

## Variability in Gastrostomy Tube Placement for Intracerebral Hemorrhage Patients at US Hospitals

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*Objective:* We sought to characterize the variability among US hospitals with regard to gastrostomy tube placement for inpatients with intracerebral hemorrhage (ICH). *Methods:* Using the Nationwide Inpatient Sample, we examined variations in the annual rate of gastrostomy tube placement from 2002 to 2011 for ICH patients admitted to hospitals with 30 or more annual ICH admissions. We then directly compared, among these hospitals, their individual frequencies of gastrostomy tube placement for ICH patients over the same time period. To quantify variability among hospitals, we used multilevel multivariable regression models accounting for a hospital random effect, adjusted for patient-level and hospital-level factors predictors of placement. *Results:* Gastrostomy tube placement rates did not significantly change from 2002 to 2011 (9.8 to 8.7 per 100 admissions; *P* trend = .57). Among 690 hospitals with 38,080 ICH hospitalizations during this period, 10.4% of patients had a gastrostomy tube placed (n = 3976). Variation in the rate of placement among individual hospitals was large, from 0% to 34.4% (interquartile range 5.7%-13.6%). For a regression model controlling for patient and hospital covariates, the median odds ratio was 1.36 (95% confidence interval 1.28-1.44), indicating that if a patient moved from one hospital to another with a higher intrinsic propensity of placement, there was a 1.36-fold median increase in the odds of receiving a gastrostomy tube, independent of patient and hospital factors. *Conclusions:* Variation in gastrostomy tube placement rates across hospitals is large and may in part reflect differences in local practice patterns or patient and surrogate preferences. **Key Words:** Cerebral hemorrhage—critical care—epidemiology—palliative care—quality of life—decision making.  
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## Introduction

For many patients with primary intracerebral hemorrhage (ICH) admitted to intensive care units (ICUs), prolonged dysphagia is a particularly morbid medical complication.<sup>1</sup> Long-term difficulty swallowing or inability to swallow has implications for nutrition, pneumonia risk, survival, and quality of life for ICH patients with disability.<sup>2</sup> Thus, the routine yet critical decision of whether to place a gastrostomy tube in an ICH patient with disability is in large part value driven and ideally involves a shared decision between a patient or surrogate and a medical team that incorporates impressions of overall prognosis, quality of life, and perceived patient preferences.<sup>3</sup>

Although shared decision making in general has received increasing attention in the ICU literature,<sup>4,5</sup> few studies have characterized gastrostomy tube decisions for ICH patients within US hospitals.<sup>6-8</sup> Certain ICH patient characteristics aside from ICH severity itself have been associated with an increased likelihood of gastrostomy tube placement, including minority race and socioeconomic status, especially at small- and medium-sized hospitals and institutions with low ICH case volume.<sup>2</sup> However, both (1) whether the overall rate of gastrostomy tube placement for ICH patients has recently changed with time and (2) how profound the practice differences for gastrostomy tube placement are even among experienced hospitals—aside from inherent differences in their ICH case mix and institutional characteristics—have not been previously explored on a national level in the United States. A change in gastrostomy tube placement rates over time may in part reflect evolving attitudes among US physicians regarding the appropriateness of aggressive care for ICH patients. Similarly, a wide variability in placement rates among hospitals may in part reflect differing philosophies regarding care aggressiveness in ICH at various institutions.

We thus sought to understand the variation of gastrostomy tube placement in ICH patients over time in the United States and the degree to which individual hospitals differ with regard to placement rates, after accounting for variations due to key patient and hospital characteristics. Given recent literature on both (1) the variability of clinician opinions of prognosis and quality of life for ICH patients with disability<sup>9</sup> and (2) the driving role that these variable clinician impressions play in advising ICU patients and surrogates,<sup>10</sup> we hypothesized that the variability in placement rates among individual hospitals would be large.

## Materials and Methods

We conducted a retrospective observational study of trends, between-hospital variation, and patient and hospital characteristics associated with gastrostomy tube placement for patients with a diagnosis of primary ICH

admitted to US acute care hospitals in the Nationwide Inpatient Sample (NIS) of the Agency for Healthcare Research and Quality Healthcare Cost and Utilization Project.<sup>11</sup> The NIS is a cross-sectional, all-payer, inpatient care dataset that represents an approximately 20% stratified random sample of nonfederal US hospitals. The NIS contains information from over 1000 hospitals, encompassing over 8 million hospitalizations annually. The Johns Hopkins Institutional Review Board approved the study.

### *Patient and Hospital Selection*

We identified adult (age  $\geq 18$  years) ICH admissions from January 1, 2002, to December 31, 2011, using the International Classification of Diseases, Ninth Revision (ICD-9) primary diagnosis code 431—cerebral hemorrhage.<sup>12</sup> Observations with missing data for variables such as age, sex, and death were excluded, as well as those admissions admitted under elective status. Individuals with a diagnosis of arteriovenous malformation (ICD-9 code 437.3), brain tumor (ICD-9 code 191), and traumatic brain injury (ICD-9 codes 800, 801, 850-854) were excluded to focus the study on patients with primary ICH.

Within this selected ICH patient population from 2002 to 2011, we identified the individual hospitals in the NIS where patients were admitted. The 2012 and 2013 datasets for the NIS were available; however, because of changes in data collection, these more recent years can no longer reliably be used to study questions pertaining to the hospital level.<sup>13</sup> Hospitals with fewer than 30 annual ICH admissions were excluded from our analysis.<sup>14</sup> This minimum admission volume of 30 ensured that 95% confidence intervals (CIs) were no wider than 10% for hospitals using gastrostomy tubes at the mean rate. Admissions that were transferred to other acute care hospitals accounted for approximately 3% of hospitalizations, and exclusion of these individuals did not substantially change the results of the study (data not shown). Finally, because race and ethnicity had a high degree of missing patient data compared with other variables because of state suppression or partial reporting by hospitals, we conducted our analysis using only hospitals with complete data on race and ethnicity. Figure e-1 in the Supplemental Digital Content shows the selection method for the sample.

### *Patient Characteristics*

Demographic and socioeconomic factors were identified for eligible patients from eligible hospitals. We identified comorbidities using ICD-9 codes and accounted for 16 conditions included in the Charlson comorbidity index tailored for stroke outcomes studies.<sup>15</sup> We identified individuals with cancer separately in regression analysis because of the implications of end-of-life care in these patients.

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