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# The association between primary language spoken and all-cause mortality in critically ill patients☆,☆☆

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ABSTRACT

*Purpose:* The study objective was to investigate the association between primary language spoken and all-cause mortality in critically ill patients.
*Materials and Methods:* We performed a cohort study on 48 581 patients 18 years or older who received critical care between 1997 and 2007 in 2 Boston hospitals. The exposure of interest was primary language spoken determined by the patient or family members who interacted with administrative staff during hospital registration. The primary outcome was 30-day mortality. Associations between language and mortality were estimated by bivariable and multivariable logistic regression models with inclusion of covariate terms thought to plausibly interact with both language and mortality. Adjustment included age, race, sex, Deyo-Charlson index, patient type (medical vs surgical), sepsis, creatinine, hematocrit, white blood count, and number of organs with acute failure.
*Results:* Validation showed that primary language spoken was highly accurate for a statement in the medical record noting the language spoken that matched the assigned language. Patients whose primary language spoken was not English had improved outcomes (odds ratio 30-day mortality, 0.69 [95% confidence interval, 0.60-0.81; $P < .001$), relative to patients with English as the primary language spoken, fully adjusted. Similar significant associations are seen with death by days 90 and 365 as well as in-hospital mortality. The improved survival in patients with a non-English primary language spoken is not confounded by indicators of severity of disease and is independent of the specific language spoken and neighborhood poverty rate, a proxy for socioeconomic status. There are significant limitations inherent to large database studies that we have acknowledged and addressed with controlling for measured confounding and evaluation of effect modification.
*Conclusions:* In a regional cohort, not speaking English as a primary language is associated with improved outcomes after critical care. Our observations may have clinical relevance and illustrate the intersection of several factors in critical illness outcome including severity of illness, comorbidity, and social and economic factors.



## 1. Introduction

In the United States, a large minority of the population has limited proficiency in the English language. In the data from the 2006 to 2008 American Community Survey obtained by the US Census, nearly 19.6% of Americans speak a non-English language at home and 8.6% of Americans cannot speak English "very well" [1,2]. Adults 65 years and older make up the largest proportion of Americans with limited English proficiency. Poor communication in patients with limited English proficiency may have consequences for optimum patient care [3].

Language discordance occurs when patients are not proficient in the language spoken by providers of health care [2]. Limited English proficiency and language discordance is postulated to be associated with lower health care quality including decreased referral appointments, longer stays in emergency departments, greater diagnostic testing, increased likelihood of hospital admission, increased length of stay, and increased readmission after discharge but not a difference

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in mortality [2,4-10]. In the intensive care unit (ICU), patients with limited English proficiency are noted to receive suboptimal information and support in family conferences [11]. Clarifying the impact of primary language spoken on health care outcome may enlighten efforts to reduce health care disparities in general [12] and specifically in the critically ill.

Primary language spoken and its significance in critical care outcomes are not well studied [11]. With limited English proficiency, patients in the United States have decreased access to care and poor communication with their providers [13]; thus, we hypothesized that in a critically ill cohort based in Boston, the primary language spoken by the patient may be related to patient survival. To explore the role of the primary language spoken in the outcome of the critically ill, we performed a 2-center observational study of 48 581 critically ill patients hospitalized between 1997 and 2007. The objective of this study was to determine the relationship between primary language spoken by patients and all-cause mortality after critical illness.

## 2. Materials and methods

We extracted electronic data from 2 academic teaching hospitals in Boston. Brigham and Women's Hospital (BWH) has 100 ICU beds, and Massachusetts General Hospital (MGH) has 109 ICU beds. Both institutions employ fully staffed interpreter and telephone interpreter services. Data on all patients admitted to BWH or MGH between November 2, 1997, and December 31, 2007, were obtained through the Research Patient Data Registry (RPDR) [14], a repository for electronic records at BWH and MGH. Approval was granted by the Partners Institutional Review Board (Protocol No. 2010P000645).

During the study, there were 54 392 unique patients 18 years or older assigned the current procedural terminology (CPT) code 99291 (critical care, first 30-74 minutes). Two hundred twenty-five patients with a foreign address were identified but not excluded. We excluded the following: 2372 patients assigned CPT code 99291 who received care only in the emergency department were not admitted to the hospital; 1169 patients with a subsequent admission to the hospital involving critical care within 30 days of discharge; 321 patients with missing data; and 1744 patients without primary language spoken data recorded. A total of 48 581 patients constituted the study cohort.

The exposure of interest was the primary language spoken by the patient. The primary language spoken is determined by the patient or by family members who interact with registration services administrative staff during the time of patient registration at hospital admission or outpatient registration. Primary language spoken is determined by a series of standardized questions answered by the patient or family during registration. The questions include the following: Does the patient speak and understand English? Does the patient require an interpreter? In which language does the patient prefer to communicate during medical appointments or to discuss health-related information? If the patient indicates that they do not speak and understand English and require an interpreter, then the language preference question answer is recorded as the primary language spoken. If the patient indicates that they speak and understand English and decline an interpreter, then they are recorded as an English speaker. The language data collected at registration is recorded electronically and stored in the RPDR, a central computerized clinical data registry [14]. For the purposes of this study, we considered primary language spoken as the language that the patient prefers to communicate in during medical appointments or to discuss health-related information (ie, English, Spanish, Portuguese, Italian, Cantonese, etc), which was extracted from the RPDR.

The critical care initiation date is the first CPT code 99291 assignment date, which has been validated for ICU admission in the RPDR [15]. Early ICU admission was a CPT code 99291 assignment within 3 days of hospital admission. *Sepsis* was defined by *International Classification of Diseases, Ninth Revision, Clinical Modification* (*ICD-9-CM*) codes 038.0-038.9, 020.0, 790.7, 117.9, 112.5, and 112.81, 3 days before 7 days after critical care initiation [16]. *Acute organ failure* was defined by acute organ dysfunction *ICD-9-CM* and CPT codes assigned from 3 days before 30 days after critical care initiation [16,17]. *Patient type* is defined as medical or surgical and incorporates the Diagnostic-Related Grouping methodology [18]. We used validated *ICD-9* coding algorithms for the Deyo-Charlson index to assess chronic illness [19,20]. Laboratory values were obtained on critical care initiation.

Neighborhood poverty rate is the percent living below the federal poverty level cutoff [15,21-27] and determined by linking patient address to Public Health Disparities Geocoding Project Monograph data [28]. Exposure to inotropes and vasopressors was determined in the 3 days before 7 days after critical care initiation for dopamine, dobutamine, epinephrine, norepinephrine, phenylephrine, milrinone, and vasopressin.

Procedures during the first 7 days after critical care initiation were determined by CPT codes: renal replacement therapy (CPT 90935, 90937, 90945, 90947), left heart cardiac catheterization (CPT 93508, 93510, 93526, 93542-93556), endoscopy (CPT 44.43, 45.13, 45.14, 45.16), and bronchoscopy (CPT 31622-31625, 31628). Mechanical ventilation (CPT 31500, 31600, 94656-94657) was determined after critical care initiation [29].

The primary end point was 30-day mortality after critical care initiation. Other prespecified end points included 90-day, 365-day, and in-hospital mortality. Vital status for the cohort was obtained from the Social Security Administration Death Master File, which has a sensitivity for mortality up to 92.1% and a specificity of 99.9% [30-33]. The censoring date was July 27, 2009.

To validate the accuracy of Language spoken assignment at registration, 100 cohort patients were chosen at random [34], and the medical record was evaluated for language spoken and English fluency using a natural language processing application [35]. Charts were validated by a blinded investigator (T.M.) who used an abstraction form to record the following: (*a*) if the patient speaks the assigned language, (*b*) if the patient speaks English, (*c*) level of English fluency, and (*d*) primary language spoken. The validation criterion was a statement in the medical record noting the language spoken that matched the assigned language. In addition, we randomly [34] chose 100 patients assigned English and 100 patients assigned a language other than English and validated the assigned language and determined English fluency.

Categorical covariates were described by frequency distribution and compared across primary language spoken groups using contingency tables and $\chi^2$ testing. Continuous covariates were examined graphically and in terms of summary statistics and compared across exposure groups using 1-way analysis of variance. Survival analyses considered death by days 30, 90, and 365 after critical care initiation as well as in-hospital mortality. “”A follow-up of 365 days was present for all 48,581 patients in the cohort.

Unadjusted associations between primary language spoken groups and outcomes were estimated by contingency tables, $\chi^2$ testing, and bivariable logistic regression analysis. Adjusted odds ratios (ORs) were estimated by multivariable logistic regression models with inclusion of covariate terms thought to plausibly interact with both primary language spoken and mortality. For the primary model (30-day mortality), specification of each continuous covariate was adjudicated by the empiric association with the primary outcome using Akaike Information Criterion; overall model fit was assessed using the Hosmer-Lemeshow test. We assessed possible effect modification of neighborhood poverty rate, race, sepsis, mechanical, vasopressor/intropes, renal replacement therapy, endoscopy, cardiac catheterization, and central venous catheter on the risk of 30-day mortality. We tested the significance of the interaction using the likelihood ratio test. All *P* values presented are 2 tailed; values below