Association Between Language, Serious Adverse Events, and Length of Stay Among Hospitalized Children

AUTHORS
K. Casey Lion, MD, MPH,[1,2] Sarah A. Rafton, MSW,[3] Jaleh Shafii, RN, MS,[4] Dena Brownstein, MD,[1,4] Eriberto Michel, BS,[1] Michelle Tolman, MPH,[3] and Beth E. Ebel, MD, MSc, MPH[1,2,5,6]

[1]*Department of Pediatrics,*
[2]*Center for Child Health, Behavior and Development*
[3]*Odessa Brown Children's Clinic;*
[4]*Patient Safety Department;*
[5]*Harborview Injury Prevention & Research Center, University of Washington, Seattle, Washington; and*
[6]*Center for Diversity and Health Equity, Seattle Children's Hospital and Research Institute, Seattle, Washington*

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ABBREVIATIONS
aOR: adjusted odds ratio
CI: confidence interval
CRGs: Clinical Risk Groups
LEP: limited English proficiency
LOS: length of stay

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Address correspondence to K. Casey Lion, MD, MPH, Center for Child Health, Behavior and Development, Seattle Children's Research Institute, M/S CW8-6
PO Box 5371, Seattle, WA 98145-5005.
E-mail: casey.lion@seattlechildrens.org

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abstract

OBJECTIVE: To evaluate the risk for serious/sentinel adverse events among hospitalized children according to race, ethnicity, and language and to evaluate factors affecting length of stay associated with serious/sentinel adverse events.

METHODS: We conducted a retrospective cohort study of all pediatric inpatients at a large children's hospital from October 2007 to October 2009. We evaluated the relationship between self-reported race, ethnicity, and primary language; with having a serious or sentinel adverse event, defined as an unexpected occurrence involving risk of death or serious injury; or a potentially harmful event resulting from nonstandard practice. We also examined length of stay. Clinical complexity was adjusted for by using Clinical Risk Groups.

RESULTS: Of 33 885 patients, 8% spoke Spanish and 4% spoke other languages. Serious and sentinel events were rare; however, among patients with such events, 14% spoke Spanish. Adjusting for potential confounders, Spanish speakers trended toward an elevated odds of adverse event (odds ratio: 1.83 [95% confidence interval: 0.98–3.39]). Controlling for age, language, and clinical complexity, having an adverse event was associated with a nearly fivefold increase in length of stay (95% confidence interval: 3.87–6.12). Spanish-speaking patients with an adverse event were hospitalized significantly longer than comparable English speakers (26 vs 12.7 days; $P = .03$ for interaction between language and adverse event).

CONCLUSIONS: Hospitalized children from Spanish-speaking families had significantly longer hospital stays in association with an adverse event and may have increased odds of a serious or sentinel event. These findings suggest that an important component of patient safety may be to address communication barriers.

Adverse events among hospitalized patients are common and costly; they place patients at risk for harm and contribute to the increasing cost of care.[1] Adverse events may not affect all patients equally,[2] and identifying patients at increased risk for adverse events may suggest interventions to improve patient safety.

Disparities in patient safety according to race and ethnicity have been reported for adults.[3–8] These studies have mostly focused on rates of specific events (eg, health care–associated infections) or collections of events (eg, the Agency for Healthcare Research and Quality's Patient Safety Indicators) derived from administrative data; the majority found disparities in some but not all safety measures evaluated. A handful of studies examined safety events in hospitalized children.[9–13]

The studies that relied on billing codes specifically for medical errors found no differences by race or ethnicity in multivariate analyses,[12,13] whereas those using more sensitive algorithms identified disparities in some but not all metrics evaluated.[10,11]

Difficulties with communication have been more widely associated with the risk of adverse medical events. Hospitalized adults with language barriers were more likely to have an adverse event compared with adults without a language barrier.[14] Language barriers were also associated with higher odds of multiple preventable adverse events during a single hospitalization. In a study of patients with an adverse event, patients with limited English proficiency (LEP) were more likely to have a severe or physically harmful event relative to English-proficient patients.[15] One study conducted among hospitalized children at our institution between 1998 and 2003 found increased odds of an adverse event among Spanish-speaking LEP patients compared with English speakers.[16] Since that time, substantial institutional efforts have been directed toward improving access to professional in-person and telephonic interpretation and decreasing nonproficient language use by providers in clinical situations.[17] These efforts, along with improvements in patient safety awareness, may have affected risk for adverse events among LEP patients.

Motivated by this previous work, our primary study objective was to evaluate the current risk for serious adverse events among pediatric inpatients according to race, ethnicity, and primary language. Our secondary objective was to evaluate factors influencing length of stay (LOS) for pediatric inpatients with an adverse event.

METHODS

Data Sources

We conducted a retrospective cohort study at Seattle Children's Hospital, a large pediatric medical center in the Pacific Northwest. We collected administrative and adverse event data for all admitted children from October 2007 through October 2009. This study was approved by the Seattle Children's Hospital institutional review board.

Age, gender, insurance (private versus public/charity care), self-identified race, ethnicity, and primary language were collected at patient registration at the time of admission. Race categories were white, black, American Indian or Alaska Native, Asian, other, ≥2 categories, and unknown or refused to indicate. Primary language spoken was used because no data on English proficiency were available for the study period. These data, along with LOS, were abstracted from the hospital registration database for all inpatients during the study time period. LOS was recorded to the tenth of a day (eg, 2.3 days).

Adverse events were collected through a Web-based reporting system available to hospital staff, patients, and families. Families are oriented to the system at admission, with the use of professional interpretation as appropriate. Event reports can be entered by anyone on the hospital campus, and they may be submitted anonymously. Events were analyzed and coded by the clinical patient safety staff to identify cause, type of error, and contributing factors. Multiple events per admission were linked by patient name or medical record number and dates of admission and discharge. We included only adverse events designated as sentinel or serious events. A sentinel event is 1 that meets the definition provided by The Joint Commission as "an unexpected occurrence involving death or serious physical or psychological injury, or the risk thereof."[18] A serious event is defined internally by the hospital as an unintended event or outcome resulting from a variance from expected practice or policy that does not meet the definition for sentinel but leads to or has the potential to lead to patient injury, reveals a system defect which is likely to recur, or relates to identified high acuity, frequent, or pervasive patient safety issues.

We used 3M Clinical Risk Groups (CRGs) to adjust for patient clinical severity and complexity, using hospital administrative data (Health Information Systems, Salt Lake City, Utah). CRGs use administrative data over time to place children into 1 of 9 core health status groups, which in turn map to the 3 clinical groups (nonchronic conditions, episodic chronic conditions, and lifelong chronic conditions) used in this study.[19] The use of CRGs for risk adjustment has been well described in the literature.[20–23]

Data Analysis

Adverse events were analyzed for all patients who had a serious or sentinel event between October 2007 and October 2009 during an inpatient hospitalization. Events occurring in all hospital locations (eg, emergency department, operating room) were included if they were a part of an inpatient stay. Event reports with incorrect or incomplete medical record numbers (ie, the patient was not able to be identified) were excluded, and we limited our analysis to 1 event per admission, excluding 3 subsequent events.

Patients who experienced a serious or sentinel event were compared with those without a reported event on age,

gender, insurance type, LOS, self-reported race and ethnicity, and self-reported primary language. Analysis was conducted by using χ^2 tests for categorical variables and the Wilcoxon test for continuous variables. Race categories were collapsed into white, non-white, and refused/unknown, given the small numbers in multiple categories. Ethnicity categories were non-Hispanic/Latino, Hispanic/Latino, and refused/unknown. Primary language categories were grouped as English, Spanish, and other. For regression analyses, child age was grouped into 5 categories: <1, 1 to 4, 5 to 12, 13 to 17, and ≥18 years. We calculated rates of adverse events by language group per 1000 patient-days.

We evaluated the relationship between adverse event occurrence and race, ethnicity, and language in 3 logistic regression models, controlling for age, LOS, and illness complexity (CRGs).

Factors associated with LOS were explored by using multivariate linear regression. Because the distribution of LOS was positively skewed, outcomes were modeled by using log-transformed LOS. We back-transformed point estimates to report more easily interpretable estimations of geometric mean ratios and 95% confidence intervals (CIs). Geometric means are more stable to outliers than arithmetic means but provide similar information.[24] Using LOS as the outcome, we conducted multivariate logistic regression with potential predictors (having an adverse event and primary language) and confounders (age and clinical complexity). Effect modification between language and adverse event occurrence was assessed by adding an interaction term to the model. We also modeled the adjusted relationship between LOS and adverse event, stratified according to language. The results of the adjusted, stratified regression were used to calculate the geometric mean LOS in days for English and Spanish speakers, with and without a serious or sentinel event. We considered 2-sided *P* values of ≤.05 to be statistically significant.

RESULTS

Characteristics of Study Participants

Among 33 885 admissions during the study time period, 87 serious or sentinel adverse events were reported. Patients who experienced a serious or sentinel adverse event were significantly younger (median age: 3 vs 6 years; $P = .04$) and had a longer median LOS (20.2 vs 2.8 days; $P < 0.001$) compared with patients who did not have such an event (Table 1). Patients with a reported adverse event were also more likely to be Spanish-speaking (14% vs 8%; $P = .04$). The rate of serious or sentinel adverse events among Spanish speakers, at 0.68 event per 1000 patient-days, was higher than that for patients with families who spoke English (0.40 event per 1000 patient-days; $P = .05$). Patients with an event were also more likely to have lifelong chronic disease (71% vs 48%; $P < .001$). We found no significant differences between those with and without a serious or sentinel event according to gender, ethnicity, race, or insurance type.

TABLE 1 Demographic Characteristics According to Serious or Sentinel Adverse Event, 2007 to 2009

Characteristic	No Event (*N* = 33 798)	Adverse Event (*n* = 87)	*P*
Age, y (median [IQR])	6 (1–13)	3 (0–11)	.04[a]
Male sex	54% (18 251)	63% (55)	.08[b]
Private health insurance	48% (16 204)	43% (37)	.31[b]
Length of stay, d (median [IQR])	2.8 (1.4–5.8)	20.2 (5.3–85)	<.001[a]
Ethnicity			
Not Hispanic/Latino	75% (25 348)	70% (61)	
Hispanic/Latino	15% (5201)	23% (20)	.12[b]
Unknown/refused	10% (3249)	7% (6)	
Race			
White	59% (19 756)	53% (46)	
Non-white	33%[c] (11 251)	39%[d] (34)	.51[b]
Unknown/refused	8% (2791)	8% (7)	
Primary language			
English	88% (29 706)	86% (75)	
Spanish	8% (2788)	14% (12)	.04[b]
Other	4% (1304)	0	
CRGs			
Nonchronic	34% (11 444)	18% (16)	
Episodic chronic	18% (6013)	10% (9)	<.001[b]
Lifelong chronic	48% (16 341)	71% (62)	

IQR, interquartile range.
[a] Wilcoxon test.
[b] χ^2 test.
[c] Includes 1.7% American Indian or Alaska Native, 5.8% Asian, 6.8% black, 5.4% multiracial, and 13.6% other.
[d] Includes 1.2% American Indian or Alaska Native, 8.1% Asian, 6.9% black, 5.8% multiracial, and 17.2% other.

Odds of Adverse Events by Race, Ethnicity, and Language

We found no significant difference in the odds of an adverse event according to race or ethnicity in multivariate logistic regression (Table 2). After adjusting for age, LOS, and clinical complexity, children from Spanish-speaking families had an increased odds of adverse event. This result was of borderline statistical significance (adjusted odds ratio [aOR]: 1.83 [95% CI: 0.98–3.39]; $P = .056$).

TABLE 2 Logistic Regression Examining the Association of Serious or Sentinel Adverse Event With Individual Demographic Factors

Variable	aOR[a] (95% CI)	*P*
Ethnicity		
Non-Hispanic/Latino	Ref	
Hispanic/Latino	1.50 (0.89–2.56)	.13
Unknown/ refused	0.89 (0.38–2.06)	.78
Race		
White	Ref	
Non-white	1.23 (0.78–1.94)	.36
Unknown/refused	0.71 (0.28–1.79]	.47
Language		
English	Ref	
Spanish	1.83 (0.98–3.39)	.056
Other	–[b]	

[a] Adjusted for CRGs, LOS, and age groups.
[b] Dropped from the model because there were no serious or sentinel adverse events in the "other" category.

Factors Associated With LOS

In a multivariate linear regression model, having an adverse event was independently associated with a nearly fivefold increase in the LOS, controlling for age, gender, language, and clinical complexity (aOR: 4.87 [95% CI: 3.87–6.12]; $P < .001$) (Table 3).

Among patients who had an adverse event, those whose families spoke Spanish had significantly longer hospital stays compared with children whose families spoke English (26 vs 12.7 days) (Fig 1), reflecting a twofold increase in LOS (aOR: 1.95 [95% CI: 1.06–3.62]; $P = .03$). Among patients overall, Spanish language was not associated with an increased LOS, whereas the "other" language category was associated with an increased LOS (aOR: 1.07 [95% CI: 1.02–1.14]; $P = .01$). In language-stratified regression models, an adverse event was associated with a 4.8-fold increased LOS among English-speaking inpatients (95% CI: 3.88–6.14) but a 9.6-fold increase among Spanish speakers (95% CI: 5.53–16.8).

DISCUSSION

Risk of Serious or Sentinel Event

Hospitalized children from Spanish-speaking families had higher rates of serious or sentinel adverse events relative to English-speaking children, although this difference was of borderline statistical significance after controlling for potential confounders. Results according to ethnicity were similar but somewhat attenuated, suggesting that language difference, rather than Hispanic/Latino ethnicity, was the operative factor. Although adjustment for the nonmodifiable risk factors for a serious adverse event, such as age and illness severity, did compromise our statistical power to detect a difference on the basis of language, it also serves to highlight the importance of communication as a potentially modifiable risk factor. We cannot change a child's age in the interest of patient safety, but we can improve communication with patients and families and use professional interpretation to overcome language barriers. Consequently, quality of communication is an important risk factor for serious adverse events, given that it holds promise as a target for intervention.

TABLE 3 Association of LOS With Adverse Event and Language Spoken by Using Multivariate Linear Regression

Variable	Adjusted Estimated Ratio[a] (95% CI)	*P*
Adverse event	4.87 (3.87–6.12)	<.001
Language		
English	Ref	
Spanish	1.03 (0.99–1.07)	.18
Other	1.07 (1.02–1.14)	.01
Spanish*adverse event	1.95 (1.06–3.62)	.03

Point estimates are risk ratios of geometric mean values obtained by log-transformation of the outcome variable.
[a] Adjusted for age group, CRGs, adverse event, language group, and the adverse event/Spanish interaction; no interaction term for the "other" language group was used, as there were no adverse events in that group.

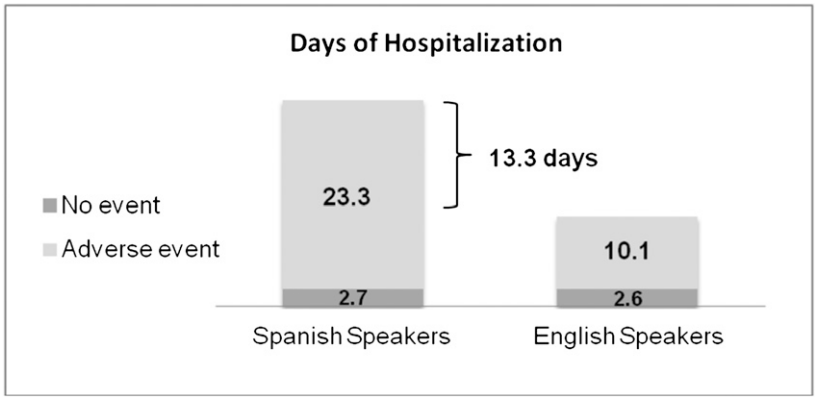

FIGURE 1 Adjusted LOS in days according to patient language, with and without a serious or sentinel adverse event. [a]Adjusted for age group and clinical complexity (CRGs). [b]Calculated from geometric mean LOS by using language-stratified regression model ratios.

Nearly a decade ago, Cohen et al[16] found a 2.3-fold increased odds of adverse events among LEP Spanish speakers at our institution. Although our techniques were slightly different from their case-control approach, we were encouraged that the overall risk of adverse events for Spanish-speaking families was somewhat lower than the risk reported by Cohen et al (1.8 vs 2.3). These changes may reflect improvements in care provided to LEP patients and families, for whom frequent professional interpretation is now the rule.[25]

Our finding of an increased odds of adverse events for Spanish speakers, but not for families from other language groups, is also similar to the findings of Cohen et al.[16] This difference could be attributable to a smaller inpatient population for other language groups but could also result from decreased reporting of events for some groups of LEP families. Another potential explanation for higher adverse event rates specifically among Spanish speakers is provider use of nonproficient language skills, which is well documented with Spanish-speaking families[17,26,27] and has been linked to serious medical errors.[17,28,29]

Length of Stay

Other authors have reported increased length of hospital stay for LEP patients and families unrelated to adverse events.[30–32] Among all hospitalized patients, our finding of 7% longer stays for families speaking "other" languages, but not among those who spoke Spanish, has not previously been documented. Comparable LOS among families who spoke English or Spanish may have reflected the excellent access to professional Spanish interpreters at our institution.[25] Although access to in-person interpretation for other languages was also very good, and access to telephone interpretation was immediate and available for >100 languages, providers may have preferred to use in-person interpretation for discharge discussions, especially for teaching home care skills (eg, wound care, inhaler use). Families who spoke languages other than Spanish may have waited longer for an in-person interpreter, which could have contributed to longer LOS. Cultural factors may also have played a role, contributing to the communication barriers and decreasing provider comfort with early discharge. Further research is required to better understand differences in LOS by language group and the implications for care delivery.

Relative to children without an event, the LOS for English-speaking children with a serious or sentinel adverse event was 5 times longer. The difference was substantially more pronounced for Spanish-speaking children, in whom mean LOS was ~10 times longer than mean LOS for children without an event, perhaps reflecting a risk for more serious physical harm, as has been found by other investigators.[15] Thus, Spanish-speaking patients who suffered a serious or sentinel adverse event during hospitalization remained in the hospital an average of 13 additional days per patient. It is likely that these events represent a significant health risk to the child, substantial additional cost to the medical system, and prolonged disruption to the lives of the patient and family.

To the best of our knowledge, this is the first study to report a longer LOS according to language group in patients with a serious or sentinel adverse event. Although our study was unable to elucidate reasons for this disparity, multisite studies of hospitalized adults suggest possible explanations. Adverse events among adult inpatients with language barriers are more likely to be severe and physically harmful than those experienced by patients without language barriers.[15] They are also more likely to have multiple adverse events during a single hospitalization.[14] If these differences in adverse event characteristics apply to children, longer LOS may indicate more serious

harm. Non–English-speaking patients may also stay in the hospital longer with an adverse event because of challenges associated with arranging proper follow-up,[30–32] insurance coverage,[33] or reestablishing trust in the setting of ongoing language barriers. However, such explanations do not seem to adequately account for the size of the difference. Regardless of reasons, the difference in LOS represents financial costs to the health care system and financial, logistical, and emotional costs to the families, and these costs are being borne disproportionately by already disadvantaged families. Eliminating health disparities has been identified as a foundational goal of Healthy People 2020 and has risen to the top of the national research agenda.[2,34] Further research is needed to understand whether Spanish-speaking children are at risk for more severe or harmful adverse events and, most importantly, to identify effective interventions to reduce risk for all hospitalized children, regardless of race, ethnicity, or language spoken.

The results of this study highlight the importance of effective communication for ensuring safe medical care. Our hospital uses relatively few bilingual medical providers and staff members but offers around-the-clock access to in-person and telephone-based professional interpreters. A first step in making our health care system safer is to ensure that LEP children and their families are able to communicate with medical providers and participate in care by using professional interpretation or certified bilingual providers.[35,36] Addressing these disparities in patient safety will be essential for creating a safe and equitable health care system, and for reining in the increasing costs of health care in the United States.

Limitations

This study was limited by the small number of serious and sentinel adverse events captured during the 2-year period, which decreased the overall study power to explore associations. In addition, the hospital adverse event–monitoring system relies on voluntary reporting by providers and families. Voluntary systems are susceptible to underreporting and may miss events, especially if a barrier exists to family reporting or if no harm reached the patient. Administrative adverse events databases can also contain errors. We restricted our analysis to serious and sentinel events, which may be more likely to be reported and verified and are less reliant on family reporting than are less serious adverse events. An additional limitation is that we used patient-reported primary language rather than degree of English proficiency, reflecting the available information collected during the study period. LEP is more useful than primary language spoken at home for detecting differences between groups because primary language groups include families who may speak another language at home but are fluent in English and have no language barrier.[37] Use of primary language, rather than English proficiency, tends to bias results toward the null, which may have attenuated the strength of our language-related findings.

It is important to note that our adverse event–monitoring system did not allow us to pinpoint the exact date and time of the adverse event. Consequently, we were unable to determine LOS specifically after the event. As a result, we cannot say definitively whether an adverse event led to prolonged hospitalization or whether prolonged hospitalization increased the risk of an adverse event. Although this limitation affects the confidence with which we can attribute additional hospital days to a particular event, it does not influence our finding of a disparity on the basis of language because the data limitation affects all groups equally. Finally, we analyzed 1 serious or sentinel adverse event per admission. Only 3 patients had multiple events recorded, and we felt these were likely to be interrelated. We used log-transformed LOS and geometric means to decrease the influence of outliers on results.

Conclusions

Hospitalized children from Spanish-speaking families had significantly longer hospital stays in association with an adverse event and may have increased odds of a serious or sentinel event. The difference in LOS amounted to 23.3 additional hospital days for Spanish-speaking patients with an adverse event, compared with 10.1 additional days for comparable English speakers with an event. These findings suggest that 1 important component of overall patient safety may be to meaningfully address communication barriers with professional interpretation, while simultaneously investing in efforts to improve the diversity of underrepresented minority health care providers. Understanding and eliminating these disparities in patient safety is a crucial step on the road to a safe, equitable, and cost-effective health care system for all children.

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