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Health insurance and disparities in mortality among older survivors of critical illness: A population study

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Abstract

Background—The 1.5 million Medicare beneficiaries who survive intensive care each year have a high post-hospitalization mortality rate.

Objective—To determine whether mortality after critical illness is higher for Medicare beneficiaries with Medicaid compared to those with commercial insurance.

Design—A retrospective cohort study from 2010 through 2014 with one year of follow-up using the New York Statewide Planning and Research Cooperative System database.

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SUPPLEMENTARY MATERIAL LEGEND

Supplementary Methods

Details regarding the abstraction and classification of covariables

Supplementary References

Supplementary Tables S1–S9

Hazard ratios for all sensitivity analyses

Supplementary Figure S1

Quantitative bias plots for (A) the entire study cohort and (B) those discharged to skilled-care facilities

Setting—A New York State population-based study of older survivors (age ≥ 65 years) of intensive care.

Participants—Adult Medicare beneficiaries age ≥ 65 years who were hospitalized with intensive care at a New York State hospital and survived to discharge.

Interventions—None.

Measurements—Mortality in the first year after hospital discharge.

Results—There were 340,969 Medicare beneficiary survivors of intensive care with a mean (SD) age of 77 (8) years, and 20% died within one year. There were 152,869 (45%) with commercial insurance, 78,577 (23%) with Medicaid, and 109,523 (32%) with Medicare alone. Compared to those with commercial insurance, those with Medicare alone had a similar 1-year mortality rate (adjusted hazard ratio [aHR] 1.01, 95% CI 0.99–1.04), and those with Medicaid had a 9% higher 1-year mortality rate (aHR 1.09, 95% CI 1.05–1.12). Among those discharged home, the 1-year mortality rate did not vary by insurance coverage, but among those discharged to skilled-care facilities, the 1-year mortality rate was 15% higher for Medicaid recipients (aHR 1.16; 95% CI, 1.12–1.21, p-for-interaction <0.001).

Conclusions—Older adults with Medicaid insurance have a higher 1-year post-hospitalization mortality compared to those with commercial insurance, especially among those discharged to skilled-care facilities. Future studies should investigate care disparities at skilled-care facilities that may mediate these higher mortality rates.

Keywords

critical illness; insurance coverage; skilled nursing facilities

INTRODUCTION

There are approximately 45 million older (age ≥ 65 years) Americans who receive health insurance from either Medicare and commercial insurance, Medicare alone, or Medicare and Medicaid insurance.¹ Medicaid insurance is offered to approximately 10 million older adults who live at less than 133% of the federal poverty level.² Compared to older adult Medicare beneficiaries with commercial insurance, those with Medicaid are more likely to die from early stage lung cancer,³ lymphoma,⁴ and have worse outcomes after acute coronary syndrome.⁵ Older adult Medicare beneficiaries with Medicaid have also been found to receive lower quality out-patient preventive care.⁶

Over 1.5 million older American adults survive intensive care every year, but approximately 20% die during the first year after hospital discharge.⁷ Improving survivorship is considered the defining challenge of critical care in the 21st century.⁸ Studies of critical illness survivors have identified pre-hospitalization disability and frailty,^{9–11} comorbidities,^{9,12} and treatment factors related to intensive care (e.g. mechanical ventilation¹³) as risk factors for poor outcomes after hospital discharge. However, less attention has been paid to how healthcare disparities after hospital discharge might affect mortality among older intensive care unit (ICU) survivors.

In our previous work, we found that mortality among older Medical-ICU survivors from two New York City tertiary care medical centers differs by insurance status, but not race or ethnicity.¹⁴ Those with commercial insurance had a lower post-hospitalization mortality rate than those with Medicare only or Medicaid insurance, independent of several demographic, clinical, and hospital characteristics. These results, however, may not be generalizable to older adults who receive surgical or coronary intensive care, and who are treated in community hospitals or less urban environments. Therefore, we sought to investigate, on a population level, whether 1-year mortality among older ICU survivors differs by health insurance coverage. We conducted a retrospective cohort study using the New York Statewide Planning and Research Cooperative System (SPARCS), an administrative database of all hospital discharges in New York State. Our primary hypothesis was that older adult Medicare beneficiaries with Medicaid insurance have a higher mortality rate in the year after surviving intensive care when compared to those with commercial insurance.

METHODS

Participants, Study Design, and Data Sources

We conducted a retrospective, New York State population-based, cohort study of Medicare beneficiaries age 65 years and older who had their first hospitalization requiring medical, surgical, or coronary ICU level of care (defined by ICU bed utilization billing codes,¹⁵ see Supplementary Methods), and who survived to discharge between January 1, 2010 and December 31, 2014. We retrieved data from the New York Statewide Planning and Research Cooperative System (SPARCS), which is a comprehensive data-reporting system of patient-level data for every acute care hospitalization in New York State.¹⁶ SPARCS data was linked with New York State Vital Records and New York City Vital Records to obtain mortality data. We matched hospital-level variables from the 2012 American Hospital Association annual survey with each subject's index hospitalization hospital. We linked participants' zip code with 2012 US census data in order to obtain their neighborhood median household income and classification of urban versus not-urban residence.¹⁷

We excluded participants who did not survive to hospital discharge, had a hospital length of stay greater than 365 days, had an out-of-state address, or who were admitted from or discharged to hospice because death within 6 months is the expected outcome for hospice patients. We excluded those who did not have a SPARCS unique personal identification number since these patients would be missing demographic data that would make it impossible to identify them in the Vital Records. We excluded those who had misreported death dates. We excluded those with no insurance, government insurance coverage, or other insurance coverage without any Medicare or Medicaid insurance. See Supplementary Methods for further details.

For participants who were transferred between acute care hospitals (defined as having an acute hospital visit <1 day apart), we combined these events into a single acute care hospitalization. The Columbia University Medical Center Institutional Review Board approved the study with a waiver of informed consent (protocol: AAAR4981).

Variables

The primary exposure was insurance coverage, which we categorized as Medicare and commercial insurance (subsequently referred to as commercial insurance), Medicare only, or Medicare and Medicaid (subsequently referred to as Medicaid) based on the listed insurer(s) expected to pay for the acute hospitalization. See Supplementary Methods for further details.

The primary outcome was the rate of death in the first year after surviving hospitalization involving intensive care. Follow-up time was right censored 365 days after the date of hospital discharge.

We included demographic, clinical, and hospital-level co-variables in our statistical models. Demographic covariables were age, sex, race/ethnicity (white, black, Hispanic, other), neighborhood household median income, urban residence, and year of hospital discharge. Clinical covariables were a count of Elixhauser comorbidities,¹⁸ having received medical versus surgical intensive care, use of mechanical ventilation, tracheostomy during the hospitalization, use of dialysis, length of hospital stay, discharge location (home [home or home with services], skilled-care facility [skilled-nursing facility, inpatient rehabilitation, or long-term acute care facility], other hospital type [e.g. psychiatric hospital], or other location), and in-hospital mortality risk (low, medium, high), which was derived for the SPARCS database using validated software.¹⁹ Hospital-level covariables were the hospital from which the participant was discharged, and whether the hospital was in an urban location or had teaching hospital status (based on 2012 American Hospital Association (AHA) survey data). See Supplementary Methods for further details regarding the abstraction and classification of covariables.

Statistical Analyses

Baseline characteristics are expressed as a mean (SD) or median (IQR). We estimated hazard ratios for death using stratified Cox proportional hazards models with strata for discharge location and a cluster standard errors variable for hospital. We included discharge location as a stratification variable in order to satisfy the assumption of proportion hazards, which were examined using log-log plots of survival and by regressing Schoenfeld residuals against time. We evaluated continuous covariates for nonlinear associations with the mortality rate after hospital discharge using additive Cox models with penalized splines. Since age and length of stay had nonlinear associations with the mortality rate, they were changed to categorical variables to accommodate the nonlinear trend. A p -value <0.05 was considered significant.

We used multiple imputation with a Markov Chain Monte Carlo method for missing variables (age, sex, urban zip code designation, median income, surgical versus medical intensive care) with less than 1% missing data for any variable. We performed pre-specified stratified analyses based on discharge location, use of mechanical ventilation, tracheostomy, race/ethnicity, age quartiles, median neighborhood income quartiles, hospital teaching status, and urban versus rural hospital location. The presence of interaction was assessed using the likelihood ratio test and a p -for-interaction <0.05 was considered significant.

We conducted three sensitivity analyses. (1) We excluded those with Blue Cross insurance because some participants with Blue Cross could have been misclassified as having Medicare and commercial insurance, when instead they had Medicare and Medicaid insurance. Blue Cross is a commercial insurance provider that also provided Medicaid insurance plans during the study period (see Supplementary Methods for further details). (2) We combined the Medicare only and Medicare and commercial insurance categories. Some Medicare only participants may have had outpatient commercial insurance that they purchased through the Medigap program, but commercial Medigap insurance would not be reported in the SPARCS database, which only reports insurance expected to pay for in-patient services. (3) We included those discharged directly from hospital to hospice because differential hospice enrollment across insurance types could have potentially biased our survival analyses.

We performed a quantitative bias analysis to estimate the magnitude of association between a single unmeasured confounder and mortality needed to abrogate the adjusted association between Medicaid insurance coverage and mortality for our entire study cohort, and among those discharged to skilled-care facilities.^{20,21} We assumed a baseline prevalence of a hypothetical confounder of 10% or 20% for participants with commercial insurance held constant against a 20%, then 30%, and then 40% prevalence for participants with Medicaid insurance. Analyses were performed using StataSE v15.0 (College Station, TX) and RStudio (Boston, MA).

RESULTS

Participants

A total of 625,579 adults, age ≥ 65 years, had their first hospitalization with ICU care in New York State between January 1, 2010 and December 31, 2014. We excluded 224,895 (36%) who died during the hospitalization and 59,715 (10%) for meeting other exclusion criteria (see Figure 1), resulting in a study cohort of 340,969 older adult ICU survivors. The mean (SD) age was 77 (8.1) years, 52% were women, and the 1-year mortality was 20%. Forty-five percent had commercial insurance, 32% had Medicare only, and 23% had Medicaid (Table 1). Compared to those with commercial insurance or Medicare only, those with Medicaid were significantly more non-White or Hispanic, more likely to be from an urban neighborhood with a lower median household income, and treated at a teaching hospital (all $p < 0.001$). Those with Medicaid appeared to be more severely ill than those with commercial insurance or Medicare only given that Medicaid participants more often had a principal diagnosis of sepsis, more often required mechanical ventilation, tracheostomy, or dialysis, had a longer hospital length of stay, and more often had an in-hospital mortality risk rating of “extreme” (all $p < 0.001$). Those with Medicaid were more often discharged to skilled-care facilities (38%), compared to those with commercial insurance and Medicare only (28% for both categories) ($p < 0.001$).

Health Insurance and Outcomes

In the unadjusted analysis, compared to those with commercial insurance, Medicaid participants had a 22% higher 1-year mortality rate (Hazard ratio [HR] 1.22, 95% CI 1.19–

1.24) (Table 2, Figure 2). In the fully adjusted analysis, Medicaid participants had only a 9% higher 1-year mortality rate (Table 2, Model 3 adjusted hazard ratio [aHR] 1.09, 95% CI 1.05–1.12), which was attenuated primarily after controlling for measures of comorbidity and severity of critical illness (Table 2, Model 2). The absolute difference in 1-year mortality between Medicaid participants and those with commercial insurance was 3.5% (22.2% versus 18.7%) (Table 2). Compared to those with commercial insurance, those with Medicare only did not have a higher adjusted 1-year mortality rate (Table 2, Model 3 aHR 1.01, 95% CI 0.99–1.04) (Table 2).

Pre-specified subgroup analyses revealed that the risk of 1-year mortality after hospital discharge for those with Medicaid insurance status was greatest for those who were older, received mechanical ventilation, a tracheostomy, and who were discharged to a skilled-care facility (all *p*-for-interaction <0.05, Figure 2). Compared to those with commercial insurance who were discharged to skilled-care facilities, those with Medicaid discharged to skilled-care facilities had a 16% higher 1-year mortality rate (aHR 1.16, 95% CI, 1.12–1.21) (Figure 2). The absolute difference in 1-year mortality between Medicaid participants and those with commercial insurance who were discharged to skilled-care facilities was 4.2% (34.2% versus 30.0%). There was no significant association between type of insurance coverage and 1-year mortality among those discharged home. Subgroup analyses also showed that the association between Medicaid insurance and 1-year mortality did not vary significantly by race/ethnicity, neighborhood median income, or whether participants were treated at urban or teaching hospitals (Figure 2).

Sensitivity analyses

When those with Blue Cross were excluded (*n* = 72,065), the 1-year mortality rate for those with Medicaid increased from 9% to 11% higher than those with commercial insurance (aHR 1.10; 95% CI, 1.07–1.15) (Supplementary Table S1). Among those who were discharged to a skilled care facility, those with Medicaid had a 1-year mortality rate that increased from 16% to 18% higher than those with commercial insurance (aHR 1.18, 95% CI, 1.13–1.22) (Supplementary Table S2). Similar increases in effect estimates were seen in analyses stratified by age, mechanical ventilation, tracheostomy, and hospital characteristics (Supplementary Table S3, S4). When we combined those with commercial insurance and Medicare and Medicare only, and compared them to those with Medicaid, the effect estimate of the association between Medicaid and 1-year mortality decreased one percentage point from 9% to 8% (Model 3 aHR 1.08, 95% CI, 1.05–1.11) (Supplementary Table S5), and the effect estimates in stratified analyses did not meaningfully change (Supplementary Table S6–S8). When those discharged to hospice were included, the effect estimate for the association between Medicaid and 1-year mortality did not change (Model 3 aHR 1.09, 95% CI, 1.05–1.12) (Supplementary Table S9–S12).

Quantitative Bias Analysis

Using the lower bound of the confidence interval from the fully adjusted model (1.06), if the prevalence of a single unmeasured confounder was 10% in the commercial insurance group and 20% in the Medicaid group, this unmeasured confounder would need to have a hazard ratio of 1.54 in order to abrogate the association between Medicaid health insurance and 1-

year mortality. As the association between Medicaid and mortality was more pronounced in the subgroup of patients discharged to skilled care facilities, an unmeasured confounder would need to have a hazard ratio of 2.46 to nullify the observed association. If the difference in prevalence of the unmeasured confounder between groups increased (10% in commercial insurance, 40% in the Medicaid group), then an unmeasured confounder would need to have a hazard ratio of 1.17 in the overall cohort, and a hazard ratio of 1.44 in patients discharge to SCF to nullify the association (Supplementary Table S13, and Supplementary Figure S1).

DISCUSSION

In the older adult population of Medicare beneficiaries in New York State, we found that survivors of intensive care with Medicaid health insurance had an increased risk of death in the first year after hospital discharge that was independent of socio-demographics, comorbidities, several measures critical illness severity, and hospital-level factors. This increased risk of death was concentrated among the oldest and most debilitated survivors of mechanical ventilation who required post-acute skilled-facility care. Medicaid beneficiaries tend to cluster in skilled-care facilities,^{22,23} and Medicaid reimbursement rates are usually lower than commercial insurance.²⁴ Our findings suggest that poor older ICU survivors with Medicaid insurance have an increased risk of death because they may receive either a suboptimal level of post-acute skilled-facility care, or a suboptimal level of care once discharged to home from a post-acute care facility. Furthermore, since most critical care studies and trials now examine post-hospitalization outcomes, investigators should now consider whether insurance status and post-hospitalization care may affect study results.

While prior studies have shown that adults <65 years of age without health insurance receive fewer critical care services and experience worse outcomes,²⁵ less attention has been paid to disparities between insurance coverage and outcomes among adults ≥ 65 years of age, who make up more than half of all ICU admissions.²⁶ This is perhaps because older Americans have basic universal health insurance coverage through government funded Medicare and Medicaid programs.^{1,2} Our findings build on a body of research that has demonstrated that older Americans with Medicaid insurance are more likely to be discharged to facilities with lower quality ratings,²⁷ lower nurse-to-patient ratios,^{22,28} and greater number of health-care related deficiencies,²⁹ to suggest that these disparities in post-acute care may mediate the 16% higher death rate we observed among older ICU survivors with Medicaid insurance. Medicaid recipients tend to cluster in lower quality skilled-care facilities that tend to be located in poor communities.^{22,23,30} Despite variation in Medicaid's per diem nursing home payment rates from state to state, Medicaid reimbursement rates are usually lower than commercial insurance.²⁴ Specifically, Medicare pays for post-acute care for the first 90 days after hospital discharge, but only reimburses the full cost of post-acute care for the first 20 days. Co-payments from commercial insurance, the patient, or Medicaid insurance are then used to cover post-acute care costs not paid for by Medicare. Medicaid programs can refuse reimbursement of co-payments, or reimburse at less than the full co-payment cost, which is allowed under the Medicare statute (ADD CITATIONS FROM POINT-BY-POINT 8: Ref 28 Rahman, and Administration AfHC citation). Therefore, skilled-care facilities that are highly dependent on Medicaid recipients as a source of revenue may have difficulty in securing

enough resources to pay for a higher quality of care. Older studies have suggested that increasing the Medicaid payment rate raises nursing home quality.^{31–33} However, more recent studies have shown that increases in Medicaid payment have not led to higher nurse-to-patient ratios,³⁴ and pay-for-performance for nursing homes by state Medicaid agencies has not resulted in consistent improvements in nursing home quality.³⁵ Our findings should prompt both clinical and health policy investigations into the barriers to high-quality post-acute facility care delivery for older intensive care survivors, especially as they relate to insurance status.

Our study has limitations. The SPARCS database includes insurance providers of inpatient care for participants, but the accuracy of insurance status has not been evaluated in administrative data. Since these data are used for billing, there is unlikely to be substantial error. Furthermore, our sensitivity analyses suggest that our findings are robust to potential misclassification bias. The quality of the Hispanic ethnicity variable in SPARCS has not been fully investigated, but is 91–95% concordant with Vital Statistics data that is believed to be accurate.³⁶ We were able to control for socioeconomic predictors at the neighborhood level using US Census data, but not at the individual level. We were unable to control for direct or surrogate measures of pre-hospitalization disability (e.g. admission from nursing home), or for preferences for life-sustaining therapy at hospital discharge, both of which are important predictors of post-hospitalization mortality in older ICU survivors.^{9–11,37} However, in our prior study of older ICU survivors from two New York City medical centers, after controlling for these variables, the hazard ratio of the association between Medicaid insurance and the post-hospitalization mortality rate was greater than what we observed in this study.¹⁴ The Medicare Shared Savings Program for Accountable Care Organizations was implemented during the study period, and we were unable to adjust for how this new program may affect survivors of critical illness with different types of insurance. We also sought to examine the possibility of residual confounding with a quantitative bias analysis. This analysis demonstrated that a single unmeasured confounder would have to either have a strong association with 1-year mortality, or be highly differential between Medicaid patients and patients with Medicare/commercial insurance in order to nullify our observed association in patients discharged to a skilled care facility. Given our inclusion of multiple variables measuring differences in socio-demographics and severity of illness factors, the likelihood of such unmeasured confounding may be minimized, which advocates for the robust nature of our findings. We did not separately analyze those discharged to LTAC facilities (0.3% of the study population), since there were so few of these facilities in New York State during the study period. We do not know how or whether hospice enrollment after hospital discharge may affect our results. Finally, since Medicaid is a federally subsidized state run insurance program, our results may not be generalizable to other states. However, studies that have identified deficiencies in skilled-facility care among Medicaid recipients were conducted using national samples.^{22,27,28}

US population-based studies have shown that in-hospital mortality rates for the two most common and severe critical illnesses, the Acute Respiratory Distress Syndrome (ARDS) and sepsis, have been cut by one-third to one-half in the past decade.^{38,39} As ICU patients survive longer after critical illness, critical care trial endpoints have been extended from in-hospital or 28-day mortality to 90-day mortality,^{40–45} and an entire field of research

dedicated to understanding and improving long-term outcomes after critical illness has emerged.^{46,47} Our finding that Medicaid insurance is independently associated with increased mortality in the first year after intensive care among older adults discharged to post-acute skilled-care facilities identifies healthcare disparities as an important factor in post-critical illness outcomes. Healthcare providers, investigators, and other stakeholders from both the acute and post-acute care settings should collaborate to identify the patient-, facility-, and healthcare system-level factors that need to be changed in order to improve post-acute care and outcomes for the poorest older survivors of critical illness.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Study Impact

Over the past 15 years, an entire field of research in long-term outcomes after critical illness has emerged, but little is known about how healthcare disparities after hospital discharge might affect mortality among intensive care unit (ICU) survivors. In this New York State Medicare population-based cohort study of older (age ≥ 65 years) adult survivors of intensive care, we present novel work showing that Medicaid recipients had a 9% higher 1-year mortality rate compared to those with commercial insurance. Among those discharged to skilled-care facilities, the 1-year mortality rate for Medicaid recipients was 16% higher. This is the first population-based study to identify an independent association between Medicaid insurance and increased mortality among older adult survivors of intensive care – especially among those discharged to skilled-care facilities. Our results extend the field of healthcare disparities research into the field of long-term outcomes after critical illness research. Further studies are needed to identify the patient-, facility-, and healthcare system-level factors that need to be changed in order to improve post-acute care and outcomes for the poorest older survivors of critical illness.

Figure 1.
Flow diagram for study participant selection.

Figure 2. Kaplan-Meier incidence curve for (A) mortality in the first year after hospitalization with intensive care by Commercial + Medicare insurance, Medicare only, and Medicare + Medicaid insurance. (B) Magnified plot with 1-year mortality scaled from 0 to 25%.

Figure 3.

Forest plots for stratified analyses by discharge location, mechanical ventilation use, tracheostomy, race/ethnicity, age, neighborhood household median income, teaching hospital status, and urban hospital status. Hazard ratios and 95% confidence intervals were derived from Cox model 3 that is described in the footnote of Table 2, and represent 1-year adjusted post-hospitalization mortality rate ratios.

Table 1.

Participant characteristics by insurance coverage

Characteristic	All	Commercial	Medicaid	Medicare only	p Value
No. of participants, n (%)	340,969	152,869 (45)	78,577 (23)	109,523 (32)	
Age in years, mean (SD)	77 (8.1)	78 (8.2)	77 (8.3)	77 (7.8)	<0.001
Male, n (%)	164,625 (48)	77,738 (51)	31,372 (40)	55,525 (51)	<0.001
Race & Ethnicity, n (%)					<0.001
White	238,825 (70)	127,051 (83)	31,398 (40)	80,376 (73)	
Black	40,499 (12)	9,642 (6.3)	16,700 (21)	14,157 (13)	
Hispanic	27,199 (8.0)	6,702 (4.4)	13,707 (17)	6,790 (6.2)	
Other	34,446 (10)	9,474 (6.2)	16,772 (21)	8,200 (7.5)	
Elixhauser comorbidity count, mean (SD)	3.4 (1.9)	3.3 (1.9)	3.7 (1.9)	3.4 (1.9)	<0.001
Patient type, n (%)					<0.001
Medical	189,208 (55)	80,351 (53)	49,375 (63)	59,482 (54)	
Surgical	151,760 (45)	72,518 (47)	29,202 (37)	50,040 (46)	
Principal Diagnosis Sepsis, n (%)	78,949 (23)	31,139 (20)	23,799 (30)	24,011 (22)	<0.001
Mechanical Ventilation, n (%)	44,008 (13)	16,300 (11)	14,572 (19)	13,136 (12)	<0.001
Tracheostomy, n (%)	7,082 (2.1)	2,345 (1.5)	2,887 (3.7)	1,850 (1.7)	<0.001
Dialysis, n (%)	12,157 (3.6)	4,781 (3.2)	4,263 (5.4)	3,113 (3.0)	<0.001
CPR, n (%)	1,946 (0.57)	812 (0.53)	468 (0.60)	666 (0.61)	0.021
Median Length of stay, n (IQR)	7 (4–13)	7 (4–13)	8 (4–15)	7 (4–13)	0.001
Risk of in-hospital mortality, n (%)					<0.001
Minor	59,627 (17)	28,842 (19)	11,181 (14)	19,604 (18)	
Moderate	99,887 (29)	47,041 (31)	20,175 (26)	32,671 (30)	
Major	103,823 (31)	45,608 (30)	24,688 (31)	33,527 (31)	
Extreme	77,631 (23)	31,378 (21)	22,533 (29)	23,720 (22)	
Discharge location, n (%)					<0.001
Home	127,945 (38)	60,839 (39)	23,289 (30)	43,817 (40)	
Home with services	93,468 (27)	42,248 (28)	21,188 (27)	30,032 (27)	
Skilled-Care Facility	104,747 (31)	43,529 (28)	30,245 (38)	30,973 (28)	
Inpatient Rehabilitation	5,442 (1.6)	2,639 (1.7)	1,125 (1.4)	1,678 (1.5)	
Long-Term Acute Care	1,324 (0.39)	508 (0.34)	420 (0.63)	396 (0.36)	
Other Type of Hospital	5,643 (1.7)	2,399 (1.6)	1,363 (1.7)	1,881 (1.7)	
Other Location	2,400 (0.71)	707 (0.46)	947 (1.2)	746 (0.68)	

Characteristic	All	Commercial	Medicaid	Medicare only	p Value
Hospital location, n (%)					<0.001
Urban Hospital	316,402 (93)	140,153 (92)	75,001 (95)	101,248 (92)	
Rural Hospital	24,567 (7.2)	12,716 (8.3)	3,576 (4.6)	8,275 (7.6)	
Teaching Hospital, n (%)	236,454 (69)	95,838 (63)	62,453 (79)	78,163 (71)	<0.001
Urban zip code residence (%)	302,148 (90)	131,399 (88)	74,824 (96)	95,925 (88)	<0.001
Median neighborhood household income, \$	57,393	67,041	47,070	56,058	<0.001

Abbreviations: HR: hazard ratio; Commercial: Medicare + Commercial insurance; Medicaid: Medicare + Medicaid; Other race: unknown race non-Hispanic and multi-racial non-Hispanic, Asian, Native American, Native Hawaiian; CPR: Cardiopulmonary Resuscitation.

Table 2.

Associations between insurance status and mortality among older ICU survivors

Insurance Status	Commercial	Medicaid	Medicare only
Number of participants, n (%)	152,869 (45)	78,577 (23)	109,523 (32)
1-year mortality, % (95% CI)	18.7 (18.5–8.9)	22.2 (22.0–22.6)	18.5 (18.3–18.7)
Mortality rate, per 100 person-years (95% CI)	21.1 (21.0–21.4)	26.0 (25.4–26.2)	21.0 (20.5–21.1)
Unadjusted HR for death (95% CI)	1	1.22 (1.19–1.24)	0.99 (0.97–1.01)
Model 1: HR for death (95% CI) ^a	1	1.29 (1.27–1.32)	1.02 (1.00–1.03)
Model 2: HR for death (95% CI) ^b	1	1.07 (1.05–1.09)	0.99 (0.98–1.01)
Model 3: HR for death (95% CI) ^c	1	1.09 (1.05–1.12)	1.01 (0.99–1.04)

Abbreviations: HR, hazard ratio; Commercial = Medicare + Commercial insurance; Medicaid = Medicare + Medicaid.

^aModel 1: Age, sex, race/ethnicity, type of patient (medical vs. surgical), neighborhood median income.^bModel 2: Model 1 + Elixhauser comorbidity count, sepsis diagnosis, dialysis, mechanical ventilation, tracheostomy, length of stay, in predicted in-hospital mortality risk.^cModel 3: Model 2 + teaching hospital status, urban hospital status, year of admission, and cluster standard errors variable for hospital