3 children, with 1 child with a metabolic conditions requiring dextrose containing intravenous fluids to prevent a catabolic state. One patient was readmitted to ICU due to hypovolemic shock.

reasons for category assignment ($K = 0.37$, 95% CI: 0.28–0.45).

Patient gender and admission to a hospitalist-only unit were significantly associated with potentially preventable readmissions. No other patient, physician, or hospital characteristics were significantly associated with preventable readmissions (Table 1 and Table 2). The median time interval between admissions was shorter for preventable readmissions compared with

nonpreventable readmissions, 6 versus 12 days, $P = .002$ (Table 2). Among patients with preventable readmission, the probability of having had a readmission by 7 days and 15 days was 73% and 78%, respectively (Fig 2). Eleven percent of patients ($n = 22$ of 204) had >1 readmission during the study period. Demographic characteristics were similar to the characteristics of the entire population with 36% (8 of 22) being <1 year of age and 59% (13 of 22) having public

TABLE 4 Factors Rated as Reasons for Readmission

Major Categories	Reasons	Example	<i>n</i> (%), <i>N</i> = 204
Physician-related reasons	Premature discharge before resolution of medical problem	Discharged with inadequate oral intake of fluids.	7 (3)
	Incorrect diagnosis or therapy	Discharge diagnosis of transient synovitis. Readmitted with diagnosis of osteomyelitis.	25 (12)
	Incomplete discharge instructions	Missing anticipatory guidance for when to seek medical attention.	2 (1)
Caretaker-related reasons	Parental perception of early discharge	Second admission notes describe that parent felt that patient was sent home too soon or not ready for discharge.	3 (1)
	Parental perception of incomplete evaluation during previous hospital stay	Second admission notes describe specific tests that parents felt should have been performed.	1 (<1)
	Noncompliance with discharge medications	Patient refusing to take clindamycin because of poor taste.	7 (3)
Disease-related reasons	Unforeseen worsening of disease process	Infant with bronchiolitis was breathing comfortably at discharge but returns with respiratory distress.	60 (29)
	Unforeseen development of a complication of the disease process or treatment	Patient with osteomyelitis is sent home with a PICC line for intravenous antibiotics and returns with a PICC line infection.	51 (25)
	Recurrence of disease with evidence of improvement after first admission	Infant with grade V vesicoureteral reflux admitted for UTI. Afebrile and eating well at discharge. Readmitted for a second UTI due to different pathogen.	67 (33)
Unrelated	Different admission diagnosis unrelated to the first admission	Discharged with pneumonia and readmitted for cellulitis.	27 (13)

PICC, peripherally inserted central catheter; UTI, urinary tract infection.

Readmissions with a physician-related or caretaker-related reason for readmission were considered potentially preventable. Because 46 patients had >1 reason for readmission, the sum of percentages exceeds 100%.

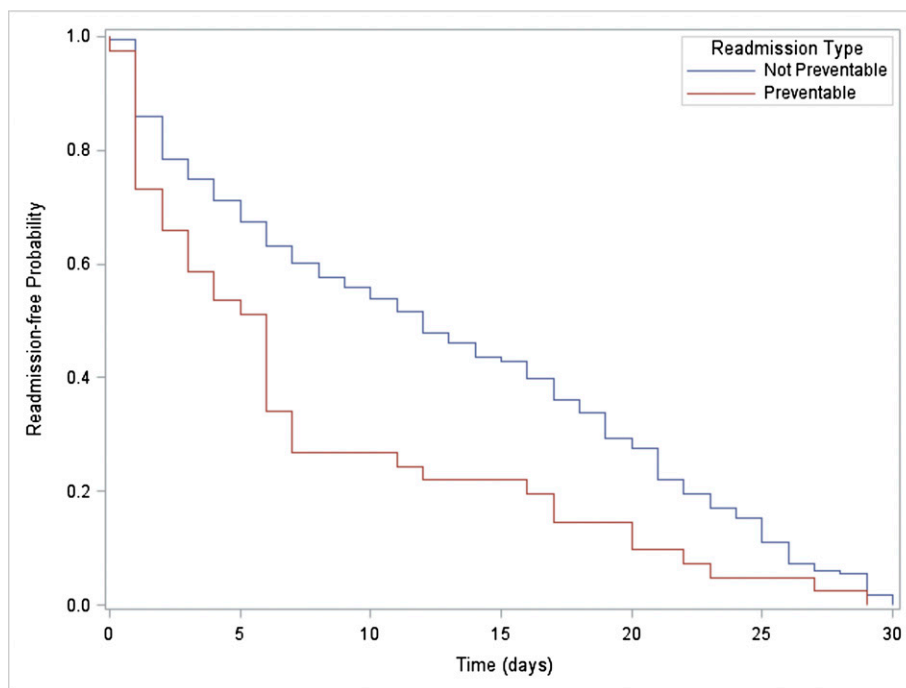


FIGURE 2 Time to readmission by preventability status. Time to readmission was significantly shorter for preventable readmissions.

DISCUSSION

With the recent changes in health care policies, defining the role of pediatric readmissions as a quality-of-care measure has become a priority. Identifying preventable readmissions remains a significant challenge. To our knowledge, this is the first study seeking to identify the reasons for readmissions to a pediatric hospital medicine service. These patients represent high volume and high turnover admissions, which result in great cost to the health care system.¹⁹ We found that the overall readmission rate was low, and the majority of readmissions were disease-related. The percentage of preventable readmissions were low and comprised only 0.5% of all discharges from PHM service during the study period. We found only moderate interrater reliability between 2 reviewers when trying to classify the reason for readmission. This discrepancy occurred despite the fact that the second reviewer had been oriented and trained to use the classification system. On closer review of cases with discrepancies, several recurrent themes were identified that may have led to different classifications. First, there were different interpretations of appropriate discharge criteria when evidence was scant

(eg, the length of observation after oxygen was discontinued). Second, despite the provision of a brief algorithm on how to review charts, the elements of data extraction from the chart were not always the same. Extra information extracted by one reviewer led to a different classification in some cases.

Our experience highlights the difficulty in reliably classifying readmissions based on data from chart review. Hain et al had similar findings using a 5-point Likert scale to define preventability status via chart review. They achieved initial consensus on only 38% of cases based on individual ratings but were able to achieve consensus on preventable status of readmissions through group discussion of cases.¹⁸ Many adult studies also report the subjectivity involved in the numerous approaches used to define preventability.^{21–22} Van Walraven et al had even more detailed information through patient interviews but also had similar experience using an ordinal scale to rate adult readmissions as an adverse event and/or avoidable.²⁴ Even though we used a different classification system and approach, we had the same difficulty reliably classifying readmissions when comparing individual ratings. We suggest

that chart audits likely need to be paired with subsequent peer review panel discussion to reliably identify preventable readmissions. In some cases, accurate classification may require patient details that can only be acquired through interview of caregivers.^{24,25} The amount of resources needed to sustain a peer review panel and prospective data collection should be balanced with the potential impact on patients. For institutions with low overall readmission rates, resources could be diverted to tracking measures with higher potential for impact.

For institutions with high readmission rates, an efficient approach to the review of readmissions is needed given the potential to use a large amount of resources to identify preventable readmissions. Berry et al found that there was a significant variability between condition-specific readmission rates across institutions,²⁶ which may lend room for improvement in management practices for certain conditions with high readmission rates. When reviewing our readmitted population, we did find that certain disease processes, such as failure to thrive and lymphadenitis, had high readmission rates at our institution.

Identifying such institution-specific patterns may prove valuable in prioritizing quality improvement efforts across organizations.

A more efficient review on a smaller number of readmissions could also be achieved by identification of readmissions that are more likely to be preventable. Our data indicate that a difference exists in preventable and nonpreventable groups in terms of interval days between admissions. Patients with preventable readmissions returned to the hospital much sooner than did patients with nonpreventable readmissions, and the 7-day time interval seemed to capture most of the preventable readmissions. We also found that a larger percentage of female patients and patients admitted to the hospitalist-only unit had a preventable readmission. However, the reasons for these associations are unclear. It is possible that factors such as severity of illness may have confounded these associations because the ICU was considered a mixed unit, and patients with severe illness may have been more likely to have a nonpreventable disease-related reasons for readmission. When analyzing other potential risk factors, we had insufficient power to detect statistical differences. Larger studies are needed to further evaluate these potential risk factors for preventable readmission.

Additional study is needed to examine urgent readmissions to an ICU because our study was limited by the small sample size for this subgroup. These readmissions have been described as another potential way to look at readmissions²⁴ and could provide another means to prioritize review of pediatric readmissions. Larger studies are needed to examine whether these readmissions are preventable because these patients tend to have higher mortality and poor outcomes.²⁷

Studies are also needed to further examine the preventable nature of readmissions for patients with multiple readmissions because these patients are the highest utilizers of the health care system.²⁸ Our chart review suggests that many of these patients were medically fragile with chronic complex conditions and had frequent hospitalizations related to infectious

etiologies. However, the 30-day readmission interval used in this study may have limited our ability to capture all readmissions for these patients. Readmissions within the short-term seem to be nonpreventable based on a small number of patients but larger studies are needed to explore preventability over the short- and long-term. Larger prospective study of this population using a 365-day interval would be helpful to describe the full scope of this problem and the preventable nature of these readmissions.²⁸

Our study has several other limitations. Because of the retrospective nature of this study, information may have been missing related to caretaker-related reasons for readmission, outpatient visits, and readmission to other hospitals. Furthermore, because our study was based on data from a single-site tertiary academic center with a low overall readmission rate, results may not be generalizable to community settings or to other centers with higher readmission rates. Last, our study population included only patients discharged from a pediatric hospital medicine service, which comprised mainly medical patients. Therefore, our results cannot be applied to surgical or other subspecialty readmissions.

CONCLUSIONS

Readmissions to a pediatric hospital medicine service are complex, and identifying the reasons for readmissions reliably from chart review remains a significant challenge. Institutions should not rely on individual reviewers to determine preventable status of readmissions because this is not a reliable method. Preventable readmissions may have shorter time intervals between index admission and readmission, and a focus on 7-day readmissions may capture most preventable cases. In line with recent publications, our study suggests that given low readmission rates and challenges with identifying preventable readmissions, pediatric readmissions are questionable indicators of quality. Additional study is needed, however, to explore preventability in children with medical complexity

and those that experience readmission to the ICU.

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