The "Hispanic Paradox" Exists in Emergent Conditions: Better or Equivalent Surgical Outcomes Among US Hispanic Emergency General Surgery Patients

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ABSTRACT

Objective: In the United States, Hispanic patients tend to present with similar risk profiles to non-Hispanic black (NHB) patients but experience better outcomes for chronic conditions and elective operations, similar to those of non-Hispanic white (NHW) patients—a phenomenon known as the "Hispanic Paradox." The finding is thought to be the result of selective migration among foreign-born Hispanic patients, making it theoretically less likely to occur when care is urgent. The objective of this study is to determine whether the "Hispanic Paradox" exists in emergency situations requiring operative emergency general surgery (EGS) care.

Methods: Age-specific differences (pediatric/adult/older adult) in mortality, major morbidity, and unplanned readmission at ≤30, 90, 180, and 365 days among NHW, NHB, and Hispanic patients from three US states with large Hispanic populations were assessed using survival analysis. Data were abstracted from state inpatient claims from 2007 to 2015. Models accounted for clustering of patients within hospitals and states and potential confounding associated with operation type, diagnosis, patient demographics (age, admission year, gender, Charlson Comorbidity Index, income, and insurance), and hospital-level factors (operative volume, rurality, teaching status, and registered nurses (RNs)/bed).

Results: Relative to Hispanic patients, adult NHB and NHW EGS patients fared significantly worse (e.g., ≤365-day mortality hazard ratios (HR) [95% CI]: 1.74 [1.72–1.76], 1.25 [1.24–1.26]). The trend persisted for pediatric (HR [95% CI]: 1.57 [1.50–1.64]) and older adult (1.31 [1.30–1.32]) NHB patients. In contrast, when comparing pediatric NHW vs Hispanic patients, no significant differences in EGS outcomes were found. Among older adults, the apparent protective influence of the Hispanic Paradox waned, pointing to marginally better outcomes among NHW patients aged ≥65 years (HR [95% CI]: 0.94 [0.93–0.95]). Identical patterns were found in major morbidity and unplanned readmission. Differences were most pronounced in adult patients from more ethnically diverse Hispanic states (e.g., Florida vs California) and were markedly reduced by access to insurance.

Conclusion: Outcomes similar to or better than outcomes of US NHW patients were found among US Hispanic patients for EGS. Our findings provide evidence that the "Hispanic Paradox" exists under emergent conditions in contrast to expectations and that its effects appear to decrease with age.

Keywords: Emergency general surgery, Hispanic Paradox, Morbidity, Mortality, Race/ethnicity, United States, Unplanned readmission.

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ABSTRATO

Objetivo: En los Estados Unidos (USA), los pacientes hispanos tienden a presentar perfiles de riesgo similares a los pacientes negros no hispanos (NHB), sin embargo presentan mejores desenlaces en enfermedades crónicas y operaciones electivas, similares a los de los blancos no hispanos (NHW)- Un fenómeno conocido como la "paradoja hispánica." Se cree que este fenómeno es el resultado de la migración selectiva entre pacientes hispanos nacidos en el extranjero, lo que hace que en teoría sea menos probable que ocurra cuando la atención es urgente. El objetivo de este estudio fue determinar si la "paradoja hispánica" existe en situaciones de emergencia que requieren atención quirúrgica de emergencia (EGS).

Método: Utilizando análisis de supervivencia, se evaluaron las diferencias específicas por edad (pediátricas/adultos/adultos mayores) en la mortalidad, morbilidad y re-admisiones no planificadas a ≤30, 90, 180 y 365 días entre los pacientes NHW, NHB e hispanos de tres estados de USA que cuentan con grandes poblaciones hispanas. Los datos se extrajeron de las reclamaciones estatales de pacientes hospitalizados en los años 2007–2015. Los modelos tomaron en cuenta la agrupación de pacientes dentro de los hospitales, estados y la posibilidad de variables de confusión asociada con el tipo de operación, el diagnóstico, la demografía del paciente (edad, año de ingreso, sexo, índice de comorbilidad de Charlson, ingresos y aseguramiento) y factores a nivel hospitalario (volumen operativo, ruralidad, nivel de enseñanza, y enfermeros por cama).

Resultados: En relación con los pacientes hispanos, los pacientes adultos NHB y NHW de EGS les fue significativamente peor (por ejemplo, mortalidad de 365 días HR [95%CI]: 1.74 [1.72–1.76], 1.25 [1.24–1.26]). La tendencia persistió en pacientes NHB pediátricos (HR [CI95%]: 1.57 [1.50–1.64]) y adultos mayores (1.31 [1.30–1.32]). En contraste, al comparar pacientes NHW pediátricos y pacientes hispanos no se encontraron diferencias significativas en los desenlaces de EGS. En adultos mayores, la aparente influencia protectora de la paradoja hispana disminuyó, evidenciando desenlaces ligeramente mejores para los pacientes NHW de edad ≥65 year (HR [95%CI]: 0.94 [0.93–0.95]). Se encontraron patrones idénticos para morbilidad y readmisión no planificada. Las diferencias fueron más pronunciadas en pacientes adultos de estados hispanos con mayor diversidad étnica (por ejemplo, Florida vs California) y se redujeron notablemente por el acceso a aseguramiento.

Conclusione: Se encontraron desenlaces similares o mejores que los desenlaces de los pacientes NHW de USA entre los pacientes hispanos de USA para EGS. Nuestros hallazgos proporcionan evidencia de que la "paradoja hispánica" existe en condiciones emergentes en contraste con las expectativas y que sus efectos parecen disminuir con la edad.

Palabras clave: Estados Unidos, Morbilidad, Mortalidad, Paradoja Hispánica, Quirúrgica de emergencia, Raza/etnicidad, Re-admisiones no planificadas.

INTRODUCTION

Patients with ethnic origins encompassing ancestry from Mexico, the Caribbean, Central America, and South America—collectively reported in the United States (US) Census as "Hispanic or Latino"—represented 16.3% of the US population in 2010.[1] By 2045, they are estimated to account for one-fourth (24.6%) of the US population.[1] In the United States, Hispanic patients tend to present with similar risk profiles to non-Hispanic black (NHB) patients but experience better outcomes for chronic conditions and elective operations similar to those of non-Hispanic white (NHW) patients. The seemingly unintuitive phenomenon known as the "Hispanic Paradox" is thought to result primarily from selective-migration among foreign-born Hispanic patients,[2,3] particularly those of working age.[4,5] Given its close association with patients' decision of when/where to seek care, the Hispanic Paradox as a form of racial/ethnic disparity in US surgical care is expected to be less likely to occur when the need for care is urgent[6] and limited time is available for patients to make alternative plans.

Classic explanations of the Hispanic Paradox suggest (1) that younger and more mobile Hispanic patients facing health threats are more likely to return to their countries of origin where they have increased familial and community support and have ready access to medical care (thereby decreasing the number of patients at higher risk) and (2) that healthier Hispanic patients are more likely to immigrate to the US (thereby increasing the number of patients at lower risk).[2,3] Underreporting of ethnicity on death certificates, presence of healthier lifestyles and behaviors adopted in patients' countries of origin, and availability of strong social networks within Hispanic communities in the United States have also been suggested as potential contributing factors.[2,3] Ultimately, whatever the cause, the persistence of the phenomenon has been widely described for mortality in conditions ranging from cardiovascular disease[7] and end-stage renal disease[8] to outcomes of laparoscopic/open cholecystectomy,[9] kidney transplantation,[10] operations for non-small cell lung cancer,[11] and need for cesarean section at birth.[12,13] It has been reported in a single-year assessment of trauma registry data from the 2010 US National Trauma Data Bank[14] and in longer-term outcomes of emergency general surgery (EGS) patients assessed from the standpoint of NHW patient health.[15,16]

The objective of this study is to build on that work, using longitudinal data from three geographically and ethnically diverse US states with large Hispanic populations (California, New York, and Florida) to specifically determine whether the Hispanic Paradox exists in emergency situations requiring operative EGS care. The study looked at differences in ≤30, 90, 180, and 365 day outcomes including mortality, major morbidity, and unplanned readmission among pediatric (0–17 year), adult (18–64 year), and older adult (≥65 year) Hispanic patients relative to those of NHW and NHB patients.

METHODS

Data Source and Study Population

The data from California (2007–2011), New York (2007–2014), and Florida (2007–2015) State Inpatient Databases (SID) collected by the Agency for Healthcare Research and Quality's Healthcare Cost and Utilization Project (HCUP)[17] were queried for pediatric/adult/older adult index inpatient admissions with primary International

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Classification of Diseases, 9th edition, Clinical Modification (ICD-9-CM) diagnosis codes consistent with EGS conditions as defined by the American Association for the Surgery of Trauma (AAST).[18] Included data represented the most recent years available for each state. Patients were required to present with "emergent" or "urgent" admissions, no concurrent trauma diagnoses (ICD-9-CM: 800.x-959.x), and ≥1 EGS operative procedure code.[15,16,19] As a secondary point of comparison, patients with ≥1 of the 7 most common 3-digit ICD-9-CM procedure codes found to account for at least 80% of the US national operative EGS burden were also identified.[20]

SID provides a longitudinal follow-up of inpatient encounters from hospitals within each state, representing >98% of hospital discharges[17] and, collectively, 24.7% of the total US population.[1] Each database encompassed information on ≥25 ICD-9-CM diagnosis and ≥15 procedure codes. To attain additional hospital-level information, included patient records were matched to the hospital data that were present within the American Hospital Association Annual Survey Database.[21]

Patients with errors in ICD-9-CM coding or who were missing longitudinal variables required to link observations (HCUP-derived "visitlink" and "daystoevent"); discharged as transfers; with a race/ethnicity other than Hispanic, NHW, or NHB; or missing race/ethnicity, age, or covariate information (<5.0% of the sample) were excluded. Patients who died or were administratively censored due to the end of the calendar year were included for the amount of time that they survived/were observed. Missingness was addressed using the complete cohort analysis. Admissions for patients with a second operative EGS admission within 365 days of an index admission were counted as second index admissions instead of readmissions only if 30 days had passed and if the second EGS admission diagnosis/procedure code was different than the first.

Variable Definitions: Race/Ethnicity, Covariates, and Outcomes

Information on patient- and hospital-level factors included the following: race/ethnicity, state, admission year, age, gender, Charlson Comorbidity Index (CCI: 0, 1, 2, ≥3), state-based median

income quartile for patients' residential zip-codes, primary payer insurance status (Medicare, Medicaid, private, uninsured, other), EGS diagnostic category, EGS procedure category, quartile of hospital operative EGS volume, residential country rurality (large metro area >1 million, small metro area <1 million, suburban or town, rural), quartile of hospital full-time residents: beds (a marker of teaching intensity and the differences between large academic and smaller community hospitals), and quartile of hospital full-time registered nurses: beds (a marker of nursing-staff ratios and the extent of demand on inpatient floors). CCI was calculated using the Charlson program in Stata.

Primary outcome measures included mortality, major morbidity, and unplanned readmission measured from admission (discharge for readmission) through 30/90/180/365 days. Major morbidity was defined based on the presence of ≥1 of the following acute care surgery-related complications calculated using ICD-9-CM codes: pneumonia, pulmonary embolism, renal failure, cardiovascular accident, myocardial infarction, cardiac arrest, acute respiratory distress syndrome, sepsis, and severe sepsis/septic shock. Planned "V-code" readmissions and patients discharged/readmitted within the same day (inter-hospital transfers) were not counted as readmissions.

Statistical Analysis: Descriptive Statistics and Survival Analysis

Differences in covariates were compared by race/ethnicity among pediatric, adult, and older adult patients using standard descriptive statistics (Chi-squared tests for categorical variables and one-way analysis of variance for normally distributed age). Due to large population sizes, all were statistically significant ($p < 0.05$). Risk-adjusted outcomes were analyzed within the same groups using survival (time-to-event) analysis with Cox proportional-hazards models to give hazard ratios (HR) and 95% confidence intervals (95% CI). The use of survival analysis allows for the control of censoring and accounts for the amount of time that patients are "at risk." Group-specific cohorts for each outcome (mortality, major morbidity, unplanned readmission) at each time-point (≤30, 90, 180, and 365 days) were analyzed separately. Kaplan–Meier plots showing Nelson–Aalen cumulative hazard estimates were used to visualize the difference.

Within each survival cohort, risk-adjusted models were used to control for potential confounding. Covariates were taken as baseline fixed effects at the time of patients' index hospital admission. They were used to calculate outcome- and cohort-specific propensity scores that were incorporated in the survival models as inverse probability weights—a technique for risk-adjustment known as the inverse probability of treatment weighting. Patients who died in a hospital or after discharge were included in cohorts for major morbidity and unplanned readmission but were censored at their times of death. Models assessed for time to the first event. They were checked for multicollinearity, appropriateness of proportional hazards, and calibration. They accounted for clustering of patients within hospitals and states and relied on robust standard errors.

Stratified Analyses Assessing Which Factors Alter the Hispanic Paradox Among Adult EGS Patients

To determine whether the results could be explained by differences in state, procedure group, or variations in demographic/hospital factors known to influence racial/ethnic disparities in US surgical care,[22,23] stratified analyses further analyzed differences in adult adverse outcomes (a) within each state; (b) among the 7 most common 3-digit EGS operative procedure groups[20]; and (c) based on differences in primary payer insurance status, median income of patients' residential zip-codes (Q1 vs Q4), quartile of hospital operative EGS volume (Q1 vs Q4), quartile of hospital full-time residents: beds (Q1 vs Q4), and quartile of hospital full-time registered nurses: beds (Q1 vs Q4). Comparisons in the later category, accounted for the magnitude of change, presented as the relative percent change between the most and least privileged sociodemographic groups (e.g., the lowest Q1 vs the highest Q4 income level), and the significance of corresponding effect modification, presented as the p value of the interaction term.

Data were analyzed using Stata Statistical Software: Release 14.2. Two-sided p values <0.05 were considered significant. The Yale Human Investigation Committee deemed the study exempt from full review.

Results

Study Population Characteristics

A total of 2,275,507 adult patients met AAST operative inclusion criteria. One-fifth (20.6%, $n = 469,632$) identified as Hispanic. An additional 63.0% ($n = 1,434,097$) identified as NHW and 16.3% ($n = 371,778$) were NHB (Table 1). Distributions of pediatric ($n = 144,008$) and older adult ($n = 1,633,295$) patients are presented in Supplemental Tables 1 and 2. Relative to Hispanic patients, NHW patients tended to be older (Supplemental Fig. 1), while NHB patients were nearly identical in age distribution. For adults, this resulted in mean ages that ranged from 42.7 year (±13.0 year) for Hispanic patients to 47.7 year (±12.3 year) among NHW patients. In each adult racial/ethnic group, the majority of patients presented with a CCI score ≤1. Hispanic and NHB patients were more likely than NHW patients to come from low-income residential areas, be insured through Medicaid, and live in large metropolitan centers. They were approximately equally likely to present to hospitals with a larger number of full-time residents or registered nurses per bed. While NHB patients were most likely to present to hospitals with a higher operative volume, Hispanic patients were the most likely to present to lower-volume centers. Similar age-dependent (e.g., different average CCI scores) distributions were observed among pediatric and older adult patients.

Mortality

Differences in time to mortality are presented in Figure 1. In pediatric patients tracked for up to 365 days, ≤1.0% of patients died. Among those who died, no significant differences in the likelihood of mortality were found when comparing NHW vs Hispanic patients (HR [95% CI]: 1.02 [0.87–1.19]). NHB patients, in contrast, were significantly more likely than Hispanic patients to die (HR [95% CI]: 1.92 [1.62–2.30]). Among adults, ≤3.0% of EGS patients died. Adult Hispanic patients were significantly less likely than both NHW (NHW vs Hispanic: 1.08 [1.05–1.11]) and NHB (NHB vs Hispanic: 1.55 [1.51–1.60]) patients to die—a trend which was replicated among adult patients with ≥1 of the 7 most common operative EGS procedures. Among older adults, ≤9.0% of EGS patients died. Hispanic patients were again less likely than NHB patients to die (NHB vs Hispanic: 1.26 [1.20–1.32]) but were more likely than NHW patients to die (NHW vs Hispanic: 0.93 [0.92–0.95]).

For adult patients, similar trends were reported at ≤30, 90, 180, and 365 days (Table 2). Each time-point suggested the existence of a

Table 1: Distributions of demographic variables stratified by race/ethnicity among adult operative emergency general surgery patients from 2007 to 2015

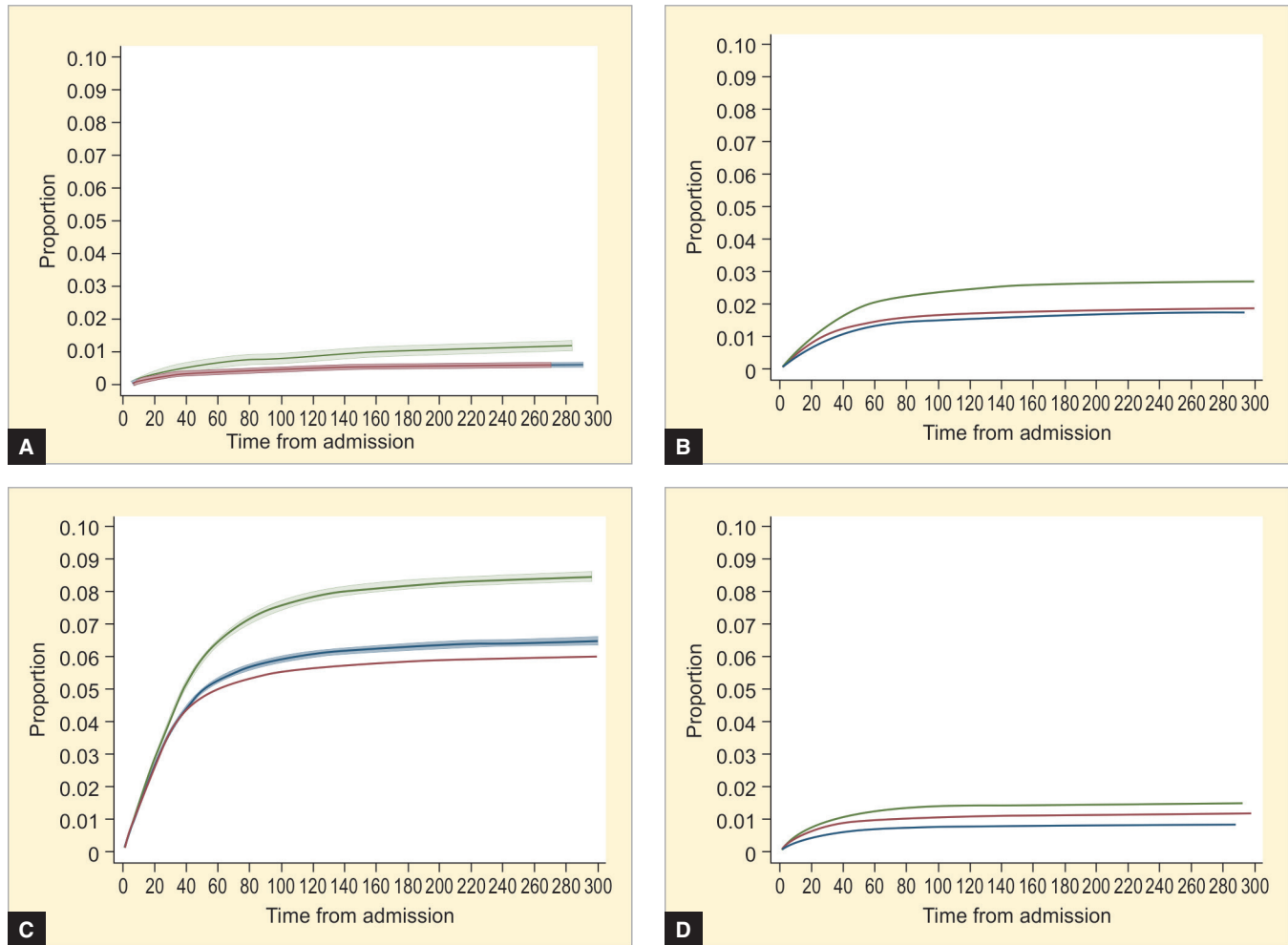|	Adult patients aged 18–64 years					
	Hispanic		Non-hispanic white		Non-hispanic black	
	469,632	20.6%	1,434,097	63.0%	371,778	16.3%
Mean age in years, SD	42.7	13.0	47.7	12.3	45.0	12.5
Gender						
Male	195,930	41.7%	653,805	45.6%	146,852	39.5%
Female	273,702	58.3%	780,292	54.4%	224,926	60.5%
Charlson Comorbidity Index						
0	277,412	59.1%	758,207	52.9%	170,274	45.8%
1	71,713	15.3%	247,812	17.3%	60,637	16.3%
2	46,259	9.9%	178,975	12.5%	48,926	13.2%
≥3	74,202	15.8%	249,103	17.4%	91,978	24.7%
Median income of residential zip-code						
Q1—lowest	172,214	36.7%	300,874	21.0%	187,227	50.4%
Q2	131,826	28.1%	396,528	27.7%	84,542	22.7%
Q3	103,977	22.1%	360,819	25.2%	61,678	16.6%
Q4—highest	61,616	13.1%	376,020	26.2%	38,293	10.3%
Primary payer insurance status						
Medicare	48,466	10.3%	187,580	13.1%	68,593	18.5%
Medicaid	150,705	32.1%	190,591	13.3%	113,244	30.5%
Private	189,074	40.3%	877,237	61.2%	135,996	36.6%
Uninsured (self-pay)	43,535	9.3%	89,057	6.2%	28,515	7.7%
Other	37,852	8.1%	89,631	6.2%	25,430	6.8%
Quartile of hospital operative volume						
Q1—lowest	147,417	31.4%	355,226	24.8%	71,010	19.1%
Q2	136,005	29.0%	340,741	23.8%	107,035	28.8%
Q3	102,896	21.9%	368,993	25.7%	82,274	22.1%
Q4—highest	83,313	17.7%	368,993	25.7%	111,459	30.0%
Residential county rurality						
Large metro area (>1 million)	384,910	82.0%	890,861	62.1%	305,007	82.0%
Small metro area (<1 million)	77,724	16.6%	421,481	29.4%	57,626	15.5%
Suburban or town	5,542	1.2%	83,464	5.8%	5,316	1.4%
Rural	1,456	0.3%	38,290	2.7%	3,866	1.0%
Quartile of residents: beds						
Q1—lowest	147,605	31.4%	535,635	37.4%	100,417	27.0%
Q2	58,187	12.4%	215,545	15.0%	47,327	12.7%
Q3	137,978	29.4%	357,664	24.9%	103,206	27.8%
Q4—highest	125,908	26.8%	325,253	22.7%	120,865	32.5%
Quartile of registered nurses: beds						
Q1—lowest	87,070	18.5%	368,420	25.7%	91,346	24.6%
Q2	117,408	25.0%	349,203	24.4%	97,964	26.4%
Q3	142,017	30.2%	343,323	23.9%	96,514	26.0%
Q4—highest	123,138	26.2%	373,152	26.0%	85,918	23.1%

Due to large population size, all variables were significant based on a two-sided alpha of 0.05 ($p < 0.001$)

Hispanic Paradox among EGS patients of working age. The disparity lessened somewhat over time when compared relative to NHW patients (30 days: 1.17 [1.13–14.21] vs 365 days: 1.08 [1.05–1.11]) but became more pronounced when compared relative to NHB patients (30 days: 1.47 [1.41–1.53] vs 365 days: 1.55 [1.51–1.60]). Mortality differences among states (Fig. 4A) suggested the largest survival benefit for adult Hispanic patients living in Florida and the smallest for adult Hispanic patients in California. The risk of mortality and associated racial/ethnic differences did not change with changes in the calendar year for the patients in New York and Florida between 2007 and 2015 (Supplemental Fig. 2A).

Major Morbidity

Differences in time to major morbidity are presented in Figure 2. Similar to the results for mortality, no significant differences were observed in the likelihood of experiencing major morbidity when comparing NHW vs Hispanic patients aged 0 to 17 years (HR [95% CI]: 0.97 [0.93–1.01]). NHB pediatric patients, in contrast,
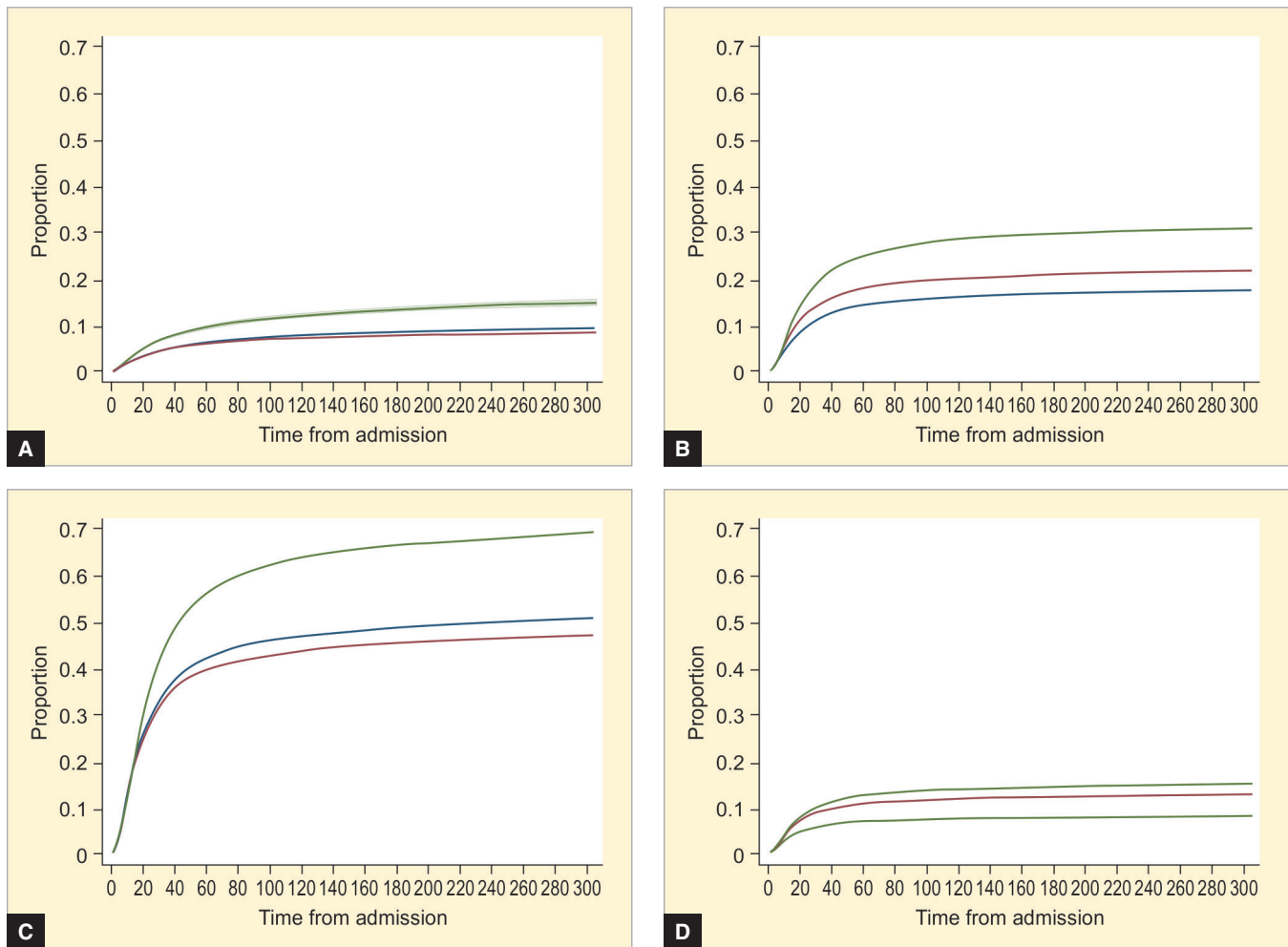
	A. Pediatric, 0–17 years	B. Adults, 18–64 years	C. Older adults, ≥65 years	D. Most common, 18–64 years
	HR (95%CI)	HR (95%CI)	HR (95%CI)	HR (95%CI)
Hispanic	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Non-Hispanic white	1.02 (0.87–1.19)	1.08 (1.05–1.11)	0.93 (0.92–0.95)	1.39 (1.32–1.45)
Non-Hispanic black	1.93 (1.62–2.30)	1.55 (1.51–1.60)	1.26 (1.20–1.32)	1.78 (1.68–1.90)

Figs 1A to D: Mortality differences among racial/ethnic groups in the United States, 2007–2015. (A) Pediatric patients aged 0–17 years. (B) Adult patients aged 18–64 years. (C) Older adult patients aged ≥65 years. (D) Seven most common operations among adults. Kaplan-Meier plots show Nelson-Aalen cumulative hazard estimates stratified by race/ethnicity. Cox-proportional hazards models accounted for clustering of patients within hospitals and states. Models were risk-adjusted using inverse probability of treatment weighting (IPTW) based on calculated propensity scores that accounted for potential confounding associated with operation type, diagnosis, patient demographics (age, year, gender, Charlson Comorbidity Index, income, insurance), and hospital-level factors (operative volume, residential county rurality, hospital teaching status, RNs/bed).

were significantly more likely than Hispanic pediatric patients to experience major morbidity (HR [95% CI]: 1.57 [1.50–1.64]). Differences among adults also mimicked mortality trends with Hispanic patients demonstrating significantly lower risks of developing major morbidity relative to both NHW (HR [95% CI]: 1.25 [1.24–1.26]) and NHB patients (1.74 [1.72–1.76]). Among older adults, Hispanic patients were again less likely than NHB patients to experience major morbidity (HR [95% CI]: 1.31 [1.30–1.32]) but were more likely than NHW patients (0.94 [0.93–0.95]). Trends among adults suggest minimal changes in HRs over time (Table 2) albeit a slight decrease in the magnitude of differences relative to NHW patients and a slight increase relative to NHB patients consistent with those reported for mortality.

Unplanned Readmission

Differences in time to unplanned readmission are presented in Figure 3. Consistent with prior patterns, no significant difference in the risk of unplanned readmission among NHW and Hispanic pediatric patients was found (HR [95% CI]: 0.99 [0.96–1.02]); however, NHB patients were significantly more likely to be readmitted (1.26 [1.22–1.31]). Among adults, Hispanic patients were again the least likely to present with adverse outcomes, HR (95% CI): 1.15 (1.14–1.16) and 1.43 (1.41–1.44)—a trend which persisted among adults with ≥1 of the seven most common operative procedures, HR (95% CI): 1.34 (1.32–1.35) and 1.38 (1.36–1.40). Among older adults, NHB patients remained more likely than Hispanic patients

	A. Pediatric, 0–17 years	B. Adults, 18–64 years	C. Older adults, ≥65 years	D. Most common, 18-64 years
	HR (95%CI)	HR (95%CI)	HR (95%CI)	HR (95%CI)
Hispanic	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Non-Hispanic white	0.97 (0.93–1.01)	1.25 (1.24–1.26)	0.94 (0.93–0.95)	1.55 (1.53–1.58)
Non-Hispanic black	1.57 (1.50–1.64)	1.74 (1.72–1.76)	1.31 (1.30–1.32)	1.81 (1.78–1.85)

Figs 2A to D: Major morbidity differences among racial/ethnic groups in the United States, 2007–2015. (A) Pediatric patients aged 0–17 years. (B) Adult patients aged 18–64 years. (C) Older adult patients aged ≥65 years. (D) Seven most common operations among adults. Kaplan-Meier plots show Nelson-Aalen cumulative hazard estimates stratified by race/ethnicity. Cox-proportional hazards models accounted for clustering of patients within hospitals and states. Models were risk-adjusted using inverse probability of treatment weighting (IPTW) based on calculated propensity scores that accounted for potential confounding associated with operation type, diagnosis, patient demographics (age, year, gender, Charlson Comorbidity Index, income, insurance), and hospital-level factors (operative volume, residential county rurality, hospital teaching status, RNs/bed).

to require unplanned readmission (HR [95% CI]: 1.21 [1.19–1.22]), while NHW patients were less likely than Hispanic patients to be readmitted (0.89 [0.88–0.90]).

Results at shorter time-points reported in Table 2 suggest that while overall HRs remained largely unchanged, the size of the difference between adult NHW and Hispanic patients for unplanned readmission actually increased slightly with time (30 days: 1.11 [1.10–1.12] vs 365 days: 1.15 [1.14–1.16]), while that between NHB and Hispanic patients did not follow an appreciable trend. Differences among states reported in Figure 4A suggest the largest protective effect for Hispanic patients living in Florida and the smallest among Hispanic patients in California. Those among the seven most common operative procedures (Fig. 4B) all tell a similar story with the largest protective effects demonstrated among cases requiring

lysis of peritoneal adhesions and emergent cholecystectomy. Little to no significant differences were found in cases of partial colectomy or small bowel resection. The risk of readmission and associated racial/ethnic differences did not change over calendar time (Supplemental Fig. 2B).

Stratified Analyses Assessing Which Factors Alter the Hispanic Paradox Among Adult EGS Patients

Given the persistence of an apparent Hispanic Paradox among adult patients that lessened at pediatric ages and inverted for NHW and Hispanic patients of older age, stratified analyses compared differences in adverse outcomes for adult NHW vs Hispanic patients to determine the extent to which variations in sociodemographic factors known to affect racial/ethnic disparities among US surgical

Table 2: Differences in risk-adjusted adult outcomes at 30, 90, 180, and 365 days

	Hispanic		Non-Hispanic white			Non-Hispanic black		
	HR	(95% CI)	HR	(95% CI)		HR	(95% CI)	
I. Adult patients aged 18–64 year								
Mortality (days from admission)								
≤30 days	1.00	(Reference)	1.17	1.13	1.21	1.47	1.41	1.53
≤90 days	1.00	(Reference)	1.10	1.07	1.31	1.56	1.51	1.61
≤180 days	1.00	(Reference)	1.08	1.05	1.11	1.56	1.51	1.61
≤365 days	1.00	(Reference)	1.08	1.05	1.11	1.55	1.51	1.60
Major morbidity (days from admission)								
≤30 days	1.00	(Reference)	1.29	1.27	1.30	1.71	1.68	1.73
≤90 days	1.00	(Reference)	1.26	1.25	1.27	1.75	1.74	1.77
≤180 days	1.00	(Reference)	1.25	1.24	1.27	1.75	1.74	1.77
≤365 days	1.00	(Reference)	1.25	1.24	1.26	1.74	1.72	1.76
Unplanned readmission (days from discharge)								
≤30 days	1.00	(Reference)	1.11	1.10	1.12	1.43	1.41	1.45
≤90 days	1.00	(Reference)	1.14	1.13	1.15	1.46	1.45	1.48
≤180 days	1.00	(Reference)	1.15	1.14	1.16	1.45	1.44	1.46
≤365 days	1.00	(Reference)	1.15	1.14	1.16	1.43	1.41	1.44
II. Seven most common operations among adults								
Mortality (days from admission)								
≤30 days	1.00	(Reference)	1.46	1.38	1.55	1.78	1.66	1.91
≤90 days	1.00	(Reference)	1.42	1.35	1.49	1.80	1.70	1.92
≤180 days	1.00	(Reference)	1.39	1.33	1.46	1.79	1.69	1.90
≤365 days	1.00	(Reference)	1.39	1.32	1.45	1.78	1.68	1.90
Major morbidity (days from admission)								
≤30 days	1.00	(Reference)	1.57	1.54	1.60	1.78	1.74	1.82
≤90 days	1.00	(Reference)	1.57	1.54	1.59	1.83	1.80	1.87
≤180 days	1.00	(Reference)	1.56	1.54	1.59	1.83	1.80	1.87
≤365 days	1.00	(Reference)	1.55	1.53	1.58	1.81	1.78	1.85
Unplanned readmission (days from discharge)								
≤30 days	1.00	(Reference)	1.28	1.26	1.30	1.42	1.40	1.45
≤90 days	1.00	(Reference)	1.33	1.32	1.35	1.42	1.40	1.45
≤180 days	1.00	(Reference)	1.34	1.32	1.35	1.41	1.39	1.43
≤365 days	1.00	(Reference)	1.34	1.32	1.35	1.38	1.36	1.40

Cox-proportional hazards models accounted for clustering of patients within hospitals and states
Models were risk-adjusted using inverse probability of treatment weighting (IPTW) based on calculated propensity scores that accounted for potential confounding associated with operation type, diagnosis, patient demographics (age, year, gender, Charlson Comorbidity Index, income, insurance), and hospital-level factors (operative volume, residential county rurality, hospital teaching intensity [full-time residents/bed], RNs/bed)
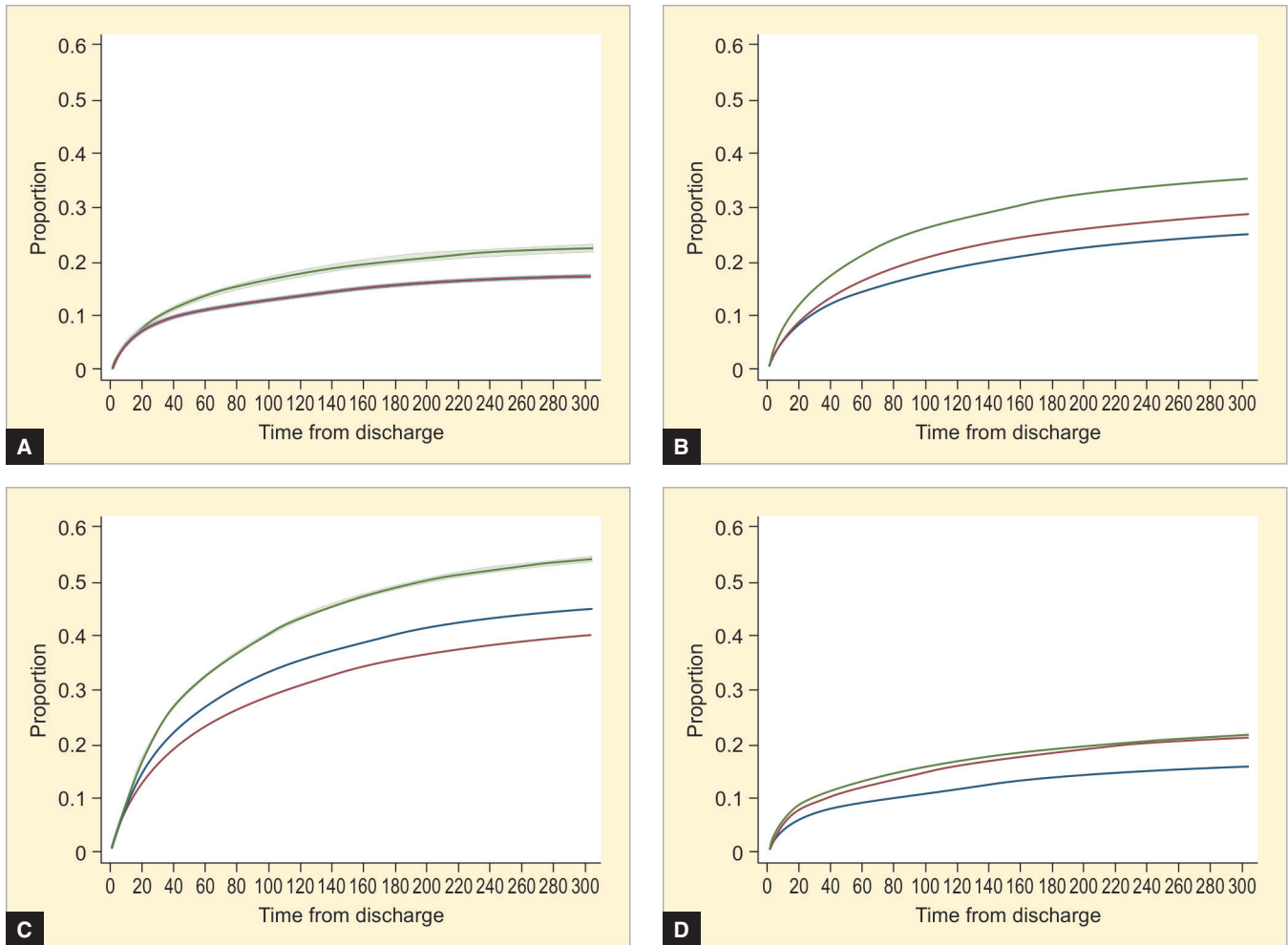
patients[22,23] might explain, or at least alter, the existence of a Hispanic EGS outcome advantage. None of the considered factors listed in Table 3 completely removed the protective effect.

Provision of insurance, whether private or through Medicaid, did reduce the outcome difference, resulting in percent changes relative to uninsured that ranged from −23.8% (major morbidity) to −14.2% (mortality) for private insurance and from −12.9% (major morbidity) to −8.8% (mortality) for Medicaid. Both demonstrated significant effect modification ($p \leq 0.007$ for each). Differences in income extremes likewise had a significant albeit inconsistent effect, increasing the magnitude of difference in mortality by a relative +24.3% and readmission by +7.0% when isolated to the wealthiest quartile of patients. Major morbidity differences, in contrast, decreased by −2.4% ($p < 0.001$ for each). Differences in operative volume had a minimal effect, while those attributable to teaching intensity and nursing staff-ratios both showed larger increases in

the protective effect of the Hispanic Paradox on mortality when the relative number of residents and registered nurses were increased (+24.3% and +9.6%, respectively). The presence of higher numbers of residents and registered nurses reduced the Hispanic Paradox's protective influence on major morbidity (−9.3% and −17.3%, respectively). Differences in readmission attributable to differences in the extreme quartiles of residents beds and registered nurses:beds were minimal.

DISCUSSION

In contrast to expectations and in support of existing literature[14–16] which suggests that some form of the Hispanic Paradox could exist among urgently admitted surgical patients, the results of this study demonstrate that in three large and geographically diverse US states with sizable Hispanic populations, US operative
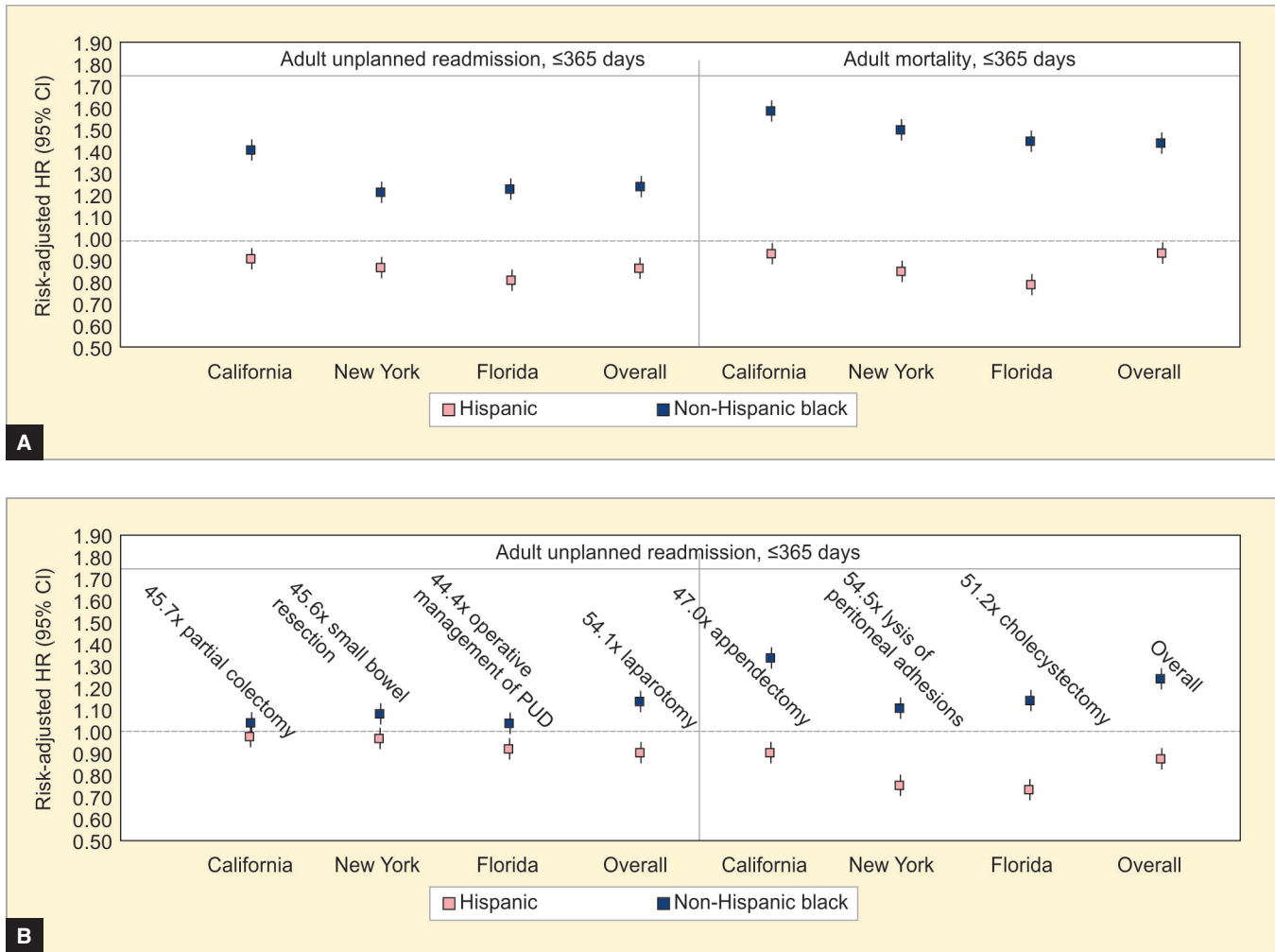
Figs 3A to D: Unplanned readmission differences among racial/ethnic groups in the United States, 2007-2015. (A) Pediatric patients aged 0–17 years. (B) Adult patients aged 18-64 years. (C) Older adult patients aged ≥65 years. (D) Seven most common operations among adults. Kaplan-Meier plots show Nelson-Aalen cumulative hazard estimates stratified by race/ethnicity. Cox-proportional hazards models accounted for clustering of patients within hospitals and states. Models were risk-adjusted using inverse probability of treatment weighting (IPTW) based on calculated propensity scores that accounted for potential confounding associated with operation type, diagnosis, patient demographics (age, year, gender, Charlson Comorbidity Index, income, insurance), and hospital-level factors (operative volume, residential county rurality, hospital teaching status, RNs/bed).

	A. Pediatric, 0–17 years	B. Adults, 18–64 years	C. Older adults, ≥65 years	D. Most common, 18–64 years
	HR (95%CI)	HR (95%CI)	HR (95%CI)	HR (95%CI)
Hispanic	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Non-Hispanic white	0.99 (0.96–1.02)	1.15 (1.14–1.16)	0.89 (0.88–0.90)	1.34 (1.32–1.35)
Non-Hispanic black	1.26 (1.22–1.31)	1.43 (1.41–1.44)	1.21 (1.19–1.22)	1.38 (1.36–1.40)

EGS patients with some form of Hispanic ancestry did have similar or better outcomes than those of NHW patients and markedly better outcomes than those of NHB patients. Risk-adjustment and stratification for potential confounders did little to alter the persistence of the effect. The apparent Hispanic Paradox was, however, most pronounced among adult patients aged 18 to 64 year. Within this age group, Hispanic EGS patients demonstrated consistently lower rates of mortality, major morbidity, and unplanned readmission relative to both NHW and NHB patients at ≤30, 90, 180, and 365 days. Differences in outcomes between NHW and Hispanic pediatric patients were equivalent, while those among older adults inverted, pointing toward worse outcomes among Hispanic patients and HR (NHW vs Hispanic) that ranged from 0.89 for unplanned readmission to 0.94 for major morbidity.

NHB patients fared significantly worse than Hispanic EGS patients in all three age groups.

Such findings are in keeping with those previously reported in a pair of studies assessing racial/ethnic disparities in longer-term outcomes among EGS patients analyzed from the perspective of NHW patient health.[15,16] In the first of the two studies, Zogg and colleagues[16] demonstrated a similar waning of racial/ethnic differences among universally insured older adult Medicare patients that is likely to be at least partially attributable to increased access to insurance as US patients age. In a similar study conducted among universally insured US military patients and their civilian families aged 18 to 64 years, little to no racial/ethnic differences in longer-term EGS outcomes were found.[24] The results of this study agree, suggesting that access to insurance whether private or governmentally sponsored through

Figs 4A and B: (A) Risk-adjusted adult outcomes stratified by state. (B) Risk-adjusted adult outcomes stratified by operative group (seven most common operations)

Medicaid reduced protective outcomes for Hispanic patients by as much as −23.8%, bringing both Hispanic and NHW adult patients to lower adverse outcome levels. The challenge when dealing with differential Hispanic outcomes, however, is that many Hispanic patients in the US are not eligible for government insurance through Medicare or Medicaid—a tendency which is invariably more pronounced among foreign-born Hispanic patients who are thought to underlie the existence of the Hispanic Paradox.[2,3] In the second of the two studies looking at differential outcomes among all-comer adult and older adult EGS patients in California, Zogg and colleagues[15] demonstrated this assertion to be likely true, showing a waning of racial/ethnic differences as patients aged that remained most pronounced among the approximately 10% of older adults in California not insured through Medicare or other alternative private options. Waning of the Hispanic Paradox among patients with insurance can presumably be attributed to a combination of overall better outcomes for patients with insurance, including NHW and NHB patients within the comparator groups, and the reality that due to insurance eligibility requirements, many insured Hispanic patients are likely to be US citizens or permanent residents with more comparable health and theoretically less need to immigrate/emigrate for health reasons given their insured (and legally secure) status. Isolation of the biggest disparities in the present study to patients of higher-incomes for mortality and readmission as well as those who

are uninsured speaks to the potential for younger patients with greater mobility and means to be the most likely to undergo selective migration when faced with issues requiring urgent medical need.

The existence of an apparent Hispanic Paradox among operative EGS patients is perplexing. While little to no differences were found among trauma patients,[14] better outcomes among adult Hispanic EGS patients were readily apparent—consistent with age-based trends reported for chronic conditions and elective operations. Such a finding suggests that in contrast to expectations and the urgency of unanticipated sudden traumatic injuries that near universally require a receipt of immediate care, presentation for operative EGS might involve more of a "choice." Whether based on individual decisions to delay care-seeking or sociodemographic and societal barriers that prohibit ready access, such a "choice" is likely to be reflective of patients' ability to utilize prior routine and preventative medical care that would enable otherwise emergent conditions to be managed medically or treated as elective operations (both of which were excluded from the current study cohort). It is possible that in addition to selective migration, presumably taking place among Hispanic patients when an initial "less urgent" diagnosis occurs, more privileged NHW and NHB patients with more ready access to care are also being removed from the cohort, leaving only the most at-risk patients to present for emergent operative EGS care.

Table 3: Stratified differences in risk-adjusted adult outcomes at 365 days

	I. Mortality					II. Major morbidity					III. Unplanned readmission				
	HR	95% CI		Percent change	p value	HR	95% CI		Percent change	p value	HR	95% CI		Percent change	p value
Primary payer insurance status															
Uninsured (self-pay)	1.48	1.32	1.67			1.74	1.68	1.80			1.53	1.48	1.58		
Private insurance	1.27	1.21	1.34	−14.2%	<0.001	1.33	1.31	1.35	−23.8%	<0.001	1.24	1.22	1.26	−19.0%	<0.001
Medicaid	1.35	1.29	1.41	−8.8%	0.007	1.52	1.50	1.54	−12.9%	<0.001	1.35	1.33	1.37	−11.8%	<0.001
Median income of residential zip-code															
Q1—lowest	1.02	0.98	1.07			1.32	1.30	1.34			1.15	1.14	1.16		
Q4—highest	1.27	1.17	1.37	24.3%	<0.001	1.29	1.25	1.32	−2.4%	<0.001	1.23	1.42	1.51	7.0%	<0.001
Quartile of hospital operative volume															
Q1—lowest	1.06	1.01	1.12			1.21	1.19	1.23			1.11	1.09	1.13		
Q4—highest	1.11	1.05	1.18	–	0.284	1.17	1.15	1.19	−3.8%	<0.001	1.10	1.08	1.11	–	0.215
Quartile of residents: beds															
Q1—lowest	1.03	0.98	1.08			1.24	1.23	1.26			1.15	1.13	1.16		
Q4—highest	1.28	1.22	1.35	24.3%	<0.001	1.13	1.11	1.15	−9.3%	<0.001	1.18	1.10	1.13	2.5%	0.007
Quartile of registered nurses: beds															
Q1—lowest	1.04	1.00	1.09			1.32	1.29	1.34			1.13	1.11	1.15		
Q4—highest	1.14	1.09	1.20	9.6%	0.002	1.09	1.07	1.11	−17.3%	<0.001	1.10	1.09	1.12	−2.7%	0.033

Cox-proportional hazards models accounted for clustering of patients within hospitals and states
Models (except where otherwise noted due to stratification and restriction) were risk-adjusted using inverse probability of treatment weighting (IPTW) based on calculated propensity scores that accounted for potential confounding associated with operation type, diagnosis, patient demographics (age, year, gender, Charlson Comorbidity Index, income, insurance), and hospital-level factors (operative volume, residential county rurality, hospital teaching intensity [full-time residents/bed], RNs/bed)

Differences in language and cultural barriers more prominent among older Hispanic patients could also be having an effect as could the reality of decreased mobility as patients' age. Similar age-based inversions, albeit in the opposite direction, have been reported for racial/ethnic minority trauma patients of older adult vs adult age.[25] The authors of the trauma study suggested that their findings could be the result of strong social support among racial/ethnic minority communities, acquiring Medicare, or a healthy-cohort effect (an epidemiologic phenomenon in which only the healthiest patients are expected to survive to older age).[25] Ethnic diversity within US Hispanic communities could also play a role, as evidenced by the larger change in EGS outcomes within Florida vs California where the Hispanic demographic is known to be more ethnically mixed. Prior studies of the Hispanic Paradox have primarily focused on migration among patients of Mexican origin.[15,16] The fact that the trend among EGS patients was more pronounced in states with a relatively small Mexican American population points to the need for further research and increased recognition of the reality that not all Hispanic patients are the same. Future studies are needed to explore inherent differences between diverse Hispanic ethnic groups and among patients with varying lengths of residency within the US.

The study is not without limitations. Most reflect its reliance on administrative data and a related lack of nuanced clinical detail, the potential for absent/misreporting of events, and the inability to detect deaths or complications that occur outside of an inpatient setting. The use of SID allowed for longitudinal follow-up of a large population of EGS patients inclusive of pediatric patients and adults. Few databases enable such assessment; however, in relying on state-level data, the findings may not be nationally representative and the individual state data might not be the same. This concern is somewhat offset given the large racial/ethnic diversity and size of California, New York, Florida, representing 24.7% of the US population. There is no agreed upon manner to account for disease severity among EGS patients in large databases. Information on the presence of specific Hispanic ethnicities (e.g., Cuban, Puerto Rican, Mexican, Dominican, etc.) and migrant status is not available. Researchers are encouraged to address these issues using detailed regional data to assess the extent to which variations in ethnic composition and longevity of US residency influence the differences in outcomes observed.

In conclusion, the results of this study show that in contrast to expectations for urgently admitted patients, outcomes similar to or better than outcomes of US NHW patients were found among US Hispanic patients for EGS. The findings provide evidence that the "Hispanic Paradox" exists under emergent conditions and that its effects appear to decrease with age. Further research is needed within subsets of the US Hispanic population in order to more closely study what causes this phenomenon to persist. Where differences are found, attention is warranted to appropriately allocate resources and funds toward the development of public health policy, surgical management guidelines, and social/educational prevention programs designed to understand the unique health needs of EGS patients and ensure that optimal outcomes of all patients exist.

Author Contributions

CKZ, JPH, TU, and AHH made substantial contributions to the conception or design of the work. CKZ participated in the acquisition and analysis of the data. CKZ, JPH, TU, NB, SS, CO, KAD, and AHH contributed toward the interpretation of data for the work. CKZ and NB drafted the manuscript, and JPH, TU, SS, CO, KAD, and AHH critically revised the manuscript for intellectual content.

All authors provided the final approval of the version to be published and agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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INVITED EDITORIAL

The "Hispanic paradox" exists in emergency conditions: better or equivalent surgical outcomes among US Hispanics emergency general surgery patients by Zogg et al.

In this issue of the Panamerican Journal of Trauma, Critical Care and Emergency Surgery, Dr Zogg and colleagues from the Yale School of Medicine, Harvard Brigham and Women's, Baylor Scott & White Health (Dallas) and the Universidad Del Valle (Cali, Colombia) present a valuable study on the "Hispanic Paradox" phenomenon and explore whether it exists in urgently admitted general surgery patients.

The "Hispanic Paradox" refers to an intriguing observation that Hispanics (or Latinos) residing in the United States (USA), have comparable or better health outcomes than non-Hispanic blacks and non-Hispanic whites, despite their lower socio-economical and education status compared to the latter. Across the world, lower socio-economic status is associate with worse health outcomes, but not for the Latinos living in the USA.

Earlier studies reported the "Hispanic Paradox" on chronic conditions and elective operations, which supported the hypothesis that selective immigration/emigration of Hispanics during illness (leaving the USA due to the inability to pay for medical care), could explain the phenomenon. Dr Zogg et al. study challenges this hypothesis, since the authors studied whether the phenomenon exists in emergent surgical situations, when the possibility of leaving the country is mostly non-existent.

The study used data from three USA states with large population of Hispanics (California, New York, and Florida), including over 2.2 million patients. Injured patients were excluded, the analysis was by the age group (pediatric, adult, and older adults) and longitudinal follow up was done for 365 days. Mortality, major morbidity, and unplanned readmission were the primary outcomes. Finally, a stratified analysis of sociodemographic factors explored the potential determining factors that alter the Hispanic paradox among emergent surgical patients.

The study findings support earlier evidence on the existence of the "Hispanic Paradox", this time in urgently admitted surgical patients and the Hispanic lower socioeconomic status—Hispanics were more likely to live in poor residential areas. However, Hispanics had similar or better outcomes than non-Hispanic whites and markedly better outcomes than non-Hispanic blacks. This effect was most pronounced in adult patients with consistently lower mortality, major morbidity, and unplanned readmissions. Similar findings were observed in pediatric patients while older Hispanics tended towards worse outcomes than non-Hispanic whites.

Access to insurance (both private and governmental) had a major effect on health outcome. Having insurance leveled the differences bringing all ages of Hispanics to a similar level as non-Hispanic whites, particularly among the elderly. Initial extrapolation of this effect of insurance on health outcomes could indicate younger Hispanic patients (with greater mobility), leave the USA when they get sick in search of lower cost care (selective migration) leaving only those most at risk to present for hospital admission. This conclusion is challenged by Dr Zogg et al. study that reported the phenomenon in patients admitted for emergent surgical cases, where time/opportunity to leave the USA is markedly reduced compared to elective surgeries. Consequently, "selective migration" cannot alone explain the phenomenon. Thus, this well-done study indicates that the "Hispanic phenomenon" is real and access to insurance could be an equalizing factor and reduce disparities in health outcome between higher and lower income patients.

The present study does advance understanding of the "Hispanic Paradox," which unfortunately continues to lack full understanding. Appropriately the authors indicate that "not all Hispanics" are the same and significant differences exist between groups and were not addressed in the current analysis. Furthermore, the findings of the study carry important implications in "allocating resources, developing public health policies, creating guidelines and prevention programs not only to the Hispanic population in the USA, but to all patients." It is an excellent work and worthwhile reading the full manuscript.

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EDITORIAL INVITADA

La "paradoja hispánica" existe en situaciones de emergencia: resultados quirúrgicos mejores o equivalentes entre los pacientes hispanos de cirugía general de emergencia de los hispanos de EE. UU. Por Zogg et al.

En este número de la Revista Panamericana de Trauma, Cuidados Críticos y Cirugía de Emergencia, el Dr. Zogg y sus colegas de la Escuela de Medicina de Yale, Harvard Brigham and Women's, Baylor Scott & White Health (Dallas) y la Universidad del Valle (Cali, Colombia) presentan un valioso estudio sobre el fenómeno de la "paradoja hispánica" y exploran si existe en pacientes de cirugía general de urgencia.

La "paradoja hispánica" se refiere a una observación intrigante de que los hispanos (o latinos) que residen en los Estados Unidos (EE. UU.) tienen resultados de salud comparables o mejores que los negros no hispanos y los blancos no hispanos, a pesar de su menor nivel socioeconómico y educativo en comparación con este último. En todo el mundo, un estatus socioeconómico más bajo está asociado con peores resultados de salud, pero no para los latinos que viven en los Estados Unidos.

Trabajos anteriores estudiados la "paradoja hispánica" en condiciones crónicas y operaciones electivas, que apoyaban la hipótesis de que la inmigración/emigración selectiva de hispanos durante la enfermedad (salir de los EE. UU. Debido a la incapacidad para pagar la atención médica) podría explicar el fenómeno. El estudio del Dr. Zogg et al desafía esta hipótesis, ya que los autores estudiaron si el fenómeno existe en situaciones quirúrgicas emergentes, cuando la posibilidad de abandonar el país es casi inexistente.

El estudio utilizó datos de tres estados de EE. UU. con una gran población de hispanos (California, Nueva York y Florida), incluidos más de 2.2 millones de pacientes. Se excluyeron los pacientes lesionados, y el análisis se realizó por grupos de edad (pediátricos, adultos y adultos mayores) y el seguimiento longitudinal se realizó durante 365 días. La mortalidad, la morbilidad mayor y la readmisión no planificada fueron los resultados primarios. Finalmente, un análisis estratificado de los factores sociodemográficos exploró los posibles factores determinantes que alteran la paradoja hispana entre los pacientes quirúrgicos emergentes.

Os hallazgos del estudio respaldan evidencia anterior sobre la existencia de la "paradoja hispánica", esta vez en pacientes quirúrgicos ingresados con urgencia y en el estado socioeconómico hispano más bajo: los hispanos tenían más probabilidades de vivir en áreas residenciales pobres. Sin embargo, los hispanos tuvieron resultados similares o mejores que los blancos no hispanos y resultados notablemente mejores que los negros no hispanos. Este efecto fue más pronunciado en pacientes adultos con una mortalidad, morbilidad mayor y reingresos no planificados consistentemente más bajos. Se observaron hallazgos similares en pacientes pediátricos, mientras que los hispanos de mayor edad tendían a obtener peores resultados que los blancos no hispanos.

El acceso a los seguros (tanto privados como gubernamentales) tuvo un efecto importante en los resultados de salud. Tener un seguro niveló las diferencias llevó a todas las edades de los hispanos a un nivel similar al de los blancos no hispanos, particularmente entre los ancianos. La extrapolación inicial de este efecto del seguro en los resultados de salud podría indicar que los pacientes hispanos más jóvenes (con mayor movilidad) abandonan los EE. UU. Cuando se enferman en busca de atención de menor costo (migración selectiva), dejando solo a los más expuestos al ingreso hospitalario. Esta conclusión es cuestionada por el estudio del Dr. Zogg y colaboradores que informó el fenómeno en pacientes ingresados para casos quirúrgicos emergentes, donde el tiempo y la oportunidad para abandonar los EE. UU. Se reducen notablemente en comparación con las cirugías electivas. En consecuencia, la "migración selective" no puede explicar por sí sola el fenómeno. Por lo tanto, este estudio bien hecho indica que el "fenómeno hispano" es real y que el acceso a los seguros podría ser un factor de igualación y reducir las disparidades en los resultados de salud entre los pacientes de ingresos más altos y más bajos.

El presente estudio hace avanzar la comprensión de la "paradoja hispánica", que desafortunadamente sigue sin tener una comprensión completa. Apropiadamente, los autores indican que "no todos los hispanos" son iguales y que existen diferencias significativas entre los grupos y no se abordaron en el análisis actual. Además, los hallazgos del estudio tienen importantes implicaciones en "asignar recursos, desarrollar políticas de salud pública, crear pautas y programas de prevención no solo para la población hispana en los Estados Unidos, sino para todos los pacientes". Es un excelente trabajo y vale la pena leer el manuscrito completo.

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Supplemental Table 1: Distributions of demographic variables stratified by race/ethnicity among pediatric operative emergency general surgery patients, 2007 to 2015
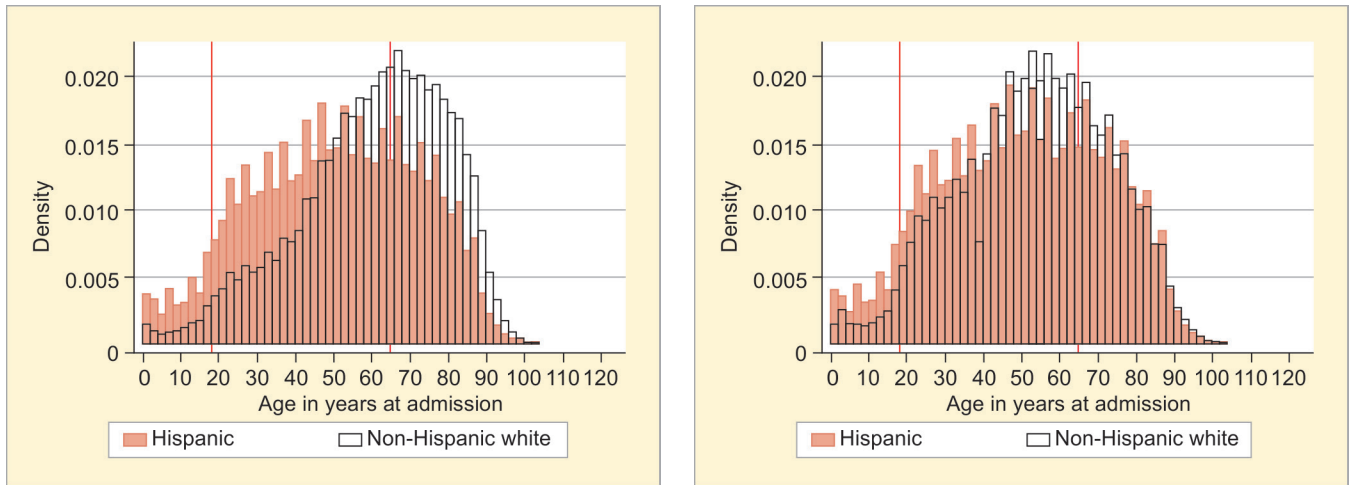
	Pediatric patiients aged ≤17 year					
	Hispanic		Non-Hispanic white		Non-Hispanic black	
	52,214	36.3%	69,581	48.3%	22,213	15.4%
Mean age in years, SD	9.6	5.5	10.2	5.7	8.5	6.2
Gender						
Male	29,558	56.6%	39,362	56.6%	12,739	57.4%
Female	22,656	43.4%	30,219	43.4%	9,474	42.7%
Charlson Comorbidity Index						
0	44,183	84.6%	58,573	84.2%	17,331	78.0%
1	5,947	11.4%	7,598	10.9%	3,774	17.0%
2	1,269	2.4%	1,893	2.7%	649	2.9%
≥3	815	1.6%	1,517	2.2%	460	2.1%
Median income of residential zip-code						
Q1—lowest	21,392	41.0%	13,186	19.0%	11,382	51.2%
Q2	14,714	28.2%	18,077	26.0%	4,785	21.5%
Q3	10,182	19.5%	16,727	24.0%	3,721	16.8%
Q4—highest	5,921	11.3%	21,591	31.0%	2,326	10.5%
Primary payer insurance status						
Medicare	–	–	–	–	–	–
Medicaid	33,762	64.7%	21,939	31.5%	14,463	65.1%
Private	13,335	25.5%	42,528	61.1%	5,771	26.0%
Uninsured (self-pay)	1,676	3.2%	1,886	2.7%	853	3.8%
Other	3,441	6.6%	3,229	4.6%	1,126	5.1%
Quartile of hospital operative volume						
Q1—lowest	21,538	41.3%	18,355	26.4%	4,407	19.8%
Q2	11,994	23.0%	12,872	18.5%	6,069	27.3%
Q3	7,388	14.2%	12,170	17.5%	2,941	13.2%
Q4—highest	11,294	21.6%	26,176	37.6%	8,796	39.6%
Residential county rurality						
Large metro area (>1 million)	41,839	80.1%	42,347	60.9%	17,941	80.8%
Small metro area (<1 million)	9,571	18.3%	20,018	28.8%	3,694	16.6%
Suburban or town	632	1.2%	4,885	7.0%	358	1.6%
Rural	1,723	3.3%	2,331	3.4%	222	1.0%
Quartile of residents: beds						
Q1—lowest	14,453	27.7%	18,293	26.3%	4,414	19.9%
Q2	3,383	6.5%	7,459	10.7%	1,853	8.3%
Q3	11,424	21.9%	14,737	21.2%	5,127	23.1%
Q4—highest	22,953	44.0%	29,085	41.8%	10,818	48.7%
Quartile of registered nurses: beds						
Q1—lowest	6,422	12.3%	10,361	14.9%	2,632	11.9%
Q2	7,858	15.1%	12,177	17.5%	4,372	19.7%
Q3	17,246	33.0%	19,796	28.5%	7,326	33.0%
Q4—highest	20,687	39.6%	27,248	39.2%	7,883	35.5%

Due to large population size, all variables were significant based on a two-sided alpha of 0.05 ($p < 0.001$).
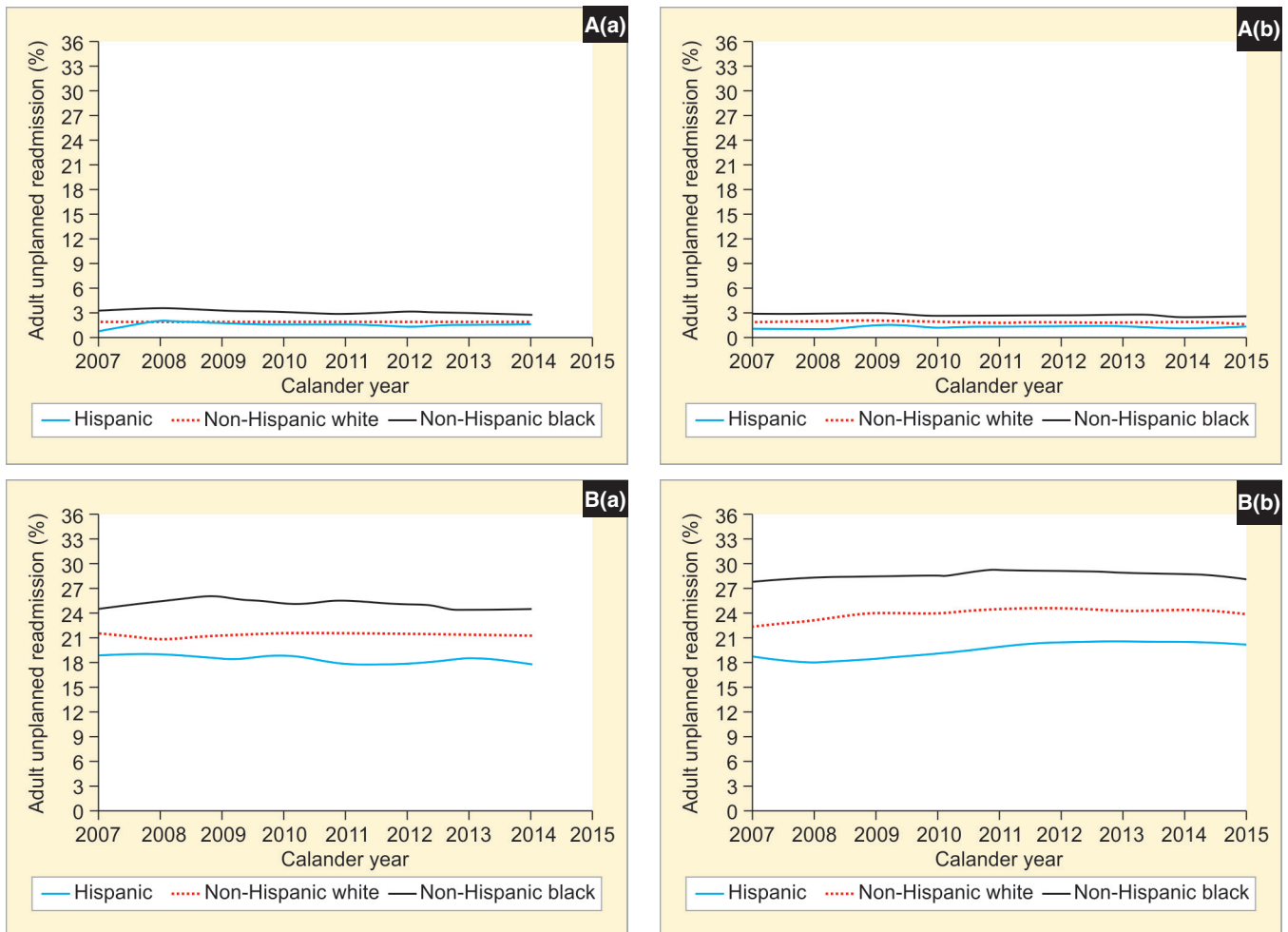
Supplemental Table 2: Distributions of demographic variables stratified by race/ethnicity among older adult operative emergency general surgery patients from 2007 to 2015

| | Older adult patients aged >65 year | | | | | |
| | Hispanic | | Non-Hispanic white | | Non-Hispanic black | |
	211,301	12.9%	1,254,047	76.8%	167,947	10.3%
Mean age in years, SD	75.5	7.3	76.3	7.6	75.2	7.4
Gender						
Male	101,065	47.8%	628,403	50.1%	71,092	42.3%
Female	110,236	52.2%	625,644	49.9%	96,855	57.7%
Charlson Comorbidity Index						
0	42,302	20.0%	285,045	22.7%	22,740	13.5%
1	41,774	19.8%	254,195	20.3%	28,753	17.1%
2	41,288	19.5%	261,093	20.8%	32,934	19.6%
>3	85,957	40.7%	453,714	36.2%	83,503	49.7%
Median income of residential zip-code						
Q1—lowest	81,414	38.5%	264,729	21.1%	85,216	50.7%
Q2	56,586	26.8%	351,509	28.0%	35,790	21.3%
Q3	48,367	22.9%	314,766	25.1%	28,887	17.2%
Q4—highest	24,912	11.8%	323,168	25.8%	18,038	10.7%
Primary payer insurance status						
Medicare	182,353	86.3%	1,142,562	91.1%	148,902	88.7%
Medicaid	14,136	6.7%	7,524	0.6%	6,164	3.7%
Private	12,509	5.9%	91,545	7.3%	10,446	6.2%
Uninsured (self-pay)	909	0.4%	3,010	0.2%	907	0.5%
Other	1,395	0.7%	9,405	0.8%	1,528	0.9%
Quartile of hospital operative volume						
Q1—lowest	66,919	31.7%	294,701	23.5%	36,932	22.0%
Q2	49,909	23.6%	309,875	24.7%	48,637	29.0%
Q3	54,727	25.9%	343,358	27.4%	35,370	21.1%
Q4—highest	39,746	18.8%	306,113	24.4%	47,008	28.0%
Residential county rurality						
Large metro area (>1 million)	181,148	85.7%	786,413	62.7%	141,294	84.1%
Small metro area (<1 million)	26,877	12.7%	369,693	29.5%	22,589	13.5%
Suburban or town	2,641	1.3%	68,973	5.5%	2,334	1.4%
Rural	634	0.3%	28,968	2.3%	1,713	1.0%
Quartile of residents: beds						
Q1—lowest	71,673	33.9%	493,844	39.4%	45,396	27.0%
Q2	33,829	16.0%	208,423	16.6%	22,236	13.2%
Q3	60,432	28.6%	303,605	24.2%	46,857	27.9%
Q4—highest	45,387	21.5%	248,050	19.8%	53,458	31.8%
Quartile of registered nurses: beds						
Q1—lowest	48,578	23.0%	351,133	28.0%	47,025	28.0%
Q2	55,065	26.1%	336,085	26.8%	43,364	25.8%
Q3	59,439	28.1%	286,801	22.9%	43,146	25.7%
Q4—highest	48,198	22.8%	280,029	22.3%	34,429	20.5%

Due to large population size, all variables were significant based on a two-sided alpha of 0.05 ($p < 0.001$).

Supplemental Fig. 1: Age distributions of EGS patients by race/ethnicity

Supplemental Figs 2A to B: (A) Lack of changes over time in (a) <365 day adult morality and (b) <365 day adult unplanned readmission. (B) Lack of changes over time in (a) <365 day adult morality and (b) <365 day adult unplanned readmission