RESEARCH ARTICLE

The Effect of Limited English Proficiency on Pediatric Hospital Readmissions

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ABSTRACT

BACKGROUND: The relationship between limited English proficiency (LEP) and worse pediatric health outcomes is well documented.

OBJECTIVES: To determine the relationship between LEP status and pediatric hospital readmissions.

METHODS: We performed a retrospective cohort analysis of children ≤ 18 years old admitted to a tertiary children's hospital from 2008 to 2014. The main exposure was LEP status. Independent variables included sex, age, race/ethnicity, insurance, median household income, surgical/medical status, severity of illness (SOI), the presence of a complex chronic condition, and length of stay. Primary outcome measures were 7- and 30-day readmission.

RESULTS: From 67 473 encounters, 7- and 30-day readmission rates were 3.9% and 8.2%, respectively. LEP patients were more likely to be younger, poorer, and Hispanic; have lower SOI; and government-subsidized insurance. Adjusted odds for 7- or 30-day readmission for LEP versus English-proficient (EP) patients were 1.00 ($P = .99$) and 0.97 ($P = .60$), respectively. Hispanic ethnicity (adjusted odds ratio [aOR]: 1.26 [$P = .002$] and 1.14 [$P = .02$]), greater SOI (aOR: 1.04 [$P < .001$] and 1.05 [$P < .001$]), and the presence of a complex chronic condition (aOR: 2.31 [$P < .001$] and 3.03 [$P < .001$]) were associated with increased odds of 7- and 30-day readmission, respectively. White LEP patients had increased odds of 7- and 30-day readmission compared with white EP patients (aOR: 1.46 [$P = .006$] and 1.32 [$P = .007$]) and the poorest LEP patients had increased odds of 7- and 30-day readmission compared with the poorest EP patients (aOR: 1.77 [$P = .04$] and 2.00 [$P < .001$]).

CONCLUSIONS: This is the first large study evaluating the relationship between LEP and pediatric hospital readmission. There was no increased risk of readmission in LEP patients compared with EP patients.

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Pediatric hospital readmissions pose a significant burden to patients, their families, and the health care system. Readmissions within 30 days account for 2% to 6% of the >2 million hospital admissions for children each year, and >20% of hospitalized pediatric patients will experience at least 1 readmission in 1 year.[1–3] These admissions incur indirect costs and opportunity loss on individual patients and families, in addition to their psychosocial and physical impacts.[4] Readmissions also constitute a financial burden on the national health care system, with an estimated total cost of >$1 billion annually for children readmitted within 1 year.[2]

Due to the negative effects of hospitalization on children, their families, and the health care system as a whole, reducing hospital readmissions has become a focus for quality-improvement efforts. In 2012, the Centers for Medicare and Medicaid Services began decreasing Medicare payments to hospitals with excess readmissions.[5] More recently, there has been an increasing focus on pediatric readmission rates, because it is 1 of the first measures that will be developed by the Pediatric Quality Measures Project (established by the federal Children's Health Insurance Program Reauthorization Act),[6] with several state Medicaid programs already penalizing hospitals with excessive readmissions.[7–10]

Research to date has shown that an increase in pediatric hospital readmission rates is associated with complex chronic health conditions,[2,11,12] longer hospital length of stay (LOS),[11–13] and socioeconomic factors, such as Medicaid insurance use and black race.[2,11] Despite this growing literature investigating the relationship between socioeconomic factors and pediatric hospital readmission rates, there are no studies evaluating limited English proficiency (LEP) status of the caregiver and patient as a potential risk factor for readmission, even though LEP status has been shown to be a risk factor for other poor health outcomes, including increased rates of serious adverse medical events,[14] worse postoperative pain management,[15] unnecessary admissions from and longer LOS in the emergency department,[16,17] longer hospitalizations,[18] and poorer access to health care.[19] Even in the adult literature there are limited data on LEP and hospital readmission, with 1 study showing no difference in readmission on the basis of LEP status[20] and another study showing a difference among specific ethnicities.[21]

This investigation seeks to address an existing knowledge gap in the current literature. If LEP status is found to be a risk factor for pediatric hospital readmissions, future interventions designed to improve care coordination for LEP families at the time of discharge may reduce readmission rates. On the basis of the known risk factors associated with pediatric hospital readmission and the association between LEP status and health outcomes, we aimed to determine whether pediatric patients with LEP in a tertiary hospital setting have increased hospital readmission rates compared with English-proficient (EP) patients.

METHODS

Study Design and Data Source

We conducted a retrospective database analysis of all patients aged ≤18 years admitted to Lucile Packard Children's Hospital (LPCH) at Stanford University Medical Center from January 1, 2008, to May 2, 2014. LPCH is a free-standing children's hospital that provides tertiary care in a university-based setting.

LPCH has in-person interpretation for Spanish, Cantonese, Mandarin, Vietnamese, Korean, and American Sign Language. Through a vendor, there is access to phone interpretation for >200 languages. In addition, there is document translation that requires advance notification.

We extracted all data by using the Stanford Translational Research Integrated Database Environment (STRIDE). STRIDE consists of 3 integrated components: a clinical data warehouse based on the HL7 Reference Information Model, which contains clinical information on >1.6 million pediatric and adult patients cared for at Stanford University Medical Center since 1995; an application development framework for building research data management applications on the STRIDE platform; and a biospecimen data management system. Oversight for STRIDE is provided by Stanford's Department of Biomedical Informatics.[22] The institutional review board at Stanford University approved the study, and a waiver of consent was granted.

Study Population

We defined LEP status for a patient as (1) the patient or guardian selecting a non-English language as the primary language on admission, (2) documentation of in-person interpreter use during the hospitalization, and/or (3) having "language barrier" selected as a barrier to education during the initial nursing assessment. Patients who did not satisfy any of these criteria were defined as EP. We excluded patients if they were admitted to labor and delivery, left against medical advice, transferred to another acute care hospital, died during the admission, or had missing data for the outcome measures or covariates.

Outcome Measures

We evaluated readmissions within 7 and 30 days. Thirty-day readmission is the metric used by the Centers for Medicaid and Medicare Service. We included the 7-day readmission as well because a shorter interval of time between readmissions may be more indicative of issues related to the index admission and transition of care, whereas longer intervals may reflect issues with chronic outpatient management.[23] Elective admissions (eg, chemotherapy, scheduled infusions, and elective surgeries) could not be considered a readmission. Admissions were labeled as elective or urgent/emergent in the electronic medical record. Administrators in patient placement and the admitting office and inpatient and outpatient schedulers had the ability to input the data into electronic medical records. Index admissions could only be associated with 1 readmission within the designated time intervals. An encounter could be considered a readmission from a previous encounter and an index admission for a subsequent encounter.

Covariates

We determined a priori those covariates most likely to be associated with our outcome measure. These include age, sex, race/ethnicity, insurance status, median income quintile, medical versus surgical status, All Patient Refined Diagnosis Related Groups (APR-DRG) severity of illness (SOI) scoring, presence of a complex chronic condition (CCC), and hospital LOS. We categorized age as <1 year, 4 to 9 years, 5 to 12 years, and 13 to 18 years.

We used data from the US Census Bureau's American Community Survey 5-year estimates[24,25] encompassing the years 2008–2012 to estimate median household income by zip code tabulation area (ZCTA). Administrative data from STRIDE include zip code and not ZCTA; therefore, zip codes were converted to ZCTAs by using data provided by the Department of Health and Human Services.[26] We created income quintiles on the basis of 2011 income data from the US Census Bureau's Current Population Survey.[27]

We determined if an admission was surgical or medical on the basis of 2015 Procedure Classes software developed as part of the Healthcare Utilization Project, a federal-state-industry partnership and sponsored by the Agency for Healthcare Research and Quality.[28] The Procedure Classes program assigns all International Classification of Diseases, Ninth Revision, procedure codes into 1 of 4 categories: minor diagnostic, minor therapeutic, major diagnostic, and major therapeutic. Minor procedures are non–operating room procedures, whereas major procedures are operating room–based procedures. Patients with no procedure codes or only minor procedures were designated "medical," whereas patients with major procedure(s) were considered surgical.

To control for disease severity, we used APR-DRG versions 25 through 31 (3M Health Information Systems) SOI levels. APR-DRGs include mutually exclusive groupings of clinically related diagnosis and procedural codes from the *International Classification of Diseases, Ninth Revision, Clinical Modification*.[29] We then used publicly available service intensity weights created by the New York State Department of Health based on costs from 3 years of cases (2009–2011)[30,31] to transform the categorical APR-DRG SOI levels into a continuous variable (from 0.1287 to 29.228) that can be compared across APR-DRGs.

To define CCCs, we used an open-source set of International Classification of Diseases, Ninth Revision, diagnosis and procedure codes related to childhood complex chronic health conditions that are strongly associated with mortality, morbidity, functional limitations, high health resource utilization, and use of a complex care clinical program.[32,33] This tool has been used in previous studies to predict readmission rates in children with chronic conditions.[11,34]

Statistical Analyses

For all statistical analyses we used Stata/SE 14.0 (StataCorp, College Station, TX) and SAS Enterprise 6.1 (SAS Institute, Cary, NC). We defined primary outcome measures as 7-day and 30-day readmission rates. We summarized patient characteristics by using frequency and percentages for categorical variables. We performed univariate logistic regressions on each variable that was determined a priori to be a potential confounder.

To assess the association between LEP and the primary outcome of 7-day and 30-day readmission rates, we performed multivariable logistic regression, controlling for patient characteristics as listed above in our a priori–determined covariates. In our model, we adjusted for patients (medical record numbers) having multiple encounters by using the clustered by robust SE method. The results are presented as adjusted odds ratios (aORs). *P* values <.05 were considered significant.

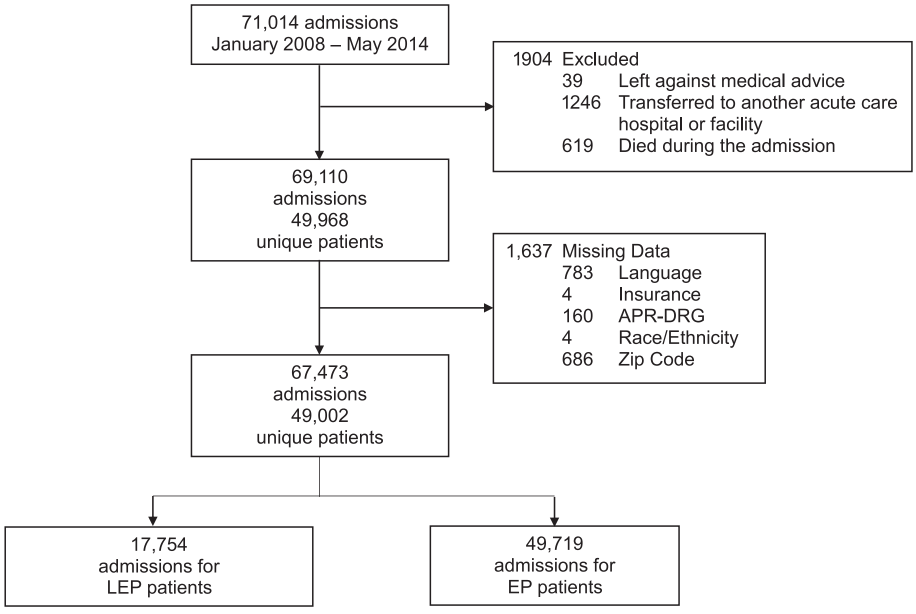

FIGURE 1 Admissions included in the study population.

We hypothesized that the effect of LEP on pediatric hospital readmissions may have strata-specific variation, as seen in previous studies.[21,35,36] We tested for interactions between our outcome variables and age, income quintile, race/ethnicity, weighted APR-DRG SOI score, CCC, LOS, and surgical/medical admission by including interaction terms one at a time in separate adjusted models. Variables to test for interaction were determined a priori. We then examined and presented stratum-specific odds ratios for all variables in which the interaction *P* value was <.10.

RESULTS

Over the study period there were 71 918 total admissions. We excluded 1904 of these admissions because the patient's disposition was not to home, and another 1637 admissions due to missing data. We analyzed the remaining 67 473 admissions for 49 002 unique patients during the study period. A total of 17 754 (26.3%) admissions were associated with LEP families and 49 719 (73.7%) admissions were associated with EP families (Fig 1). Table 1 lists the demographic and clinical characteristics of the 2 cohorts in the study population. For all encounters, there were 2536 readmissions (3.8%) within 7 days and 5288 readmissions (7.8%) within 30 days. English was reported as the primary language in 81.5% of all encounters in the study population. The most common non-English language spoken was Spanish, which was reported in 16.1% of all encounters and in 61.0% of LEP encounters in the study population.

In univariate analyses, we found that age <1 year, Hispanic ethnicity, lower income quintile, having a CCC, and higher weighted APR-DRG SOI score were associated with an increased odds of readmission within 7 and 30 days (Table 2). The unadjusted odds ratios for 7- and 30-day readmissions for LEP patients were 1.17 (95% confidence interval [CI]: 1.05–1.29; *P* = .003) and 1.15 (95% CI: 1.06–1.26; *P* = .002), respectively, compared with EP patients. After controlling for potential confounders in our multivariable

TABLE 1 Patient Characteristics of Study Population

	EP (*n* = 49 719)	LEP (*n* = 17 754)	*P*
Age, *n* (%)			
<1 year	28 348 (57.0)	10 640 (59.9)	
1–4 years	7285 (14.7)	2690 (15.2)	<.001
5–12 years	8045 (16.2)	2785 (15.7)	
13–18 years	6041 (12.1)	1639 (9.2)	
Sex, *n* (%)			
Male	26 280 (52.9)	9482 (53.4)	.21
Female	23 439 (47.1)	8272 (46.6)	
Race/ethnicity, *n* (%)			
White	23 202 (46.7)	1392 (7.8)	
Hispanic	9676 (19.4)	14 751 (83.1)	
Black	1934 (3.9)	58 (0.3)	<.001
Asian	12 714 (25.6)	1417 (8.0)	
Other	2193 (4.4)	136 (0.8)	
Insurance status, *n* (%)			
Private	34 543 (69.5)	2571 (14.5)	
Public	14 970 (30.1)	15 133 (85.2)	<.001
Uninsured/self-pay	206 (0.4)	50 (0.3)	
Median household income, *n* (%)			
First quintile ($0–$20 262)	22 (0.1)	0 (0)	
Second quintile ($20 263–$38 520)	956 (1.9)	376 (2.1)	
Third quintile ($38 521–$62 434)	9238 (18.6)	6440 (36.3)	<.001
Fourth quintile ($62 435–$101 582)	22 630 (45.5)	8946 (50.4)	
Fifth quintile (>$101 583)	16 873 (33.9)	1992 (11.2)	
Patient type, *n* (%)			
Surgical	8083 (16.3)	2872 (16.2)	.80
Medical	41 636 (83.7)	14 882 (83.8)	
CCCs, *n* (%)			
Any CCC	20 001 (40.2)	7069 (39.8)	.34
No CCC	29 718 (59.8)	10 685 (60.2)	
Organ system, *n* (%)			
Cardiovascular	6966 (14.0)	2190 (12.3)	<.001
Respiratory	1830 (3.7)	694 (3.9)	.169
Gastrointestinal	5022 (10.1)	1705 (9.6)	.06
Renal	2705 (5.4)	857 (4.8)	.002
Neuromuscular	2830 (5.7)	1078 (6.1)	.063
Oncologic	4357 (8.8)	1837 (10.4)	<.001
Congenital/genetic	2390 (4.8)	965 (5.4)	.001
Metabolic	3793 (7.6)	1518 (8.6)	<.001
Hematologic/immunologic	2319 (4.7)	868 (4.9)	.23
Premature/neonatal	1087 (2.2)	407 (2.3)	.41
Technology dependent	4897 (10.0)	1657 (9.4)	.05
Transplant	2400 (4.8)	795 (4.5)	.06
APR-DRG score, median (interquartile range)	0.66 (0.24–1.25)	0.64 (0.24–1.23)	<.001
Hospital LOS, *n* (%)			
0–2 days	24 312 (48.9)	8881 (50.0)	
3–7 days	17 537 (35.3)	5976 (33.7)	<.001
8–14 days	4205 (8.4)	1396 (7.9)	
≥15 days	3665 (7.4)	1501 (8.4)	
7-Day readmission			
Yes	1793 (3.6)	743 (4.2)	.001
No	47 926 (96.4)	17 011 (95.8)	
30-Day readmission			
Yes	3758 (7.6)	1530 (8.6)	<.001
No	45 961 (92.4)	16 224 (91.4)	

TABLE 2 Unadjusted Associations Between Covariates and 7- and 30-Day Readmission Rates

	7 Days		30 Days	
	OR (95% CI)	*P*	OR (95% CI)	*P*
Age				
<1 year	Reference			
1–4 years	1.93 (1.70–2.19)	<.001	2.54 (2.29–2.82)	<.001
5–12 years	1.74 (1.53–1.99)	<.001	2.32 (2.08–2.58)	<.001
13–18 years	1.82 (1.57–2.11)	<.001	2.65 (2.36–2.96)	<.001
Sex				
Male	Reference			
Female	0.90 (0.82–1.00)	.04	1.00 (0.91–1.09)	.94
Race/ethnicity				
White	Reference			
Hispanic	1.33 (1.18–1.50)	<.001	1.26 (1.14–1.40)	<.001
Black	1.30 (0.93–1.82)	.13	1.45 (1.04–2.02)	.03
Asian	1.06 (0.92–1.22)	.41	0.90 (0.89–1.02)	.09
Other	0.93 (0.71–1.21)	.59	0.84 (0.66–1.07)	.16
Insurance status				
Private	Reference			
Public	1.28 (1.16–1.41)	<.001	1.41 (1.30–1.54)	<.001
Uninsured/self-pay	0.23 (0.06–0.91)	.04	0.39 (0.14–1.06)	.07
Median household income				
First/second quintile	1.90 (1.38–2.61)	<.001	2.50 (1.93–3.24)	<.001
Third quintile	1.38 (1.20–1.59)	<.001	1.72 (1.52–1.94)	<.001
Fourth quintile	1.13 (1.00–1.28)	.05	1.19 (1.06–1.33)	.003
Fifth quintile	Reference			
Patient type				
Surgical	0.97 (0.87–1.09)	.64	1.03 (0.96–1.12)	.40
Medical	Reference			
CCCs				
Any CCC	2.67 (2.43–2.92)	<.001	4.17 (3.86–4.50)	<.001
No CCC	Reference			
APR-DRG score	1.05 (1.04–1.06)	<.001	1.08 (1.07–1.08)	<.001
Hospital LOS				
0–2 days	Reference			
3–7 days	1.17 (1.06–1.29)	.001	1.47 (1.37–1.58)	<.001
8–14 days	1.59 (1.39–1.82)	<.001	2.37 (2.15–2.61)	<.001
≥15 days	1.88 (1.64–2.15)	<.001	2.85 (2.59–3.13)	<.001
LEP				
No	Reference			
Yes	1.17 (1.05–1.29)	.003	1.15 (1.06–1.26)	.002

OR, odds ratio.

logistic regression, LEP was not associated with increased odds of readmission at 7 or 30 days (Table 3). In the final model, age, Hispanic ethnicity, government insurance, medical patients, and having a CCC were associated with increased odds of readmission at 7 and 30 days. For every 1-unit increase in weighted APR-DRG SOI score there was a 4% and 5% increase in odds of readmission at 7 and 30 days, respectively. There was an increased odds of 30-day readmission with increasing hospital LOS but not with 7-day readmission.

For effect modification, we found statistically significant interaction terms ($P \leq .10$) at both 7 and 30 days for the following variables: race (.02, .03) and income (.03, <.001). Compared with white EP patients, white LEP patients had aORs of 1.46 (95% CI: 1.11–1.92) and 1.32 (95% CI: 1.08–1.61) for 7- and 30-day readmissions, respectively. LEP patients in the combined first and second income quintile (lowest quintiles) had aORs of 1.77 (95% CI: 1.03–3.05) and 2.00 (95% CI: 1.37–2.92) for 7- and 30-day readmissions, respectively, compared with EP patients in the combined first and second income quintile (Table 4).

DISCUSSION

To our knowledge, this is the first study to evaluate the relationship between LEP status and pediatric hospital readmission rates. Our analysis found no increased risk of readmission at 7 or 30 days on the basis of LEP status for all patients after adjusting for covariates. Our rates of readmission at 7 and 30 days were comparable to those of previous studies in pediatric patients.[3] Similar to previous studies, after adjusting for potential confounders, we found increased odds of readmission for patients with a CCC, public insurance, and hospital LOS.[2,311,12] The finding of a small increase in the odds of readmission for Hispanic patients, but not for black patients, differs from previous studies, which found a statistically significant odds of readmission for black patients but not for Hispanic patients.[11]

Although our primary analysis did not reveal an association between LEP and hospital readmission, our secondary effect modification analysis did reveal vulnerable populations among LEP patients. We found that LEP status had a larger effect on white patients compared with other races and ethnicities. This finding may be due to the fact that these patients are more likely to speak a non-English, non-Spanish language and that non-Spanish language interpretation may be more difficult to access in general. Although not tested, this clinically relevant disparity in access to interpretation may amplify

TABLE 3 Multivariable-Adjusted Associations Between Covariates and 7- and 30-Day Readmission Rates

	7 Days		30 Days	
	aOR (95% CI)	*P*	aOR (95% CI)	*P*
Age				
<1 year	Reference			
1–4 years	1.35 (1.19–1.54)	<.001	1.67 (1.41–1.74)	<.001
5–12 years	1.23 (1.07–1.41)	<.001	1.50 (1.27–1.60)	<.001
13–18 years	1.27 (1.08–1.48)	.001	1.58 (1.32–1.71)	<.001
Sex				
Male	Reference			
Female	0.90 (0.82–0.99)	.03	0.99 (0.91–1.06)	.82
Race/ethnicity				
White	Reference			
Hispanic	1.26 (1.09–1.45)	.002	1.14 (1.02–1.28)	.02
Black	1.14 (0.84–1.56)	.40	1.19 (0.89–1.59)	.24
Asian	1.15 (1.00–1.31)	.04	1.03 (0.92–1.16)	.61
Other	1.01 (0.78–1.30)	.97	0.93 (0.75–1.16)	.53
Insurance status				
Private	Reference			
Public	1.14 (1.00–1.29)	.04	1.28 (1.15–1.41)	<.001
Uninsured/self-pay	0.27 (0.07–1.07)	.06	0.51 (0.19–1.40)	.19
Median household income				
First/second quintile	1.08 (0.78–1.50)	.64	1.12 (0.87–1.45)	.38
Third quintile	0.92 (0.79–1.07)	.29	0.99 (0.87–1.12)	.89
Fourth quintile	0.98 (0.87–1.11)	.77	0.99 (0.89–1.10)	.90
Fifth quintile	Reference			
Patient type				
Surgical	0.59 (0.52–0.68)	<.001	0.51 (0.47–0.56)	<.001
Medical	Reference			
CCCs				
Any CCC	2.31 (2.07–2.56)	<.001	3.03 (2.76–3.33)	<.001
No CCC	Reference			
APR-DRG score	1.04 (1.02–1.05)	<.001	1.05 (1.04–1.06)	<.001
Hospital LOS				
0–2 Days	Reference			
3–7 Days	0.94 (0.86–1.04)	.22	1.09 (1.01–1.17)	.019
8–14 Days	1.00 (0.87–1.15)	1.00	1.28 (1.16–1.42)	<.001
≥15 Days	1.05 (0.88–1.26)	.56	1.38 (1.22–1.56)	<.001
LEP				
No	Reference			
Yes	0.99 (0.88–1.13)	.93	0.96 (0.87–1.07)	.48

poorer communication during discharge and transition of care. Our analyses also revealed that, among low-income patients, being an LEP patient was associated with an increase in hospital readmissions compared with low-income EP patients. This finding implies that LEP status affects readmission among the poorest patients more than among middle- and upper-class patients. To reduce pediatric hospital readmissions, it may be effective to focus our attention and resources to understanding the underlying causes of increased hospital readmissions and develop interventions targeted at low-income LEP patients and white LEP patients.

We acknowledge limitations of our study. Our institution serves a community with a higher percentage of Latinos, which may not be generalizable to other areas in the country. Being in a community with a large Spanish-speaking population may provide benefit to our patient population through better access to direct and translated communication, through the Spanish-speaking hospital staff, including, but not limited to, the admitting staff, bedside nurses, physicians and ancillary staff. Due to the large Spanish-speaking population, the hospital provides 24-hour, in-person Spanish interpreter services, which may not be available at other hospitals.

As a single-center retrospective investigation, we were unable to capture readmissions that may have occurred elsewhere.[37] In addition, our definition of LEP was based on the subjective opinion of the patient/guardian, admitting personnel, and bedside nursing staff. Due to the subjective nature of this variable, patients who had LEP may have been labeled as EP, leading to a minimization of a true effect that LEP status had on odds of readmission.

In choosing to use APR-DRG SOI subclass as a measure of SOI, we needed to convert the data to a weighted score, because an SOI level is not equivalent across different APR-DRGs. To do so, we used publicly available weights developed on a different geographic population in New York State, which uses both pediatric and adult data and therefore may not accurately reflect the SOI of our patient population. Despite this situation, we believe that we were able to adequately capture the SOI of our patient population, and that SOI is important factor to consider in hospital readmissions. Last, there may be other recognized and unrecognized confounders that we were unable to extract from the data available to us, such as maternal educational level and other measures of socioeconomic status.

TABLE 4 Effect Modification for Race/Ethnicity and Income Quintile on LEP: aORs for Readmission at 7 and 30 Days

	7 Days		30 Days	
	aOR (95% CI)	*P*	aOR (95% CI)	*P*
Race/ethnicity				
White				
EP	Reference			
LEP	1.46 (1.11–1.92)	.006	1.32 (1.08–1.61)	.007
Hispanic				
EP	Reference			
LEP	0.96 (0.84–1.10)	.56	0.91 (0.83–1.00)	.06
Black				
EP	Reference			
LEP	0.69 (0.16–3.00)	.62	1.15 (0.53–2.52)	.72
Asian				
EP	Reference			
LEP	1.01 (0.76–1.35)	.94	1.00 (0.81–1.23)	.98
Other				
EP	Reference			
LEP	0.63 (0.19–2.05)	.44	0.65 (0.29–1.46)	.30
Income quintile				
First/second quintile				
EP	Reference			
LEP	1.77 (1.03–3.05)	.04	2.00 (1.37–2.92)	<.001
Third quintile				
EP	Reference			
LEP	0.99 (0.82–1.20)	.94	0.91 (0.80–1.03)	.15
Fourth quintile				
EP	Reference			
LEP	0.92 (0.79–1.08)	.32	0.93 (0.83–1.05)	.23
Fifth quintile				
EP	Reference			
LEP	1.06 (0.79–1.41)	.71	1.03 (0.83–1.28)	.75

CONCLUSIONS

LEP was not associated with increased odds of readmission to a single-center tertiary pediatric hospital. Hispanic ethnicity and high resource utilization (weighted APR-DRG SOI level and CCCs) were independently associated with increase odds of readmission.

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REFERENCES

1. Bardach NS, Vittinghoff E, Asteria-Peñaloza R, et al. Measuring hospital quality using pediatric readmission and revisit rates. *Pediatrics*. 2013;132(3): 429–436
2. Berry JG, Hall DE, Kuo DZ, et al. Hospital utilization and characteristics of patients experiencing recurrent readmissions within children's hospitals. *JAMA*. 2011;305(7):682–690
3. Berry JG, Toomey SL, Zaslavsky AM, et al. Pediatric readmission prevalence and variability across hospitals [published correction appears in *JAMA*. 2013;309 (10):986]. *JAMA*. 2013;309(4):372–380
4. Schuster MA, Chung PJ, Vestal KD. Children with health issues. *Future Child*. 2011;21(2):91–116
5. Centers for Medicare and Medicaid Services. Readmission Reduction Program (HRRP). 2014. Available at: www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/AcuteInpatientPPS/Readmissions-Reduction-Program.html. Accessed March 9, 2016
6. CHIPRA Measures by CHIPRA Categories—Initial Core Set and PQMP COE Measure Assignments. 2012.
7. New York State Health Foundation. Reducing hospital readmissions in New York State: a simulation analysis of alternative payment incentives. 2011. Available at: http://nyshealthfoundation.org/uploads/resources/reducing-hospital-readmissions-payment-incentives-september-2011.pdf. Accessed March 9, 2016
8. MassHealth. Payment for out-of-state acute hospital services, and in-state acute hospital services. 2014. Available at: www.mass.gov/eohhs/docs/masshealth/acutehosp/2014-notice-final-payment-acute-hospital-services.pdf. Accessed March 9, 2016
9. Texas Medicaid and Healthcare Partnership. Potentially preventable events. 2014. Available at: www.tmhp.com/Pages/Medicaid/Hospital_PPR.aspx. Accessed March 9, 2016
10. Illinois Department of Healthcare and Family Services. Potentially preventable readmissions policy. 2014
11. Feudtner C, Levin JE, Srivastava R, et al. How well can hospital readmission be predicted in a cohort of hospitalized children? A retrospective, multicenter study. *Pediatrics*. 2009;123(1):286–293
12. Neuman MI, Hall M, Gay JC, et al. Readmissions among children previously hospitalized with pneumonia. *Pediatrics*. 2014;134(1):100–109
13. Mackie AS, Ionescu-Ittu R, Pilote L, Rahme E, Marelli AJ. Hospital readmissions in children with congenital heart disease: a population-based study. *Am Heart J*. 2008;155(3):577–584

14. Cohen AL, Rivara F, Marcuse EK, McPhillips H, Davis R. Are language barriers associated with serious medical events in hospitalized pediatric patients? *Pediatrics*. 2005;116(3):575–579

15. Jimenez N, Jackson DL, Zhou C, Ayala NC, Ebel BE. Postoperative pain management in children, parental English proficiency, and access to interpretation. *Hosp Pediatr*. 2014;4(1):23–30

16. Gallagher RA, Porter S, Monuteaux MC, Stack AM. Unscheduled return visits to the emergency department: the impact of language. *Pediatr Emerg Care*. 2013;29(5):579–583

17. Goldman RD, Amin P, Macpherson A. Language and length of stay in the pediatric emergency department. *Pediatr Emerg Care*. 2006;22(9):640–643

18. Levas MN, Cowden JD, Dowd MD. Effects of the limited English proficiency of parents on hospital length of stay and home health care referral for their home health care-eligible children with infections. *Arch Pediatr Adolesc Med*. 2011;165(9):831–836

19. Yu SM, Huang ZJ, Schwalberg RH, Nyman RM. Parental English proficiency and children's health services access. *Am J Public Health*. 2006;96(8):1449–1455

20. López L, Rodriguez F, Huerta D, Soukup J, Hicks L. Use of interpreters by physicians for hospitalized limited English proficient patients and its impact on patient outcomes. *J Gen Intern Med*. 2015;30(6):783–789

21. Karliner LS, Kim SE, Meltzer DO, Auerbach AD. Influence of language barriers on outcomes of hospital care for general medicine inpatients. *J Hosp Med*. 2010;5(5):276–282

22. Lowe HJ, Ferris TA, Hernandez PM, Weber SC. STRIDE—an integrated standards-based translational research informatics platform. *AMIA Annu Symp Proc*. 2009;2009:391–395

23. Nakamura MM, Toomey SL, Zaslavsky AM, et al. Measuring pediatric hospital readmission rates to drive quality improvement. *Acad Pediatr*. 2014;14(5 suppl):S39–S46

24. US Census Bureau. American FactFinder. Available at: http://factfinder.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t. Accessed July 18, 2016

25. US Department of Commerce Economics and Statistics Administration. *A Compass for Understanding and Using American Community Survey Data: What General Data Users Need to Know*. Washington, DC: US Government Printing Office; 2008

26. Department of Health and Human Services. Zip code to ZCTA crosswalk. In: *Uniform Data System Resources from the Health Resource and Services Administration*. 2014

27. US Census Bureau. Historical income tables: household. Available at: www.census.gov/hhes/www/income/data/historical/household/. Accessed November 4, 2015

28. Healthcare Cost and Utilization Project. Procedure classes. 2015. Available at: https://www.hcup-us.ahrq.gov/toolssoftware/procedure/procedure.jsp. Accessed August 26, 2015

29. 3M Health Information Systems. 3M APR DRG software. Available at: http://solutions.3m.com/wps/portal/3M/en_US/Health-Information-Systems/HIS/Products-and-Services/Products-List-A-Z/APR-DRG-Software/.

30. New York State Department of Health. APR-DRG service intensity weights and average length of stay. July 1, 2014.

31. New York State Department of Health. Acute hospital inpatient rebasing and service intensity weights (SIWs) effective July 1, 2014.

32. Feudtner C, Feinstein JA, Zhong W, Hall M, Dai D. Pediatric complex chronic conditions classification system version 2: updated for ICD-10 and complex medical technology dependence and transplantation. *BMC Pediatr*. 2014;14(1):199

33. Berry JG, Hall M, Cohen E, O'Neill M, Feudtner C. Ways to identify children with medical complexity and the importance of why. *J Pediatr*. 2015:167(2):229-237

34. Feudtner C, Pati S, Goodman DM, et al. State-level child health system performance and the likelihood of readmission to children's hospitals. *J Pediatr*. 2010;157(1):98–102.e1

35. Mendu ML, Zager S, Moromizato T, McKane CK, Gibbons FK, Christopher KB. The association between primary language spoken and all-cause mortality in critically ill patients. *J Crit Care*. 2013;28(6):928–934

36. Wang L, Haberland C, Thurm C, Bhattacharya J, Park KT. Health outcomes in US children with abdominal pain at major emergency departments associated with race and socioeconomic status. *PLoS One*. 2015;10(8):e0132758

37. Davies SM, Saynina O, McDonald KM, Baker LC. Limitations of using same-hospital readmission metrics. *Int J Qual Health Care*. 2013;25(6):633–639

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