Published in final edited form as:

Ann Surg. 2018 December ; 268(6): 968–979. doi:10.1097/SLA.0000000000002449.

Racial/Ethnic Disparities in Longer-term Outcomes Among Emergency General Surgery Patients:

The Unique Experience of Universally Insured Older Adults

Cheryl K. Zogg, MSPH, MHS^{*,†}, Wei Jiang, MS[†], Taylor D. Ottesen, BS^{*}, Shahid Shafi, MD, MPH, FACS[‡], Kevin Schuster, MD, MPH, FACS, FCCM^{*,§}, Robert Becher, MD, MS^{*,§}, Kimberly A. Davis, MD, MBA, FACS, FCCM^{*,§}, and Adil H. Haider, MD, MPH, FACS[†]

^{*}Yale School of Medicine, New Haven, CT

[†]Center for Surgery and Public Health: Department of Surgery, Brigham & Women's Hospital, Harvard Medical School, Harvard TH Chan School of Public Health, Boston, MA

[‡]Department of Surgery, Baylor Scott & White Health, Dallas, TX

[§]Department of Surgery, Yale School of Medicine, New Haven, CT

Abstract

Objectives—To determine whether racial/ethnic disparities in 30/90/180-day mortality, major morbidity, and unplanned readmissions exist among universally insured older adult (≥ 65 years) emergency general surgery patients; vary by diagnostic category; and can be explained by variations in geography, teaching status, age-cohort, and a hospital's percentage of minority patients.

Summary of Background Data—As the US population ages and discussions surrounding the optimal method of insurance provision increasingly enter into national debate, longer-term outcomes are of paramount concern. It remains unclear the extent to which insurance changes disparities throughout patients' postacute recovery period among older adults.

Methods—Survival analysis of 2008 to 2014 Medicare data using risk-adjusted Cox proportional-hazards models.

Results—A total of 6,779,649 older adults were included, of whom 82.8% identified as non-Hispanic white (NHW), 9.2% non-Hispanic black (NHB), 5.6% Hispanic, and 1.5% non-Hispanic

Reprints: Cheryl K. Zogg, MSPH, MHS, Yale School of Medicine, 367 Cedar Street, Room 316 ESH, New Haven, CT 06510. czogg@jhmi.edu.

A portion of this work was previously presented as an oral (podium) presentation at the 11th Annual Academic Surgical Congress, February 2 to 4, 2016, in Jacksonville, FL.

CKZ, WJ, and AHH made substantial contributions to the conception or design of the work. CKZ and WJ participated in the acquisition and analysis of the data. CKZ, WJ, TDO, SS, KS, RB, KAD, and AHH contributed toward the interpretation of data for the work. CKZ and TDO drafted the manuscript, and WJ, SS, KS, RB, KAD, and AHH critically revised the manuscript for intellectual content. All authors provided 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.

The authors declare that we have no sources of funding or conflicts of interest relevant to the analysis to report.

Supplemental digital content is available for this article. Direct URL citations appear in the printed text and are provided in the HTML and PDF versions of this article on the journal's Web site (www.annalsofsurgery.com).

Asian (NHA). Relative to NHW patients, each group of minority patients was significantly less likely to die [30-day NHB vs NHW hazard ratio (95% confidence interval): 0.88 (0.86–0.89)]. Differences became less apparent as outcomes approached 180 days [180-day NHB vs NHW: 1.00 (0.98–1.02)]. For major morbidity and unplanned readmission, differences among NHW, Hispanic, and NHA patients were comparable. NHB patients did consistently worse. Efforts to explain the occurrence found similar trends across diagnostic categories, but significant differences in disparities attributable to geography and the other included factors that combined accounted for up to 50% of readmission differences between racial/ethnic groups.

Conclusion—The study found an inversion of racial/ethnic mortality differences and mitigation of non-NHB morbidity/readmission differences among universally insured older adults that decreased with time. Persistent disparities among nonagenarian patients and hospitals managing a regionally large share of minority patients warrant particular concern.

Keywords

disparity; emergency general surgery; insurance; Medicare; older adult; race/ethnicity; regionalization

Awareness of racial and ethnic disparities in medical care rose to increased national prominence in 2003 with the publication of the Institute of Medicine's report *Unequal Treatment*.¹ Since that time, the presence of "differential access, care, and outcomes due to factors such as race/ethnicity"^{1,2} has been widely described. Emergent cases requiring high-acuity care are thought to be at uniquely heightened risk. Despite efforts to standardize the care that patients receive, racially divergent social and access-related factors are known to influence when, where, and how emergency patients present for care.^{3–7}

For many emergency general surgery (EGS) patients—a group defined to represent both operative and nonoperative high-acuity, nontrauma patients who present to the Emergency Department (ED)⁸—prolonged postacute recovery periods often extend well beyond patients' index hospital visit.^{9–11} It is a critical period that remains largely unstudied in disparities research. Recent calls from the National Institutes of Health and American College of Surgeons echo the issue, citing an urgent need for disparities work that encompasses longer-term outcomes of care.^{2,12}

Prior assessment of longer-term outcomes among EGS patients—including mortality, major morbidity, and unplanned readmission—demonstrated the existence of racial/ethnic disparities at 30, 90, and 180 days among adults aged 18 to 64 years in California.¹³ The study found that much of the difference could be explained by underlying variations in insurance, a hospital's percentage of racial/ethnic minority patients, and hospital teaching status.¹³ When complete access to insurance was taken into account—as seen within a second national study of active military and civilian-dependent EGS patients insured through TRICARE—mortality and readmission differences were not found.¹⁴ For older adults in California aged ≥ 65 years, including those with and without Medicare, racial/ethnic differences were present but less pronounced.¹³ It remains unknown how longer-term outcomes among older adults with universal access to insurance compare on a national scale, whether trends differ with geographic variation, and whether underlying factors beyond

insurance differ in older versus younger adults. To that end, the objectives of this study were to determine whether

1. Racial/Ethnic disparities in 30-, 90-, and 180-day outcomes exist among a national longitudinally followed cohort of older adult EGS patients insured by Medicare;
2. Results vary among subgroups of EGS diagnostic categories⁸;
3. Possible explanations for differential outcomes are related to a survivorship tendency among EGS patients that increases with age,¹⁵ a hospital's percentage of older adult racial/ethnic minority patients,¹³ and hospital teaching status¹³;
4. State-level geographic variation exists.

METHODS

Data Source and Study Population

One hundred percent Medicare all-payer claims data collected by the Centers for Medicare & Medicaid Services (CMS) from 2008 to 2014 were queried for older adult ED encounters that resulted in subsequent inpatient admission. Included patients were required to present with a primary International Classification of Diseases, 9th edition, Clinical Modification (ICD-9-CM) diagnosis on inpatient admission consistent with an EGS condition, as defined by the American Association for the Surgery of Trauma.⁸ Medicare data provide longitudinal follow-up of patient encounters from all Medicare-insured patients, representing >90% of hospital encounters in the US among patients of this age. In order to attain hospital-level information, included encounters were matched to managing hospital data contained within the American Hospital Association Annual Survey Database.¹⁶

Patients discharged as transfers; with a second EGS admission within 180 days of index presentation; admitted/discharged after July 1, 2014, in order to ensure a minimum follow-up of 180 days; aged < 65 years on index admission; missing consistent HMO or Medicare Part A and B enrollment data; missing information for covariates of interest; or with errors in ICD-9-CM coding were excluded (Fig. 1). Patients who died before 180 days were included for the amount of time that they survived. Subsequent EGS admissions for the same person were taken as second index admissions only after 180 days and if the second primary diagnosis was different than the first. Missingness was addressed using complete-cohort analysis except where otherwise specified with missing indicator variables.

Variable Definitions: Race/Ethnicity, Covariates, and Outcomes

Information on patient- and hospital-level factors included Social Security Administration (SSA) self-reported race/ethnicity [categorized as non-Hispanic white (NHW), non-Hispanic black (NHB), Hispanic, non-Hispanic Asian (NHA), non-Hispanic other (NHO)], Research Triangle Institute (RTI)-imputed race/ethnicity (a variable reported by MEDPAR that was designed to correct for documented errors in SSA race/ethnicity reporting),^{17,18} age (65 to 69, 70 to 74, 75 to 79, 80 to 84, 85 to 89, 90 years), disability status (Medicare eligibility criterion), end-stage renal disease (ESRD; Medicare eligibility criterion), sex, admission

year, Charlson Comorbidity Index (CCI; 0, 1, 2, 3), intensive care unit (ICU) use, discharge to rehabilitation [none, discharge to skilled-nursing facility (SNF), discharge to inpatient rehabilitation facility (IRF), N/A-died in hospital], receipt of operative intervention,^{19,20} US Census region (Midwest, Northeast, South, West, other including Puerto Rico, and the US Virgin Islands), rurality (calculated based on a patient's residential zip code; urban, isolated rural, large rural, small rural, unknown), hospital teaching status [Council of Teaching Hospitals (COTH) major teaching, non-COTH minor teaching, nonteaching, unknown], hospital tertile of EGS volume (lowest, middle, highest), hospital tertile of older adult EGS racial/ethnic minority patients, and EGS diagnostic category.⁸ 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 days. Major morbidity¹⁹ was defined on the basis of presence of 1 of the following 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. Planned "V-code" readmissions were not counted as readmissions.

Statistical Analyses: Survival Analysis

Risk-adjusted outcomes were analyzed on the basis of differences in RTI race/ethnicity among included older adults and a subcohort of operative-only older adults using survival (time-to-event) analysis with Cox proportional-hazards models to give hazard ratios (HRs) and 95% confidence intervals (95% CIs). Use of survival analysis allows for 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 days) were analyzed separately. Comparison to SSA race/ethnicity was included as a sensitivity analysis.

Within each survival cohort, multivariable models were used to control for confounding. Covariates were taken as baseline fixed-effects at the time of patients' index hospital admission. Patients who died (in-hospital or after discharge) were included in cohorts for morbidity and readmission but were censored at their times of death. Models were assessed for time-to-first event. They were checked for multicollinearity, appropriateness of proportional-hazards, and calibration. They accounted for clustering of patients within hospitals and relied on robust standard errors.

Subanalyses Assessing Which Factors Account for Racial/Ethnic Disparities Among EGS Patients

In order to determine whether the results could be explained by differences in diagnoses within a heterogeneous EGS population or by variations in hospital factors¹³/subgroup of age (65 to 79 years, octogenarian 80 to 89 years, nonagenarian 90 years),¹⁵ subanalyses further analyzed stratified differences among (a) EGS diagnostic categories and (b) variations in age, hospital tertile of racial/ethnic minority patients, and teaching status. Mediation analysis was performed for this later group of comparisons using the

usergenerated Stata-program “ldecomp”²¹ in order to estimate the part of race/ethnicity’s effect on risk-adjusted unplanned readmissions explained by each factor independent of the others and by the collective influence of all 3. Fifty bootstrapped replications were used to ensure the consistency of the effect.

Geographic differences in 30-day mortality and unplanned readmissions were plotted by state between NHB and NHW patients. Data analyses were performed using Stata Statistical Software: Release 14.1 (College Station, TX) and SAS Statistical Software: Release 9.4 (Cary, NC). Two-sided *P* values < 0.05 were considered significant. The Partners Human Research Committee and Yale Human Investigation Committee deemed the study exempt from full review.

RESULTS

Differences in Covariates by Race/Ethnicity

A total of 6,779,649 older adults were included. The majority were identified as NHW (*n* = 5,613,035; 82.8%), followed by NHB (*n* = 625,413; 9.2%), Hispanic (*n* = 381,865; 5.6%), NHA (*n* = 99,904; 1.5%), and NHO (*n* = 59,432; 1.1%). Relative to NHW patients, NHB, Hispanic, and NHA patients were each more likely to be younger (aged 60 to 69 years: 16.0% vs 23.9%, 22.7%, and 18.4%), have ESRD (1.4 vs 6.4%, 4.2%, and 3.7%), and live in urban zip codes (70.5% vs 81.1%, 77.3%, and 92.5%). NHB patients presented with the highest CCI (>2: 18.5% vs 24.3%) and greatest postdischarge SNF (22.4% vs 25.3%) and IRF (5.3% vs 6.8%) use. They were the least likely to undergo an operative intervention (27.2% vs 23.3%). Complete distributions of patient- and hospital-level characteristics are presented by race/ethnicity along with unadjusted outcomes in Table 1. Differences in diagnostic groups are presented in Supplemental Table 1A (operative-only patients Supplemental Table 1B, <http://links.lww.com/SLA/B305>). Patterns were highly similar across races/ethnicities. Each group had comparable most prevalent diagnoses, including overall gastrointestinal (GI) bleeds, soft tissue disorders, intestinal obstructions, biliary disorders, and operative only: biliary disorders, GI cancers, hernias, intestinal obstructions.

Mortality

Fourteen percent (*n* = 792,693) of NHW patients died within 180 days. In contrast, 16.0% (*n* = 100,217) of NHB, 12.3% (*n* = 46,790) of Hispanic, and 12.2% (*n* = 12,159) of NHA patients died over the same timespan (Table 1). On risk-adjusted analysis at 30 postadmission days, NHB patients were significantly less likely to die [HR (95% CI): 0.88 (0.86–0.89); Table 2]. At 90 or 180 days, however, no significant mortality differences were found. Significantly lower risk-adjusted mortality rates at 30, 90, and 180 days were also found when comparing Hispanic vs NHW [30-day HR (95% CI): 0.84 (0.82–0.86)] and NHA-vs-NHW patients [0.78 (0.75–0.82)]. Protective differences between racial/ethnic groups became less pronounced as time extended toward 180 days [eg, 180-day Hispanic vs NHW: 0.94 (0.92–0.97)]. Similar trends were observed when restricting the population to operative patients (Supplemental Table 2, <http://links.lww.com/SLA/B305>) and using SSA race (Table 2).

Variations in Disparities by Diagnostic Category and Geography

Stratification of mortality differences by EGS diagnostic category between NHB and NHW patients is presented in Fig. 2A. The majority of risk-adjusted point-estimates indicate similar or better outcomes for NHB patients, with the greatest protective effects found among patients with GI bleeds and abdominal pain. At 90 and 180 days, NHB patients with soft tissue disorders and GI cancer were, however, more likely to die. Geographic differences are presented in Fig. 3. Figure 3A shows the national distribution of NHB Medicare enrollees. States with the greatest risk-adjusted protective mortality difference between NHB and NHW patients followed a similar trend (Fig. 3B). The largest protective effects were predominately found in the Eastern US. Five states—California, Missouri, Wisconsin, Ohio, and New Jersey—had protective effects with HR <0.85 at 30 days.

Major Morbidity

A total of 896,211 (16.0%) NHW patients experienced 1 major morbidity within 180 days—132,352 NHB (21.2%), 62,497 (16.4%) Hispanic, and 15,832 (15.9%) NHA patients (Table 1). 7.2%, 8.8%, 6.7%, and 7.0%, respectively, experienced major morbidity within 30 days. Relative to NHW patients, NHB patients were significantly more likely to experience major morbidity on risk-adjusted analysis at 30, 90, and 180 days [eg, 180-day HR (95% CI): 1.17 (1.16–1.19); Table 2]. Morbidity differences between Hispanic and NHW patients were statistically significant at 90 and 180 days [eg, 180-day HR (95% CI): 1.07 (1.05–1.09)]. No significant differences were found comparing NHA vs NHW patients. As with mortality, morbidity differences based on SSA race (Table 2) and restricted to operative cases (Supplemental Table 2, <http://links.lww.com/SLA/B305>) were similar to differences reported on the basis of RTI race.

Variations in Disparities by Diagnostic Category

Stratified comparison of diagnostic categories between NHB and NHW patients at 30, 90, and 180 days demonstrated a high degree of consistency with overall findings (Fig. 2B). At 30 and 90 days, patients with soft tissue disorders and GI cancer exhibited the largest racial/ethnic morbidity differences. At 180 days, the largest differences were found among patients with GI cancer, pancreatic disorders, and enteritis.

Unplanned Readmission

By 180 days, 2,051,907 (36.6%) NHW, 272,672 (43.6%) NHB, 147,762 (38.7%) Hispanic, and 34,035 (34.1%) NHA patients had been readmitted—15.8%, 19.1%, 16.6%, and 15.2% within 30 days (Table 1). Relative to NHW patients, NHB [eg, 180-day HR (95% CI): 1.11 (1.10–1.12)] and Hispanic [1.07 (1.06–1.08)] patients were both significantly more likely to be readmitted (Table 2). NHA patients, in contrast, were significantly less likely to be readmitted at 30, 90, and 180 days [eg, 180-day HR (95% CI): 0.90 (0.89–0.92)]. Racial/Ethnic differences based on SSA race (Table 2) and restricted to operative cases (Supplemental Table 2, <http://links.lww.com/SLA/B305>) were similar.

Variations in Disparities by Diagnostic Category and Geography

Stratification by EGS diagnostic categories between NHB and NHW patients demonstrated the consistency of the overall affect across diagnostic groups (Fig. 2C). The greatest differences were the same at all 3 timepoints. They included enteritis, vascular disorders, and soft tissue disorders. Geographic differences in risk-adjusted unplanned readmission were not as closely aligned as mortality with the geographic distribution of NHB Medicare enrollees. Instead, as shown in Fig. 3C, readmission differences at 30 postdischarge days were most pronounced toward the middle of the country, running in a West-East horizontal band that included 6 states with HR 1.15—California, Colorado, Kansas, Oklahoma, Illinois, and Pennsylvania.

Explaining Differences in Unplanned Readmission Based on Age-cohort, Hospital Teaching Status, and a Hospital's Percentage of Minority Patients

Tertile of minority patients managed within a hospital explained 16.8% of risk-adjusted readmission differences between NHB and NHW patients (Fig. 4A), 32.1% of the difference between Hispanic and NHW patients (Fig. 4B), and 31.5% of the protective difference between NHA and NHW patients (Fig. 4C) at 180 postdischarge days. Teaching status explained a more modest 3.4%, 3.2%, and 1.1% of the effect. Finally, accounting for the so-called “mortality survivorship tendency” among octogenarian and nonagenarian EGS patients¹⁵ (in addition to models already risk-adjusted for age), explained an additional 2.5%, 7.3%, and 2.0% of readmission differences between racial/ethnic groups. For each minority group, relative to NHW patients, differences in readmission became more pronounced as patients increased in age from 65 to 79 to 80 to 89 to 90 years. Among Hispanic patients, age variation changed the significance of the effect, climbing from no difference in readmissions among Hispanic vs NHW adults aged 65 to 79 years to increasingly more pronounced and significant differences among octogenarian and nonagenarian patients (Fig. 4B). For NHA patients, it qualitatively changed the result, jumping from protective differences between NHA vs NHW adults aged 65 and 79 years to significantly worse readmission outcomes among nonagenarian patients (Fig. 4C).

Combined, these 3 factors explained 22.7% of the overall readmission difference between NHB and NHW patients at 180 days (27.3% at 30 days). They explained 42.6% and 34.5% of 180-day readmission differences for Hispanic and NHA patients, and 52.8% and 48.2% of 30-day readmission differences, respectively.

DISCUSSION

As the US population ages and discussions surrounding the optimal method of insurance provision increasingly enter into national debate, longer-term outcomes are of paramount concern. The results of this study help to address the burgeoning issue of how such changes could be affecting racial/ethnic disparities by providing a nuanced understanding of the extent to which racial/ethnic disparities among older adult EGS patients exist. Using a national cohort of universally insured Medicare patients, the study found that at 30 days, NHB, Hispanic, and NHA patients were each significantly less likely to die relative to NHW patients. The protective effect began to decline as outcomes approached 180 days and was

accompanied by increasingly worse major morbidity and unplanned readmission differences between NHB and NHW patients. Morbidity and readmission outcomes among NHW, Hispanic, and NHA patients, in contrast, were largely comparable. Differences between racial/ethnic groups remained consistent across EGS diagnostic categories but were partially explained by variations in age-cohort, hospital teaching status, geography, and a hospital's percentage of minority patients.

Understanding how longer-term outcomes influence the experience of older EGS patients holds important implications for health care planning in coming years. Already, EGS conditions represent a large proportion of annual hospitalizations, accounting (in conjunction with younger adults) for an estimated \$28 billion in hospital costs and a disease burden greater than that of all incident cancer diagnoses.^{20,22,23} By 2060, EGS costs are projected to increase to >\$41 billion per year, largely as a result of the increasing number of older adults.²² Addressing disparities within this population has the potential to both drive down costs and significantly improve outcomes for the >74 million Americans (1 in 5 people) expected to be aged >65 years within 10 years.²⁴

The Role of Insurance

Compared with NHW patients, older adult minority patients were equivalently or less likely to die and had predominately similar outcomes for major morbidity and unplanned readmission. Rangel et al²⁵ and Cooper et al¹⁰ suggest a similar lack of racial/ethnic mortality differences as far out as 365 days among older patients requiring emergency abdominal care. Such findings are thought to be at least partially explained by more equitable access to care as a result of insurance. Work conducted among universally insured TRI-CARE^{14,26} patients and variably insured younger adults in the general population¹³ both demonstrated significant effects on longer-term EGS outcomes attributable to insurance. For younger adults in California, insurance explained up to 24.3% of risk-adjusted readmission differences between races.¹³ It has also been found to invert disparate in-hospital mortality between NHB and NHW trauma patients of younger versus older age.^{27,28}

The waning of insurance's influence on disparities in longer-term outcomes may be explained by the persistence of other geographic, patient, and hospital-level factors that in this study accounted for up to 50% of readmission differences between racial/ethnic groups. As older patients leave the hospital and re-enter their lives, influences beyond insurance and one's initial ability to access care and pay—such as health literacy, familial support, socioeconomic status, and nonfragmented follow-up or palliative care—are likely to be involved. The results of this study make clear that, while important, insurance alone does not account for the entirety of the complex array of factors^{2,12,29,30} associated with disparities in longer-term outcomes. Even in a universally insured population, some disparate outcomes remain. Future research is needed to better understand the influence of social determinants on older adult health during the postacute recovery period and to elucidate how such factors might differ among older versus younger adults. Differences in types of insurance should also be queried.

Other Factors Underlying the Occurrence of Racial/Ethnic Disparities

Additional measurable and potentially modifiable factors thought to have an effect on disparities among older adults include those associated with teaching status,^{13,31–33} volume of (minority) patients,^{13,34} a hospital's experience with EGS patients of more advanced age,^{35,36} and maintenance of postdischarge continuity of care.^{37,38} For older adults in our study, the effect of the volume of minority patients managed within a hospital explained up to 41.4% of risk-adjusted readmission differences. Variations likely attributable to differences in physiological and experiential factors encountered among patients of more advanced older age changed both the size and direction of differences among Hispanic and NHA patients.

For Hispanic patients, nonsignificant differences among patients aged 65 to 79 years, managed in hospitals treating the lowest percentage of minority patients, and managed in nonteaching hospitals each became significantly worse, as stratified differences moved toward older ages, a higher percentage of minority patients, or a more prominent teaching role. Worse outcomes among Hispanic patients of more advanced age present a striking contrast to better outcomes reported for Hispanic versus NHW adults aged 18 to 64 years.¹³ Termed the “Hispanic Paradox,” the phenomenon among younger adults is thought to arise from a combination of healthier Hispanic patients being more likely to immigrate to the US and of those facing health threats returning home.^{13,39,40} Stepwise changes with age toward worse outcomes could suggest a potential waning of the paradox's effect as older adults become less able to travel. NHA patients exhibited a similar pattern, resulting in significantly better outcomes relative to NHW patients aged 65 to 79 years but significantly worse outcomes among nonagenarian patients. Differences among NHA patients aged 18 to 64 years were also indicative of a protective effect.¹³ Such a trend could speak to similar selective migration patterns among NHA patients of different ages. It could also suggest the influence of a cohort effect wherein older NHA patients are more likely to be first generation, have experienced discontinuities in care throughout their lifespans, and be faced with more pronounced language and cultural barriers relative to younger second and third-generation patients.^{41–43}

For all 3 groups of minority patients, differences in experiences throughout patients' lifespans likely help to account for the worsening of disparities seen with more advanced age. NHB patients, in particular, born before 1964 lived in US with legal segregation. Although relationships between races/ethnicities have improved, the effects of that time and the events that precede it are still present and could differentially be affecting the health of America's most senior generations. Increased utilization of SNF and IRF among NHB patients while positive in terms of access to rehabilitative care could also indicate differences in postdischarge trajectories, suggesting variable influences of access to familial support, care at home, and palliative counseling/care.³⁷

Inversion/Mitigation of Mortality Differences

Among nonemergent surgical patients, racial disparities or “gaps” in short-term (in-hospital to 30-day) mortality between black and white patients of older age have been found to narrow in recent years,⁴⁴ while outcomes among trauma patients have remained largely unchanged⁴⁵ with black patients of older age tending to present with lower mortality relative

to white trauma patients.^{27,28} The inverse/comparable mortality reported among NHB (and other minority) versus NHW EGS patients immediately after discharge in this study follows suit as does their higher rate of readmission within 30 days.⁴⁶ The extent to which these trends are a result of variable presentations of different types of patients to different hospitals,⁴⁶ at different times, and with potentially different levels of disease severity—particularly for minority patients presenting to the ED^{3–7}—should be the subject of future research. It is not clear what accounts for better survival only to have presumably sicker patients return later with higher morbidity and readmission. Lower disease severity on initial presentation to the ED among minority patients could provide a potential explanation. However, it does not account for other social factors that tend to make minority patients present later in their disease course with more pronounced or hidden symptomatology^{3–7} nor the similarity of the findings to nonemergent, non-ED based surgical indications.^{44,46}

The Role of Geographic Variation

Overall, despite largely consistent trends across diagnostic groups, the study did find geographic variation. Relative to NHW patients at 30 days, NHB older adults were significantly more likely to be readmitted if they lived in states with large population densities or large urban centers. The most pronounced racial/ethnic differences were found in a West-East band in the middle of the country in states that had low overall percentages of older adult NHB patients. Stratified readmission differences reported in Fig. 4 appear to corroborate the assertion, suggesting that the effects in these states might be able to be further isolated to hospitals managing a larger, regionally disproportionate share of minority patients. Additional research is needed to ascertain the existence and extent of this potential effect, particularly in light of ongoing efforts to promote enhanced regionalization of complex EGS care and a lack of disparate findings based on differences in patient volume alone.^{47–51} Variations in mortality more closely aligned with the distribution of NHB Medicare enrollees, demonstrating a significantly lower risk of mortality relative to NHW patients in the majority of Eastern states and California.

Limitations and Conclusion

The study is not without limitations. Most reflect its reliance on administrative data, where a lack of nuanced clinical detail and the potential for absent or misreporting of events can be concerns. There is no agreed-upon manner to account for disease severity among EGS patients in large databases.⁵² An inability to assess for disease severity could be influencing disparities in EGS care were, for example, minority patients more likely to utilize the ED regardless of disease severity relative to NHW patients who may be more likely to be admitted through the ED after presentation to a non-ED based outpatient setting. The decision to limit the sample to ED-based admissions was intended to ensure that the included admissions were emergent versus elective in nature; however, in defining the sample this way, the study could be excluding some patients who would otherwise qualify as emergent admissions but never presented to the ED before receiving inpatient care. What use of Medicare data does offer is longitudinal follow-up of a large, national, and completely inclusive population of universally insured older adults that represents the vast majority of US patients at this age. No other database enables such assessment.

Ultimately, racial/ethnic disparities among universally insured older adults on a national scale were largely not found. Notable exceptions include a proximal perioperative protective mortality effect that decreased with time and persistently worse outcomes for major morbidity and unplanned readmission among NHB patients. Trends were consistent across diagnostic groups. However, variations in age-cohort, hospital teaching status, geography, and a hospital's percentage of minority patients all significantly altered the effect. Remaining disparities among nonagenarian patients and hospitals managing a regionally large share of minority patients require attention and could merit future concern. As calls for disparities research, health care reform, and the increasing number of older adults begin to turn attention toward what happens to patients outside of hospital doors, addressing longer-term outcomes offers an important first step toward understanding and preparing to account for the unique experience of older adults.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

Cheryl K. Zogg is supported by NIH Medical Scientist Training Program Training Grant T32GM007205. Adil H. Haider is the PI of a contract (AD-1306-03980) with PCORI entitled "Patient-Centered Approaches to Collect Sexual Orientation/Gender Identity in the ED," a Harvard Surgery Affinity Research Collaborative (ARC) Program Grant entitled "Mitigating Disparities Through Enhancing Surgeons' Ability To Provide Culturally Relevant Care," and a collaborative research grant from the Henry M. Jackson Foundation for the Advancement of Military Medicine in conjunction with the Uniformed Services University of the Health Sciences. Adil H. Haider is also the cofounder and an equity holder in Patient Doctor Technologies Inc., which owns and operates the website www.doctella.com.

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FIGURE 1.
Schematic of inclusion and exclusion criteria.

FIGURE 2.

Differences in risk-adjusted (A) mortality, (B) major morbidity, and (C) unplanned readmission between non-Hispanic black and white patients at 30, 90, and 180 days stratified by diagnostic category. Results represent hazard ratios and 95% CI.

FIGURE 3.

State-level geographic distribution of (A) the percentage of non-Hispanic black Medicare beneficiaries among all Medicare beneficiaries in a state, (B) risk-adjusted 30-day mortality differences between non-Hispanic black and white patients (hazard ratios), and (C) risk-adjusted 30-day unplanned readmission differences between non-Hispanic black and white patients (hazard ratios).

FIGURE 4.

Risk-adjusted differences in 30, 90, and 180-day unplanned readmissions between (A) non-Hispanic black, (B) Hispanic, and (C) non-Hispanic Asian versus non-Hispanic white patients stratified by age group, a hospital's percentage of racial/ethnic minority patients, and a hospital's teaching status. Bar graphs denote stratified hazard ratios with error bars showing 95% CI. The table below shows results from mediation analysis based on risk-adjusted multivariable logistic regression with 50 bootstrapped replications. Percentages correspond to the percentage of the differences in unplanned readmissions explained by each

factor alone and by all 3 combined after risk-adjusted for the other covariates included in the survival models.

TABLE 1
Differences in Covariates and Unadjusted Outcome Measures by Race/Ethnicity Among Older Adult Medicare EGS Patients

Overall	Total	Non-Hispanic White	Non-Hispanic Black	Hispanic	Non-Hispanic Asian	Non-Hispanic other
Patient-Level Characteristics	6,779,649	5,613,035	625,413	381,865	99,904	59,432
Age, y		82.79%	9.22%	5.63%	1.47%	1.06%
65–69	1,166,620	895,440	149,698	86,672	18,398	16,412
70–74	1,203,095	973,958	119,739	76,777	18,188	14,433
75–79	1,311,578	1,089,195	114,380	75,958	20,124	11,921
80–84	1,348,562	1,146,938	104,604	68,462	20,168	8390
85–89	1,054,176	911,671	77,240	45,816	14,340	5109
>89	695,618	595,833	59,752	28,180	8686	3167
Disabled		10.62%	9.55%	7.38%	8.69%	5.33%
No	6,747,547	5,589,715	620,018	379,218	99,634	58,962
Yes	32,102	23,320	5395	2647	270	470
End-stage renal disease		0.42%	0.86%	0.69%	0.27%	0.79%
No	6,640,865	5,536,021	585,715	365,858	96,183	57,088
Yes	138,784	77,014	39,698	16,007	3721	2344
Sex		1.37%	6.35%	4.19%	3.72%	3.94%
Male	2,767,575	2,311,827	227,598	157,233	45,236	25,681
Female	4,012,074	3,301,208	397,815	224,632	54,668	33,751
Admission year		58.81%	63.61%	58.82%	54.72%	56.79%
2008	1,151,281	952,300	108,309	66,716	14,968	8988
2009	1,101,737	915,867	102,252	59,943	14,773	8902
2010	1,047,249	872,423	94,572	56,425	14,934	8895
2011	1,012,688	841,195	91,252	55,803	15,366	9072
2012	982,704	812,136	90,517	55,720	15,499	8832
2013	987,620	812,590	91,741	57,585	15,958	9746
2014 (January–June)	496,370	406,524	46,770	29,673	8406	4997
CCI		7.24%	7.48%	7.77%	8.41%	8.41%
0	2,299,912	1,950,495	173,105	124,645	32,751	18,916
		34.75%	27.68%	32.64%	32.78%	31.83%

Overall									
Characteristic	Total	Non-Hispanic White	Non-Hispanic Black	Hispanic	Non-Hispanic Asian	Non-Hispanic other			
Patient-Level Characteristics	6,779,649	5,613,035	82.79%	381,865	5.63%	99,904	1.47%	59,432	1.06%
1–2	3,182,122	2,624,153	46.75%	183,772	48.12%	46,289	46.33%	27,844	46.85%
>2	1,297,615	1,038,387	18.50%	73,448	19.23%	20,864	20.88%	12,672	21.32%
Intensive care unit use									
No	5,286,478	4,384,631	78.12%	297,264	77.85%	75,545	75.62%	47,954	80.69%
Yes	1,493,171	1,228,404	21.88%	84,601	22.15%	24,359	24.38%	11,478	19.31%
Discharge to rehab									
None	4,683,607	3,883,310	69.18%	279,040	73.07%	72,116	72.19%	44,286	74.52%
Discharge to SNF	1,521,457	1,257,653	22.41%	74,167	19.42%	21,071	21.09%	10,073	16.95%
Discharge to IRF	365,992	297,929	5.31%	18,454	4.83%	3,914	3.92%	3,367	5.67%
N/A—died in hospital	208,593	174,143	3.10%	10,204	2.67%	2,803	2.81%	1,706	2.87%
Operative intervention									
Yes	4,959,505	4,084,773	72.77%	278,892	73.03%	73,070	73.14%	42,970	72.30%
No	1,820,144	1,528,262	27.23%	102,973	26.97%	26,834	26.86%	16,462	27.70%
US census region									
Midwest	1,734,764	1,555,143	27.71%	133,482	21.34%	9743	9.75%	9321	15.68%
Northeast	1,373,999	1,187,095	21.15%	100,475	16.07%	17,352	17.37%	8075	13.59%
South	2,658,206	2,122,124	37.81%	352,524	56.37%	16,861	16.88%	17,541	29.51%
West	967,640	747,285	13.31%	37,699	6.03%	55,313	55.37%	24,234	40.78%
Other (PR, VI)	45,040	1388	0.02%	1233	0.20%	635	0.64%	261	0.44%
Rurality									
Urban	4,888,154	3,959,246	70.54%	507,289	81.11%	92,436	92.52%	34,037	57.27%
Isolated rural	396,667	362,615	6.46%	20,212	3.23%	667	0.67%	7824	13.16%
Large rural	908,760	809,973	14.43%	58,206	9.31%	4396	4.40%	8770	14.76%
Small rural	508,418	451,446	8.04%	36,771	5.88%	1095	1.10%	8195	13.79%
Unknown	77,650	29,755	0.53%	2985	0.48%	1310	1.31%	606	1.02%
Hospital-level characteristics									
Teaching status									
COTH teaching	2,534,769	2,175,995	38.77%	183,585	29.35%	30,664	30.69%	23,348	39.29%

Overall											
Characteristic	Total	Non-Hispanic White		Non-Hispanic Black		Hispanic		Non-Hispanic Asian		Non-Hispanic other	
Patient-Level Characteristics	6,779,649	5,613,035	82.79%	625,413	9.22%	381,865	5.63%	99,904	1.47%	59,432	1.06%
Non-COTH teaching	1,247,613	997,219	17.77%	120,159	19.21%	91,387	23.93%	26,566	26.59%	12,282	20.67%
Nonteaching	662,237	505,715	9.01%	102,222	16.34%	37,241	9.75%	11,826	11.84%	5233	8.81%
Unknown	2,335,030	1,934,106	34.46%	219,447	35.09%	132,060	34.58%	30,848	30.88%	18,569	31.24%
Tertile of EGS volume											
Lowest	2,260,518	1,848,514	32.93%	202,900	32.44%	143,214	37.50%	38,849	38.89%	27,041	45.50%
Middle	2,266,981	1,895,976	33.78%	213,608	34.15%	111,506	29.20%	31,322	31.35%	14,569	24.51%
Highest	2,252,150	1,868,545	33.29%	208,905	33.40%	127,145	33.30%	29,733	29.76%	17,822	29.99%
Tertile of % minority											
Lowest	2,260,937	2,159,087	38.47%	49,135	7.86%	28,613	7.49%	11,119	11.13%	12,983	21.85%
Middle	2,954,625	2,475,069	44.10%	267,914	42.84%	148,851	38.98%	38,432	38.47%	24,359	40.99%
Highest	1,564,087	978,879	17.44%	308,364	49.31%	204,401	53.53%	50,353	50.40%	22,090	37.17%
Unadjusted outcome measures											
Mortality											
30-day	378,228	320,205	5.70%	33,804	5.41%	16,920	4.43%	4481	4.49%	2818	4.74%
90-day	697,769	581,035	10.35%	69,641	11.14%	33,123	8.67%	8724	8.73%	5246	8.83%
180-day	959,167	792,693	14.12%	100,217	16.02%	46,790	12.25%	12,159	12.17%	7308	12.30%
Major morbidity											
30-day	495,881	404,269	7.20%	55,031	8.80%	25,578	6.70%	6951	6.96%	4052	6.82%
90-day	843,752	678,193	12.08%	99,933	15.98%	46,491	12.17%	11,982	11.99%	7153	12.04%
180-day	1,116,484	896,211	15.97%	132,352	21.16%	62,497	16.37%	15,832	15.85%	9592	16.14%
Unplanned readmission											
30-day	1,092,136	884,437	15.76%	119,419	19.09%	63,705	16.68%	15,227	15.24%	9348	15.73%
90-day	1,898,257	1,536,772	27.38%	208,107	33.28%	111,206	29.12%	25,816	25.84%	16,356	27.52%
180-day	2,528,028	2,051,907	36.56%	272,672	43.60%	147,762	38.69%	34,035	34.07%	21,652	36.43%

CCI indicates Charlson Comorbidity Index; IRF, inpatient rehabilitation facility; PR, Puerto Rico; SNF, skilled nursing facility; VI, US Virgin Islands.

TABLE 2

Risk-Adjusted Racial/Ethnic Differences in Outcomes at 30, 90, and 180 Days

Overall (RTI Imputed Race)															
	Non-Hispanic White			Non-Hispanic Black			Hispanic			Non-Hispanic Asian			Non-Hispanic Other		
	HR	95% CI		HR	95% CI		HR	95% CI		HR	95% CI		HR	95% CI	
Mortality															
30-day	1.00 (reference)	–	0.88	0.86–0.89	0.84	0.82–0.86	0.78	0.75–0.82	0.93	0.90–0.97					
90-day	1.00 (reference)	–	0.97	0.96–1.00	0.88	0.87–0.90	0.84	0.81–0.87	0.98	0.96–1.01					
180-day	1.00 (reference)	–	1.00	0.98–1.02	0.94	0.92–0.97	0.88	0.84–0.93	1.03	0.98–1.09					
Major morbidity															
30-day	1.00 (reference)	–	1.09	1.07–1.11	1.01	0.98–1.04	1.00	0.96–1.05	1.06	0.99–1.12					
90-day	1.00 (reference)	–	1.16	1.15–1.18	1.06	1.04–1.08	1.00	0.97–1.04	1.10	1.06–1.16					
180-day	1.00 (reference)	–	1.17	1.16–1.19	1.07	1.05–1.09	0.98	0.95–1.01	1.11	1.06–1.15					
Unplanned readmission															
30-day	1.00 (reference)	–	1.07	1.06–1.09	1.05	1.04–1.07	0.92	0.89–0.95	1.06	1.02–1.11					
90-day	1.00 (reference)	–	1.10	1.09–1.11	1.07	1.06–1.08	0.91	0.89–0.94	1.07	1.03–1.10					
180-day	1.00 (reference)	–	1.11	1.10–1.12	1.07	1.06–1.08	0.90	0.89–0.92	1.05	1.02–1.07					
Overall (SSA Reported Race)															
	Non-Hispanic White			Non-Hispanic Black			Hispanic			Non-Hispanic Asian			Non-Hispanic Other		
	HR	95% CI		HR	95% CI		HR	95% CI		HR	95% CI		HR	95% CI	
Mortality															
30-day	1.00 (reference)	–	0.88	0.87–0.90	0.82	0.80–0.86	0.77	0.73–0.80	0.86	0.83–0.88					
90-day	1.00 (reference)	–	0.97	0.96–1.00	0.88	0.86–0.90	0.83	0.80–0.86	0.90	0.87–0.92					
180-day	1.00 (reference)	–	1.00	0.98–1.02	0.93	0.89–0.97	0.88	0.83–0.93	0.97	0.93–1.02					
Major morbidity															
30-day	1.00 (reference)	–	1.08	1.06–1.10	0.98	0.94–1.02	1.01	0.96–1.06	1.01	0.96–1.05					
90-day	1.00 (reference)	–	1.15	1.14–1.17	1.07	1.04–1.11	1.03	0.99–1.07	1.04	1.01–1.08					
180-day	1.00 (reference)	–	1.17	1.16–1.18	1.08	1.06–1.12	1.01	0.97–1.04	1.03	1.00–1.06					
Unplanned readmission															
30-day	1.00 (reference)	–	1.07	1.06–1.09	1.06	1.03–1.09	0.92	0.88–0.95	1.01	0.97–1.04					
90-day	1.00 (reference)	–	1.10	1.09–1.11	1.09	1.07–1.11	0.91	0.89–0.94	1.00	0.97–1.02					

Overall (SSA Reported Race)									
Non-Hispanic White			Non-Hispanic Black			Hispanic		Non-Hispanic Asian	
HR	95% CI	HR	95% CI	HR	95% CI	HR	95% CI	HR	95% CI
1.00 (reference)	–	1.10	1.09–1.11	1.09	1.07–1.11	0.91	0.88–0.93	0.98	0.96–1.01

Results represent separate outcome and time-point specific Cox proportional-hazard models that accounted for clustering of patients within hospitals and were risk-adjusted for baseline differences in age, disability status, end-stage renal disease, sex, admission year, CCI, ICU use, discharge to rehabilitation, receipt of operative intervention, US Census region, rurality, hospital tertile of EGS volume, and EGS diagnostic category.

95% CI indicates 95% confidence interval; HR, hazard ratio; RTI, Research Triangle Institute; SSA, Social Security Administration.