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Age differences in survival outcomes and resource use for chronically critically ill patients

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Abstract

Purpose—Chronically critically ill (CCI) patients use a disproportionate amount of resources, yet little research has examined outcomes for older CCI patients. The purpose of this study was to compare outcomes (mortality, disposition, posthospital resource use) between older (≥ 65 years) and middle-aged (45–64 years) patients who require more than 96 hours of mechanical ventilation while in the intensive care unit.

Methods—Data from 2 prospective studies were combined for the present examination. In-hospital as well as posthospital discharge data were obtained via chart abstraction and interviews.

Results—One thousand one hundred twenty-one subjects were enrolled; 62.4% ($n = 700$) were older. Older subjects had a 1.3 greater risk for overall mortality (from admission to 4 months posthospital discharge) than middle-aged subjects. The Acute Physiology Score (odds ratio [OR], 1.009), presence of diabetes (OR, 2.37), mechanical ventilation at discharge (OR, 3.17), and being older (OR, 2.20) were statistically significant predictors of death at 4 months postdischarge. Older subjects had significantly higher charges for home careservices, although they spent less time at home (mean, 22.1 days) than middle-aged subjects (mean, 31.3 days) ($P = .03$).

Conclusion—Older subjects were at higher risk of overall mortality and used, on average, more postdischarge services per patient when compared with middle-age dsubjects.

Keywords

Survival outcomes; Discharge data; Mortality; Long-term mechanical ventilation

INTRODUCTION

The increase in healthcare costs in the United States has been well documented^{1–2} with 2006 expenditures for health care exceeding 2 trillion dollars³. Reasons cited as contributing to the rise in healthcare costs are the aging of the population, increases in severity of illness, and the growing number of chronically critically ill (CCI) patients^{1,4–5}. CCI patients are intensive care unit (ICU) patients who survive an initial period of life threatening illness, but who remain dependent on the high technology services (especially mechanical ventilation) of the critical care unit⁵. This group of patients, while accounting for approximately 10% of ICU admissions, utilizes 25–40% of ICU resources with resulting high in-hospital mortality and continuing post-discharge morbidity^{5–6}.

While research has examined outcomes for CCI patients, little has focused on examining outcomes for older CCI patients. While those age 65 and over comprise only 13% of the U.S. population, they consume 36% of total U.S. personal health care expenses⁷. As a result, the cost of health care expenditures for older adults has been predicted to reach \$15,970 billion by the year 2030⁸. In addition, the number of admissions for older patients has been rising with 25% to 50% of all admissions to ICUs being for older patients⁹. It is expected that the older CCI population will continue to grow and utilize a relatively large amount of resources.

The impact of age on in-hospital outcomes of ICU patients requiring prolonged mechanical ventilation has been examined^{1,10–12}. Studies that have included age-specific data for these patients have yielded mixed results regarding whether or not age has an impact on outcomes following mechanical ventilation^{8,10,13–15}. Prior research has focused primarily on the impact of age upon in-hospital outcomes and there is a need to examine post-hospital discharge outcomes in order to more fully assess the impact of age upon outcomes^{1,14}.

The primary purpose of our study was to examine the relationship between age and in-hospital and post-hospital outcomes for older CCI patients. Specifically, we were interested in comparing outcomes (mortality, disposition, post-hospital resource use) between patients ≥ 65 years of age (older) and patients ages 45–64 years (middle-aged) who require >96 hours of mechanical ventilation while in the ICU.

We were interested in comparing these two age groups in order to more fully understand the outcomes of older subjects as they related to a comparison group of middle-aged subjects. Traditionally, research examining the impact of age upon outcomes for CCI patients has dichotomized age as older (≥ 65 or ≥ 75 years) and younger (<65 or <75 years). It has been argued that to use a cohort group whose ages range from 18 to 64 years as a comparison group is not ideal¹⁶ and it has been recommended that older and middle-aged adult age groups be used for analysis and comparisons.^{16–17} To date, no one has utilized the middle-aged group as a comparison group for older CCI patients.

There is no precise definition of “prolonged mechanical ventilation” (PMV)¹². Some define PMV based on Diagnosis Related Groups (DRG) categories focused on mechanical ventilatory support (DRG 475, 483, 541), while others define it utilizing ICD-9 codes that include patients who have received ≥ 5 days of mechanical ventilation. The National Association for Medical Direction of Respiratory Care (NAMDRRC) has recommended that PMV be defined as the need for ≥ 21 consecutive days of mechanical ventilation for ≥ 6 hours/day. In both of our studies, we chose the number of days of mechanical ventilation to define the subset of patients that we felt were “chronically critically ill”. Previous research has established that patients who require mechanical ventilation beyond 72 hours are at high risk of death or prolonged hospitalization with multi-organ dysfunction and continuing care needs beyond hospital discharge.^{10,18}

For the present study, we used >96 continuous hours of mechanical ventilation in the ICU as eligibility criteria. We did so for several reasons. First, we wanted to include patients who did not follow the usual short stay pattern, many of whom died after 10–14 days in the ICU. Secondly, we felt that the >96 hour definition encompassed patients who were requiring a greater amount of time on mechanical ventilation and for whom decisions regarding utilization of health care resources and treatment goals would be of key importance. Finally, this criterion was consistent with the number of days associated with Medicare’s definition of PMV and was felt to be more meaningful to clinicians.

METHODS

For the purposes of this retrospective study, data from two large studies were combined. This was done to increase the sample size in order to increase confidence and generalizability of

study results. Both studies used very similar eligibility and ineligibility criteria and during the time span of the two studies, key characteristics of the CCI population (e.g. mortality and percentage of patients being discharged to home) had not changed. One aspect of clinical practice that did change over the course of the two studies, however, was the use of long term acute care (LTAC) facilities for post-hospital care. While instituted in the 1980s, the use of LTACs did not begin to grow in our area until the late 1990's. Thus, during the study that took place from 1997–99, less than 1% of all study patients were discharged to an LTAC. In the second study (from 2001–03), 11.7% of all study patients were discharged to an LTAC. Today, we find that 30.4% of our CCI subjects are discharged to an LTAC. This change in practice has had an impact in shortening hospital length of stay and associated in-hospital charges. As a result, when comparing survival over time and over studies, we have examined the trajectory of the entire care experience; not only in-hospital but post-hospital outcomes as well.

Descriptions of the two studies have been presented in detail elsewhere^{18,19}. Both studies were conducted primarily at University Hospitals of Cleveland, a 950-bed tertiary care hospital associated with Case Western Reserve University. The first study (Long-Term Ventilator), a longitudinal descriptive study, was conducted from February 1997 through mid-March 1999 and included 8.6% of its subjects from a Veteran's Administration Hospital and 6.4% of its subjects from a local community hospital. The second study (Disease Management Intervention), a randomized clinical trial, was conducted from March 2001 to December 2003 with all subjects being recruited from University Hospitals of Cleveland. For both studies, all patients who met eligibility criteria during their hospitalization in any adult intensive care unit (ICU) of the study hospital(s) were enrolled. Patients and family members were approached for written consent to participate when it was clear that hospital discharge was expected within the next few days. Institutional Review Board approvals were obtained prior to data collection for both studies.

Definition of age categories

The definition of the term “older” has varied^{8,13}. For the present study, age ≥ 65 years was used to defined the “older” age group because we wanted to be able to make comparisons with other studies that have included older ICU patients as well as those requiring extended mechanical ventilation^{1,6,11,14,20}, and many of the studies used 65 years of age or older as their definition of older.

Eligibility criteria

Eligibility criteria for both studies were: age ≥ 18 years, the ability to speak English, and > 96 hours of continuous mechanical ventilation while in the ICU. All diagnoses were accepted and patients who required mechanical ventilation at home before becoming hospitalized were not eligible for enrollment. For the second study, organ transplant patients, receiving case management from the transplant team, and hospice patients were excluded.

Data collection

Study staff were trained in the use of research instruments prior to data collection and inter-rater reliability was monitored throughout the study. Retraining and refinement of data collection rules were done as needed if correlations and percent agreements fell below acceptable levels ($r > .80$, kappa $> .70$, percent agreement > 80). Research nurses gathered data from patient's charts and interviewed patients (or their proxies) within two weeks of hospital discharge and again, 2 months later. Subjects (or their proxies) were contacted every two weeks throughout the study period in order to determine the patient's location and survival status. For subjects who were alive at 2 months post-discharge, research nurses made a single phone call at 4 months for the purpose of determining the patient's survival status and current living

location. They did not obtain cognitive status information nor did they obtain additional resource use data at this time.

The post-discharge outcome time points of 2 months and 4 months were selected based upon prior research. Based upon examination of mortality, resource use, and location data from the LTV study (1997–99) we found that all curves (resource use, readmission, mortality) flattened after 2 months. Thus, the subsequent study (DMI) focused upon altering outcomes in the high risk period of the first 2 months post-hospital discharge. While we recognized that gathering data on more distant outcomes was preferable, study funding did not permit this. As a compromise, we made a 4 month phone call to check location and survival status. For subjects who could not be located by phone, we searched the Social Security Death Index Database to establish mortality status at the 4 month post-discharge period.

Instruments

Patient demographic and clinical data were abstracted from patients' hospital medical records. The Acute Physiology and Chronic Health Evaluation (APACHE) III was used to assess severity of illness upon admission to the ICU. The APACHE III is an established tool that measures mortality risk using physiologic and chronic health data taken from the first 24 hours of ICU admission. APACHE scores range from 0 – 299, with higher scores representing higher risk of death. The Acute Physiology Score (APS) was also computed (APACHE score – age score) for use in analysis. Reliability of the tool has been reported²¹.

The Katzman Short Orientation-Memory Concentration Test was used to determine cognitive status of patients at hospital discharge and two months post-discharge. The test includes three orientation questions with the range of possible points being 0 (normal) to 28. Reliability and validity have been established with scores > 6 correlating with cognitive impairment²².

Post-discharge resource used was assessed by using standardized charges, a metric for resource use that is both interpretable and standardized across settings and time²³. We used billing data from patients during the year 2001 to determine a “standardized mean charge” for resources used (one day of care for: rehospitalization, LTAC, rehabilitation facility, and nursing home facility) and then applied those charges to the appropriated resources used regardless of the year of use. Medicare reimbursement (2001) was assigned to each home resource used. Standardized charges then were summed for each category of resource use and all categories of resource use were then summed to compute a total charge for all resources used for the 2 months post-hospital discharge.

Statistical Analysis

Comparisons between age groups were done using Analysis of Variance for non-skewed continuous variables, Mann-Whitney U for skewed continuous variables, and Chi-square for categorical variables. Time-to-death was compared using survival analytic techniques and logistic regression was used to determine variables that predicted death and to examine variables that related to mortality.

Results

Figure 1 shows the distribution of the total sample. The sample is similar to other samples of CCI patients in that their average age was 68.3, predominantly Caucasian, evenly divided between males and females, with a majority (86.8%) living independently prior to this hospitalization. As a group they spent, on average, 19.9 days in the ICU and 14.3 days on mechanical ventilation. Of the 1121 subjects enrolled in-hospital, over one half were older (≥ 65 years of age) and over one-third (48.9%) died in-hospital.

Older subjects were more likely to be Caucasian, have an Advance Directive, and have a cardiac diagnosis (ICD-9) as the reason for hospital admission compared to middle-aged subjects (Table 1). While ethnicity was significantly different between age groups, it did not relate to mortality and resource use. Average length of mechanical ventilation was not statistically different between groups and respiratory distress/failure was the primary reason for mechanical ventilation for both groups.

Survival

Unadjusted in-hospital mortality was 35.2% (148/421) for middle-aged and 42.9% (300/700) for older subjects with an overall in-hospital mortality rate being 40% for the entire sample (table 1). For older subjects, the risk of in-hospital death was 1.22 times greater than for younger subjects (95% CI: 1.04, 1.42; $p=.011$). For those subjects who survived their hospital stay, post-discharge mortality risks were higher for older subjects than for middle-aged subjects: older subjects had a higher 4 month post-discharge mortality rate (42.1% versus 21.3%) and higher post-discharge risk of death (RR: 1.98; CI: 1.47, 2.67; $p=.001$) than did middle-aged subjects.

With a larger percentage of older subjects having advance directives compared to middle-aged subjects, we were also interested in examining the withdrawal of life sustaining therapy for both groups. Of the middle-aged subjects who died, 48.5% were terminally weaned compared to 42.8% of those who were older ($p=.22$) and 16.1% the middle-aged subjects had advance directives and were terminally weaned compared to 20.9% of older subjects ($p=.27$).

Figure 2 displays survival curves (Kaplan-Meier) over time, from patient in-hospital enrollment to the end of the observation period (death, drop out, or 4 months after hospital discharge) for all patients. Survival curves for both age groups were compared using the generalized Mantel-Cox log-rank test. The survival rates were significantly different for the two groups over time ($X^2(1)=19.8$, $p=.001$); the cumulative (up to 4 months post-hospital discharge) mortality rate was 60.4% (423/700) for older subjects compared to 45.6% (192/421) for middle-aged subjects. Older subjects had a 1.3 (95% CI: 1.18, 1.50, $p=.001$) greater risk for overall mortality (from admission to 4 months post-hospital discharge) than middle-aged subjects. Median time to death was 99 days from ICU admission for middle-aged (95% CI: 71.79 to 126.20) as compared to 46 days for older patients (95% CI: 39.27 to 52.73). As seen in Figure 2, survival patterns were similar for both age groups for the first 15–20 days, at which point the curves begin to diverge. Using Cox's proportional hazards analysis we examined the distribution of survival over time adjusting for ethnicity, APS, and gender. We found that after controlling for these variables, there were still statistically significant differences in survival rates over time between age groups ($p=.001$).

Predictors of Death

Using logistic regression, we examined the influence of variables shown to relate to risk of death for this population^{18,24–26}. Independent variables included as covariates were the following: length of mechanical ventilation, APS, presence of diabetes, number of pre-existing conditions, presence of mechanical ventilation at hospital discharge, and age group (middle-aged, older). Examination of the variables indicated no concerns regarding multicollinearity and all variables were left in the model. The model with all of the variables in the equation was statistically significant in predicting death ($p=.001$) and the correct classification for death and no death (from hospital admission to 4 months post-hospital discharge) occurred 72.6% of the time ($R^2 = 0.21$ [Nagelkerke test]). Four independent variables made statistically significant contributions to the prediction of death: APS (OR: 1.009, 95% CI: 1.001, 1.02, $p=.03$), presence of diabetes (OR: 2.37, 95% CI: 1.47, 3.85, $p=.0001$), requiring mechanical ventilation at

hospital discharge (OR: 3.17, 95% CI: 1.85, 5.44, $p=.0001$) and being older (OR: 2.20, 95% CI: 1.39, 3.46, $p=.001$).

Discharge Outcomes and Resource Use

Older subjects were more likely to be discharged from the hospital to an institutional setting, discharged with cognitive impairment, discharged on oxygen, and discharged on a ventilator than those who were middle-aged (Table 2). For all subjects discharged from the hospital on a ventilator, the overall risk of post-discharge death was 2.4 times greater than for those who were not on a ventilator at hospital discharge (95% CI: 1.83, 3.06; $p=.0001$). For older subjects discharged on a ventilator, the risk of post-discharge death was 1.9 times greater than for older subjects who did not require mechanical ventilation at hospital discharge (95% CI: 1.48, 2.61, $p=.0001$). For middle aged subjects discharged on a ventilator, the risk of post-discharge death was 2.76 times greater than for middle age subjects who did not require mechanical ventilation at hospital discharge (95% CI: 1.59, 4.79, $p=.0005$).

For those who survived two months post-hospital discharge, a majority (244/359 = 67.9%) spent some time during the post-discharge period in an institutional setting (LTAC, Rehabilitation, Nursing home). Seventy-two percent of older subjects (133/185) and 63.8% of middle-aged subjects (111/174) spent some time in an institutional setting. During the two months following hospital discharge, older subjects spent an average of 39.9 (SD=17.18) days and middle-aged subjects spent 37.6 (SD=17.03) days in an institutional setting ($p=.29$). As seen in Figure 3, taking into account post-discharge mortality, a greater percentage of middle-aged subjects were residing at home 2 months post-hospital discharge compared to older subjects ($\chi^2(1) = 51.79$, $p = .0001$).

In the DMI study, subjects in the experimental group had shown a reduction in readmission days (not in incidence of readmission). Thus, subjects from the DMI study who were in the experimental group and who were readmitted were dropped from the resource use analyses (Table 3). While older subjects were readmitted at a similar rate (30.1%) as middle-aged subjects (22.5%) ($p=.13$), their length of stay associated with readmission was less (Older subjects: $M=8.5$, $SD=12.3$ versus middle-aged subjects: $M=12.9$, $SD=14.6$) ($p=.16$). As a result, charges associated with readmission days were lower for older subjects compared to middle-aged subjects, but this difference was not statistically significant ($p=.16$). Older subjects had higher post-discharge charges for nursing home care and spent slightly more time in a nursing home ($M=39.6$ days) than did their middle-aged counterparts ($M=34.6$ days) ($p=.18$). While older subjects had significantly higher charges for home care, they spent less time at home ($M=22.1$ days) than middle-aged subjects ($M=31.3$ days) ($p=.03$).

Because more than a quarter (128/487 = 26.3%) of patients who participated in the post-discharge portion of both studies died during the first two months post-discharge, we were interested in examining readmission data by taking into account those who had died during the post-discharge period. Readmission data were obtained during the first two months post-hospital discharge. Given the fact that when a patient died, they were no longer included in the study (and did not have the same opportunity to be tracked for readmission), we utilized an analytic approach that involved including categories for death²⁷. For the purposes of more fully describing readmission patterns, we classified subjects into one of four categories based upon their outcome between hospital discharge and 2-month post-discharge time point: never readmitted but died, readmitted and died, readmitted but did not die, never readmitted and did not die (Figure 4). Based upon these categorizations, 6.8% (14/207) of the middle-aged subjects were readmitted and subsequently died as compared to 12.0% (31/280) of the older subjects. Using a χ^2 goodness-of-fit, we found a statistically significant increase in the percentage of subjects who were readmitted and died from the older group compared to the middle-aged group (what was expected using a χ^2 distribution), $\chi^2(1)= 14.21$, $p=.0002$. As seen in Figure

4, the percentage of deaths for “no readmission but death” was higher in the older group. Of note was that for those who were not readmitted but died, 21.1% (4/19) of middle-aged subjects had advance directives compared to 43.8% (28/64) of older subjects ($p=.02$).

DISCUSSION

It has been well documented that long-term outcomes of patients requiring prolonged mechanical ventilation are poor^{10,24–26} and that elderly patients who require PMV are at even greater risk for high mortality and morbidity^{8,9,14}. Research on elderly CCI patients has focused primarily on in-hospital outcomes and such reports have lacked examination of post-hospital outcomes for this vulnerable group of patients. In addition, prior research has primarily used all subjects younger than age 65 as the comparison group. In the present study we have used only middle-aged subjects as a comparison group in order to be more conceptually consistent with research comparing outcomes for older subjects. We have examined in-hospital and post-hospital outcomes and have several findings to note.

First, using multivariate analyses, we found that age was significantly related to overall mortality for older CCI patients, a finding supported by others^{1,10,20,28}. With more patients being transferred from ICU settings to post-hospital facilities that continue to provide acute care, the “in-hospital” and “post-hospital” distinction becomes blurred. By examining mortality over a longer continuum, we feel that we are able to provide a more meaningful estimate of the mortality experience and risk.

When examining the survival curves by group, the pattern and rate of mortality was the same regardless of age for the first 2–3 weeks of hospitalization. However, in the post-acute phase, the curves diverged and the divergence grew over time. By approximately 120–130 days after ICU admission, the curves began to flatten with small decreases in survival over time. One possible explanation for this pattern is that modern critical care technology is effective in the “rescue” phase of acute illnesses, but is not able to modify the impact of underlying comorbidities and age. Thus, we see no difference initially, when technology use is probably highest, but eventually as the body’s defenses diminish over time, we see the impact of age and underlying comorbidities. Another key finding focused upon post-discharge mortality. Not only did we report that age has an impact upon post-discharge mortality, we also found that for patients discharged on mechanical ventilation, their overall risk of post-discharge death was approximately two times greater than subjects who did not require mechanical ventilation.

Second, we found that surviving to hospital discharge does not guarantee a smooth post-hospital trajectory of care—particularly for older subjects. Older subjects were at higher risk of readmission and death and were less likely to be residing at home 2 months post-hospital discharge, as compared to their middle-aged counterparts. In addition, for those subjects who survived 2 months post-discharge, older subjects’ post-discharge charges for home care were more than middle-aged subjects—this despite the fact that older subjects spent fewer days at home post-discharge. Thus, their home care needs, while utilizing fewer days, were more costly than middle-aged subjects. While not statistically significant, we also found that older subjects had fewer readmission days than did their middle-aged counterparts. One contributing factor to this finding could be that 42% of older subjects alive at hospital discharge had advance directives compared to only 27.3% of middle-aged subjects ($p=.001$). Thus, a greater percentage of older subjects were perhaps more likely to avoid expensive life sustaining therapies since more of them had advance directives.

These findings provide needed information for families as well as health care providers. While much has been documented regarding in-hospital mortality and morbidity associated with prolonged mechanical ventilation for older patients, less is known about their post-discharge

experience. Our findings indicate that older subjects are at increased risk for mortality post-discharge and incur higher post-discharge resources than middle-aged subjects. These findings can help families and health care providers as they plan and make decisions regarding treatment options for these patients.

There are several limitations to the study. First is the measurement of resource use. Prior researcher has utilized cost-to-charge ratios in reporting resource use. Given the large period of time over which these data were collected, it was beyond the scope of this project to calculate cost-to-charge ratios. A second limitation is the limited post-hospital discharge follow-up period. We only collected post-hospital resource use data for 2 months and tracked survival for only 4 months. A longer follow-up period of time would have provided a more comprehensive view of recovery especially given our interest in examining the possibility of a slower recovery time for older patients.

In summary, this study adds new information to the literature about post-hospital experience for older and middle-aged CCI patients. As the percentage of patients $\geq$ age 65 continues to increase, information about long-term outcomes will become increasingly important as families, patients, and healthcare providers strive to make decisions and plans in the hospital that support patients' preferences and goals. Data provided by this study are a first step in this process.

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Figure 1.
Sample selection.

Figure 2.
Survival from hospital admission to 4 months post-hospital discharge for middle-aged (n=421) and older patients (n=700).

Figure 3. Comparison of categories of post-discharge location and survival status at 2 months post-hospital discharge for middle aged (n=177) and older (n=227) patients. This sample size represents subjects who had complete data 2 months post-hospital discharge (missing data: n=83)

Note. Solid black represents the percentage of patients who died during the first 2 months post-hospital discharge and were not able to provide ongoing data.

Figure 4. Comparison of categories of post-discharge readmission and survival status at 2 months post-hospital discharge for middle aged (n=207) and older (n=280) patients

Note. Solid black represents the percentage of patients who were readmitted and died during readmission and were not able to provide ongoing data.

Table 1

Comparison of demographic and clinical variables between 45–64 years old (middle-aged) and ≥ 64 years old (older) (n=1121).

Variable	Middle-aged (n=421)	Older (n=700)	z	p
	Mean (SD)	Mean (SD)		
Age	55.66 (5.41)	75.84 (6.71)	−28.1	.001
Confidence Interval	55.14 – 56.17	75.34 – 76.33		
Acute Physiologic Score	64.75 (28.86)	62.66 (26.50)	−0.8	.232
Confidence Interval	61.92 – 67.57	60.60 – 64.72		
Mechanical Ventilation (days)	14.49 (16.41)	14.17 (11.91)	−0.7	.704
Confidence Interval	12.92–16.06	13.28 – 15.05		
ICU Stay (days)	19.78 (20.27)	19.90 (15.26)	−1.9	.905
Confidence Interval	17.84 – 21.72	18.77 – 21.04		
Length of Hospital Stay (days)	26.39 (22.99)	26.85 (18.83)	−1.9	.716
Confidence Interval	24.18 – 28.59	24.45 – 28.24		
Number of Pre-existing Conditions	4.72 (3.37)	4.88 (3.11)	−1.4	.447
Confidence Interval	4.40 – 5.05	4.64 – 5.11		
	n (%)	n (%)	χ^2	p
Male Gender	218 (51.8)	341 (48.7)	.99	.320
Caucasian Race	271 (64.4)	504 (72.1)	7.37	.007
Married	220 (53.0)	345 (49.6)	1.23	.267
Living at Home Prior to Hospital	381 (91.6)	582 (84.0)	13.62	.001
Advance Directive: Yes	71 (26.3)	228 (46.1)	28.66	.001
	n (%)	n (%)		
Reason for Mechanical Ventilation			11.81	.008
• Respiratory distress/failure	194 (46.2)	321 (46.1)		
• Routine operative ventilation	112 (26.7)	239 (34.3)		
• Neuro impairment/airway	73 (17.4)	84 (12.1)		
• Post-arrest	41 (9.8)	52 (7.5)		
Admitted Medical ICU	216 (51.3)	355 (50.7)	0.37	.85
Admitting Diagnosis (ICD-9)			20.99	.001
• Coronary	85 (20.2)	203 (29.0)		
• Pulmonary	86 (20.4)	172 (24.6)		
• Neurologic	87 (20.7)	98 (14.0)		
• GI	40 (9.5)	66 (9.4)		
• Other	123 (29.2)	161 (23.0)		
Inhospital Mortality ^I	148 (35.2)	300 (42.9)	6.50	.011

^I Relative risk ratio: 1.22, 95% CI: 1.04, 1.42.

Comparison of discharge variables between middle-aged and older subjects alive at hospital discharge (n = 673).

Table 2

Variable	Middle-aged (n=273) n (%)	Older (n =400) n (%)	χ^2	p	RR [95% CI]
Discharge Disposition			27.90	.001	1.2 [1.11, 1.29]
• Institution	208 (76.2)	364 (91.0)			
• Home	65 (23.8)	36 (9.0)			
DC: Oxygen	129 (49.2)	234 (60.9)	8.66	.003	1.2 [1.07, .43]
DC: Tracheostomy	102 (40.0)	161 (42.7)	.46	.498	1.1 [0.88, .29]
DC: Ventilator	37 (13.6)	81 (20.3)	5.09	.024	1.5 [1.05, .14]
DC: Cognitive Impair. ¹	59 (34.9)	96 (49.0)	7.35	.007	1.4 [1.09, .80]
Post-Discharge death ² : Yes	44 (21.3)	118 (42.1)	23.39	.001 ²	1.9 [1.47, .67]

¹ Sample size (n=365) due to missing data.

² Sample size (n=487) due to refusal (n=186) of post-hospital follow-up.

Table 3

Comparison of post-discharge resource use between middle-aged and older subjects who survived 2 months post-hospital discharge (n=244^I).

Variable	Middle-aged (n=111)	Older (n=133)	F	p
	Mean (SD)	Mean (SD)		
Charges: Nursing home	\$22,449.60 (12,326.83)	\$25,240.13 (12,191.72)	1.3	.25
<i>Confidence Interval</i>	18,746.21 – 26,152.99	22,117.69 – 28,362.58		
Charges: Rehabilitation	\$30,706.67 (17,084.19)	\$29,067.769(15,429.89)	0.2	.68
<i>Confidence Interval</i>	23,492.64 – 37,920.69	24,771.98 – 33,363.40		
Charges: LTAC	\$118,079.50 (42,364.59)	\$110,896.30 (58,713.12)	0.2	.69
<i>Confidence Interval</i>	95,505.01 – 140,653.99	82,597.44 – 139,195.08		
Charges: Readmission	\$43,954.35 (49,713.31)	\$29,164.10 (41,973.92)	2.1	.16
<i>Confidence Interval</i>	25,719.36 – 62,189.35	17,235.24 – 41,092.96		
Charges: Home care	\$1,475.83 (1,405.50)	\$2,401.99 (2,369.73)	7.5	.007
<i>Confidence Interval</i>	1,138.20 – 1,813.47	1,789.83 – 3,014.16		
Charges: Total	\$47,307.58 (51,678.98)	\$51,421.56 (46,913.89)	0.4	.52
<i>Confidence Interval</i>	37,586.72 – 57,028.44	43,374.75 – 59,468.36		

^I Sample size excludes those who were in the experimental group (DMI study) and were readmitted. It also excludes those who have missing data. Sample sizes presented for each variable represent the number of subjects who used those services: nursing home (n=106), rehabilitation (n=76), LTAC (n=35), readmission (n=81), home care (n=129).