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The Natural History of Code Status Changes and Its Implications on Inpatient Mortality in Younger and Older Hospitalized Patients

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Abstract

Objectives—To examine the differences in code status changes and subsequent mortality between younger and older inpatients.

Design—Retrospective cohort study

Setting—Kaiser Permanente Northern California (KPNC)

Participants—Patients hospitalized at 21 KPNC hospitals between 2008 and 2012

Measurements—We categorized 227,252 inpatients into young, elderly, and very elderly age groups (<65, 65–84, and ≥85 years, respectively). We evaluated the effect of age on adding new and reversing prior life-sustaining treatment (LST) limitations. We compared survival to inpatient discharge by age group after adding new LST limitations.

Results—At admission, 18,256 (54.2%) of the very elderly and 18,349 (20.8%) of the elderly had a non-full code order, compared with 3,258 (3.1%) of the young patients. Among the 187,664 patients admitted as full code, 15,932 (8.5%) added new limitations; among the 39,861 patients admitted with LST limitations, 3,017 (7.6%) had these reversed. New limitations were more likely

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to be seen in older patients (odds ratio (OR)=2.27, 95% confidence interval (CI)=2.16-2.39 for elderly; and OR=6.43, 95% CI=6.05-6.84 for very elderly), and reversals of prior limitations were less likely to be seen in older patients (OR=0.73, 95% CI =0.65-0.83 for elderly; and OR=0.46, 95% CI=0.41-0.53 for very elderly), compared with younger patients. Among those who added new limitations, survival rates were 71.7% in very elderly, 57.2% in elderly, and 43.4% in young patients ($p<0.001$).

Conclusion—Changes in code status were common among hospitalized patients. Age was a key determinant in the likelihood of adding new or reversing prior LST limitations. Compared with younger patients, older patients who added LST limitations were more likely to survive to hospital discharge.

Keywords

Resuscitation order; Life support care; Hospitalization

INTRODUCTION

Discussions between clinicians and patients or their surrogate decision-makers regarding patients' preferences for life-sustaining treatments (LSTs) have been used in hospitals for more than two decades to promote patient autonomy.¹ These discussions commonly lead to orders designating a patient's 'code status' or care directive in the hospital. However, prior studies have shown that such orders have had limited success in preserving patient self-determination.²⁻⁷

These limitations may result from an incomplete understanding of LST decision-making and code status orders in contemporary hospital settings.⁸⁻¹⁰ Prior studies have elaborated on the substantial variability that exists in LST orders based on differences in patient, family, provider, and institutional factors.^{3, 4, 7, 11-30} However, these studies have primarily focused on specific populations such as patients in the intensive care unit (ICU), patients with selected diagnoses, or those with a poor prognosis; they also focus primarily on the addition of new LST limitations.^{13, 16, 31-37}

Furthermore, although advanced age is known to be associated with an increased use of do-not-resuscitate (DNR) orders,^{38, 39} little is known about how age impacts the decision to add new or to reverse prior LST limitations. Because age plays an important role in physicians' decisions and recommendations regarding the use of DNR orders,^{40, 41} an improved understanding of how inpatient LST changes vary by age is important to ensure that the elderly are not treated differently from younger patients.

In a community-based, multi-center population of 227,525 patients hospitalized in the Kaiser Permanente Northern California (KPNC) integrated healthcare delivery system, we examined changes to LST orders in younger and older patients. We hypothesized that, compared to younger patients, older patients would be more likely to add new, and less likely to reverse prior, LST limitations during hospitalization. We further hypothesized that patients across different age categories would consider factors such as their acute severity of

illness, admitting diagnosis, comorbidity burden, and prior stated preferences differently in making their LST decisions.

METHODS

This study was approved by the KPNC Institutional Review Board which has jurisdiction over all study hospitals.

Subjects and Hospitalizations

We conducted a retrospective study of inpatient admissions at 21 KPNC hospitals between January 1, 2008 and September 30, 2012 that: (1) involved patients aged ≥ 18 years, (2) included at least one overnight stay, (3) began at a KPNC hospital which had used the current electronic medical record (EMR) for ≥ 3 months, (4) were not for childbirth or observation, and (5) originated from the emergency department (ED). If a patient had multiple admissions, we only included the last or most recent admission in our records.

Patient Characteristics

Based on methods detailed in prior studies, we obtained patients' age, gender, comorbidity burden, prior hospitalization, acute severity of illness, hospital events, hospital mortality, and code status orders from clinical and research databases.⁴²⁻⁴⁶ We grouped patients into young, elderly, and very elderly categories by age (<65 , 65-84, and ≥ 85 years, respectively) at the time of admission. We quantified comorbidity burden with the Comorbidity Point Score, version 2 (COPS2), an externally validated system incorporating diagnosis data from the year prior to hospitalization.^{44, 46} We quantified acute severity of illness at admission with the Laboratory Acute Physiology Score, version 2 (LAPS2), a score which incorporates 21 laboratory values, vital signs, and neurological status in the 72 hours preceding inpatient admission.^{46, 47}

We identified patients' admitting diagnoses based on *International Classification of Disease, 9th edition, Clinical Modification* (ICD-9) diagnosis codes. We grouped these codes into 8 major groups using the Agency for Healthcare Research and Quality Clinical Classifications Software multi-level diagnosis: infectious, neoplastic, respiratory, circulatory, neurological or psychiatric, gastrointestinal, endocrine, and other.⁴⁸ We determined patients' ICU utilization and ascertained hospital mortality from inpatient records.

Code Status Orders

Physicians are required to enter code status orders as part of their electronic admission orders, and they can be updated during hospitalization to reflect new LST preferences. At KPNC, four code status orders are used: full, partial, DNR, and comfort care. 'Full' code indicates that full resuscitation will be attempted without any limitations in the event of a cardiopulmonary arrest. 'Partial' code indicates that resuscitation may be performed but with certain restrictions (e.g., no endotracheal intubation or no chest compressions). 'DNR' indicates a desire for no cardiopulmonary resuscitation or other forms of LST such as mechanical ventilation following cardiopulmonary arrest. 'Comfort care' indicates that death is expected and is often accompanied by protocolized analgesic and anxiolytic treatment to

direct goals towards comfort-oriented measures. In our primary analysis, we grouped all non-full code orders into a ‘limited LST’ category to distinguish them from patients without any LST limitations.

We designated the first code status order during a hospitalization as the ‘index code status’. We excluded patients without a code status order within 6 hours of admission (n=4,843, 2.1% of total starting sample). If a ‘DNR’ order was placed within 2 hours of a ‘comfort care’ order, we disregarded the ‘DNR’ order and only retained the ‘comfort care’ order.

Changes in Code Status Orders

To evaluate patients with changes in code status orders during hospitalization, we identified two subgroups: (1) patients who entered the hospital with a full code order and had a subsequent limited LST order (‘addition of new LST limitations’ subgroup); and (2) those who entered the hospital with a limited LST order and then had any part of their LST limitations reversed (‘reversal of prior LST limitations’ subgroup). Patients in the reversal of prior LST limitations subgroup included those changing from comfort care to any other code status, from DNR to partial or full code, or from partial to full code. We included patients in each subgroup even when their final hospital discharge code status order was the same as their admission order (indicating they had 2 changes during hospitalization).

Statistical Analysis

We compared the baseline characteristics of patients by age group with analysis of variance or chi-squared testing. To understand the differential impact of age on the timing of code status changes, we summarized the elapsed time between admission and the first care order change among patients who changed their code status during hospitalization. We also characterized code status changes in relation to ICU use and compared the frequency of changes that occurred within and outside of the ICU by age group.

We evaluated the effect of age on code status changes using multivariable logistic regression models with addition of new LST limitations or reversal of prior LST limitations as the outcome in separate models. All regressions controlled for gender, acute severity of illness (LAPS2) and comorbidity scores (COPS2), prior KPNC hospitalizations within the past year (none, 1-2, or >2), prior KPNC hospitalization with order to limit LST, direct ICU admission, admitting time of day (overnight, daytime, and evening), weekend versus weekday admission, season, admitting diagnosis, and hospital facility. We then stratified the regressions by age group. To obtain the relative contribution of each predictor to overall model explanatory power, we calculated the differences between the log-likelihood of the full model and the log-likelihood of models excluding each of the independent predictors one at a time (sub-models). The relative contribution of a predictor was defined as the ratio of its log-likelihood difference to the sum of the sub-models’ log-likelihood differences, multiplied by 100.^{43, 49}

We compared differences in survival to inpatient discharge after code status change among patients who added new LST limitations by age group with Kaplan-Meier analysis and compared them using log-rank tests.

Continuous data are summarized using mean (standard deviation) or median (interquartile range) and categorical data as number (%). We conducted all analyses using STATA/SE version 13 (StataCorp; College Station, TX) and considered a p-value 0.05 to be significant.

Sensitivity Analysis

We performed 3 sensitivity analyses. First, because a patient's preferences for LST may not always be known immediately upon admission, we hypothesized that clinicians might default to assigning either 'full code' or the most recent code status during a prior admission, later revising it after clarifying with patients and/or their surrogates. To address this, we disregarded the initial order and considered the next order to be the true index code status if a second order had been placed within 2 hours of the initial order (n=2,031, 0.89% of total sample). Second, to avoid misclassification that could come from the ambiguity associated with partial code orders, we excluded patients who had a partial code order placed at any time during their hospitalization (n=7170, 3.2% of total sample). Third, because DNR and comfort care orders could be used interchangeably, we excluded patients who changed from comfort care to DNR in the reversal subgroup (n=214, 7.1% of the original reversal subgroup).

RESULTS

Baseline Characteristics

Our final sample contained a total of 227,525 patients. Almost half (n=105,711, 46.6%) of the patients were younger than age 65, while 14.8% (n=33,707) were very elderly. More than half of the very elderly (18,256 or 54.2%) and one in five of the elderly (18,349 or 20.8%) had a non-full code order on admission, compared with 3.1% in the younger patients. Older patients had higher chronic and acute disease acuity, were less likely to be male, and more frequently had prior hospitalizations and prior LST-limiting orders (p<0.01 for each; Table 1).

Frequency and Likelihood of Code Status Change by Age

Overall, 15,932 (8.3%) of the patients admitted as full code changed to add LST limitations, and 3,017 (7.6%) of those admitted with LST limitations had at least one reversal, during hospitalization. The proportion of patients adding new and reversing prior LST limitations differed significantly by age (Figure 1). Among patients admitted with a full code order (Figure 1a), only 3.2% of young patients added new LST limitations, compared with 28.4% of very elderly patients (p<0.001). In contrast, among patients admitted with a limited LST order (Figure 1b), 11.9% of young patients reversed their prior LST limitations, compared with 5.6% in very elderly patients (p<0.001). These differences remained significant even after adjusting for patient and hospital-level factors: results from the multivariable model showed that older patients were much more likely to add new limitations (adjusted odds ratio (OR)=2.27, 95% confidence interval (CI)=2.16-2.39 for elderly; and adjusted OR=6.43, 95% CI=6.05-6.84 for very elderly) and much less likely to reverse prior limitations (adjusted OR=0.73, 95% CI=0.65-0.83 for elderly; and adjusted OR=0.46, 95% CI=0.41-0.53 for very elderly), compared with young patients.

Differences in the Timing and Location of Code Status Change by Age

The timing between hospital admission to the addition of new LST limitations differed significantly by age. The median time to adding new LST limitations was 1.4 days in the very elderly patients, compared with 2.3 days in the elderly and 3.0 days in young patients ($p<0.01$). Among patients experiencing reversals of prior LST limitations, the median time from admission to reversal was 0.9 days for all patients and did not differ significantly by age.

Overall, more than half of the patients (52.0%) experiencing at least one code status change were never admitted to the ICU. Fewer older patients with code status changes were admitted to the ICU compared with younger patients, regardless of whether LST limitations were added or reversed. For example, 65.3% of the very elderly who added new LST limitations were never admitted to the ICU, compared with 34.4% of the young patients ($p<0.01$). Similarly, 72.2% of the very elderly who reversed prior LST limitations were never admitted to the ICU, compared with 58.6% of the young patients ($p<0.01$).

Factors Determining Code Status Changes by Age

Among patients admitted with a full code order, factors that had the strongest association across all age groups with adding new LST limitations were: having a prior DNR order, admission for cancer-related diagnosis, acute severity of illness, and high comorbidity burden (Table 2a). However, the relative contribution of the key factors to overall model explanatory power varied considerably by age (Figure 2a). For example, having a prior DNR order explained 39.6% of model performance in the very elderly compared with only 11.4% in young patients. Conversely, while comorbidity explained 34.7% of model performance in young patients, it only explained 1.8% in the very elderly. The contribution of acute severity of illness was similar in all age groups.

Among patients admitted with a non-full code order, factors that consistently had the strongest association across all age groups with reversing prior LST limitations were admitting diagnosis and having a prior DNR order (Table 2b). Again, the relative contribution of the key factors to overall model explanatory power varied by age. For example, admitting diagnosis explained 64.2% of overall model performance in the very elderly patients, compared with 36.5% in young patients. Having a prior DNR order explained less than 5% of the LST reversal model, regardless of age (Figure 2b).

Implications of Adding New LST Limitations on Inpatient Mortality by Age

A striking finding was that the elderly and very elderly had significantly better inpatient survival, as 71.7% of the very elderly and 57.2% of the elderly patients survived to discharge, compared with 43.4% of young patients (log-rank test $p<0.01$), despite having clinically negligible differences in their acute severity of illness scores (LAPS2 106 ± 40 , 107 ± 43 , and 111 ± 48 in the very elderly, elderly, and young patients, respectively).

Sensitivity Analyses

Our main results, including the frequency, the odds ratios (Table 3), and the key determinants of code status changes (data not shown), remained similar with each of the three sensitivity analyses outlined earlier.

DISCUSSION

In this population-level study of inpatients drawn from a multi-center community care setting, we found that the majority of very elderly patients were admitted to the hospital with a limited LST order in place. We also found that changes to patients' LST orders were common: more than one in every 12 patients admitted with a full code order added new LST limitations during their hospitalization, and a similar proportion of patients with LST limitations at admission had some of these limitations reversed during their hospital stay. Both types of changes occurred early during patients' hospitalizations and they often occurred among patients who were never admitted to the ICU. Among those who added LST limitations, the majority of patients were alive at discharge.

Additionally, we found that advanced age was one of the most important factors in adding new and reversing prior LST limitations. However, the impact of age differed based on the type of code status change: Older patients were much more likely to add new LST limitations, but were significantly less likely to reverse prior LST limitations, compared with younger patients, even after controlling for severity of illness and comorbidity burden.

While prior studies have found age to be an important factor in the placement of DNR orders,^{8, 13, 16, 38, 39} ours is the first to provide a detailed examination on how age might differentially impact the decision to change a patient's code status during hospitalization. Our findings expand on existing knowledge in several important ways. First, we found that close to half of the very elderly patients entered the hospital with a DNR order and close to 90 percent of these patients were alive at discharge. The fact that the vast majority of the patients entering the hospital with a DNR order survived to discharge suggests that the use of the DNR order in the modern era has become broader and commonplace in some patient groups.

Second, we showed that factors such as illness severity and comorbidity burden had different effects in different age groups, suggesting that the importance of these factors in LST decision-making varies considerably by age. Specifically, compared with younger patients, older patients' prior stated preferences were more strongly associated with adding new LST limitations than admitting diagnosis or comorbidity. Conversely, prior stated preferences contributed very little to the reversal of LST limitations, regardless of age. In all age groups, the degree of acute severity of illness contributed significantly to model performance. It is important for clinicians to be aware of these differences when discussing LST options to ensure that patients and their families of all ages make informed decisions that are appropriate in the clinical context and adequately reflect patients' values.

Third, we showed that the majority of changes to LST limitations occurred outside of the ICU and among patients who were never admitted to the ICU, especially among the very

elderly who reversed their previous LST limitations. Although we were not able to determine the circumstances under which these changes occurred, our findings indicate that LST-related discussions and decisions in hospitalized patients do not occur only during periods of emergent changes in a patient's clinical course. While prior studies have often emphasized the impact of LST decisions on ICU utilization,^{13, 31, 35, 49} the fact that the majority of code status changes occurred in medical-surgical patients who never entered the ICU suggests that effective communication for LST decision-making in the inpatient setting should begin at hospital admission and include patients admitted to general medical-surgical wards.

Finally, we found that among those who added LST limitations, advanced age was not associated with an increased risk of inpatient death. On the contrary, among such patients, older patients were much more likely to survive to hospital discharge compared with younger patients. This further suggests that the process and decision of placing limits on LST in the inpatient setting differ markedly by age. Among younger patients, discussions and decisions to forgo LST appeared to occur more frequently as a consequence of clinical deterioration when the chances of recovery become limited. In the elderly, discussions to elicit their general preferences towards LST might instead be occurring as a part of an overall care plan.

Our findings should be noted in light of the study's limitations. First, we only examined changes in code status among hospitalized patients admitted from the ED and therefore are not generalizable outside of the inpatient setting or to patients not admitted directly from the ED. Second, our cohort included patients and hospitals within a single integrated healthcare delivery system in Northern California. Prior reports have found that DNR orders are more common in the West compared with other regions and may be higher at community hospitals compared to academic centers.¹⁷ Furthermore, KPNC is an integrated delivery system with a comprehensive EMR where prior code status orders are readily available to the admitting physician, which may result in fewer reversals compared to a more fragmented system. Third, we utilized care orders placed within an EMR system, thus, we cannot determine the extents to which these orders reflected the stated preferences of patients and their families; although it is standard practice for attending physicians within KPNC to discuss and document conversations prior to changing a patient's code status.

Fourth, we did not have data to specifically evaluate other factors that are known to influence changes in LST preferences such as patients' race/ethnicity, functional status, health literacy, or psychosocial and spiritual support.^{4, 24-28} Fifth, we were not able to assess the circumstances that may have led to the changes in code status or the quality of the LST decision-making process. Finally, our ability to model a patient's likelihood of reversing LST limitations was less robust than our ability to model the addition of new LST limitations, suggesting that the reversal process involves complex interactions of patient/surrogate preferences, demographics, and patient-provider communication that are poorly captured in the EMR. Future studies should focus on capturing and operationalizing these factors to improve our understanding of the LST decision-making process.

In summary, we found that changes in code status were common among hospitalized patients and highlighted important differences in making LST-related decisions between younger and older patients. Future studies are needed to better understand the LST decision-making process with respect to the needs of the elderly and to evaluate the implications of such decisions on patient- and family-centered outcomes.

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Figure 1.

Percentage of index full code patients who subsequently added new LST limitations with the adjusted odds ratios¹ associated with the addition of new LST limitations, by age (1a); and the percentage of non-full code patients who subsequently reversed prior LST limitations with the adjusted odds ratios¹ associated with the reversal of prior LST limitations, by age (1b).

LST: Life-Sustaining Treatment

**P<0.01

¹Adjusted for gender, acute severity of illness (LAPS2) and comorbidity scores (COPS2), prior hospitalizations within the past year (none, 1-2, or >2), prior hospitalization with order

to limit LST, direct intensive care unit admission, admitting time of day (overnight, daytime, and evening), weekend versus week-day admission, season, admitting diagnosis, admission time (according to nursing shift), weekend vs. weekday admission, season of admission, teaching status of the hospital, hospital volume, and volume of intensive care unit at each hospital, and hospital facility. The referent category was age <65.

Figure 2.

Relative contribution of key predictors to overall model explanatory power based on log-likelihood by age group among patients who added new (2a) and reversed prior (2b) LST limitations.

LST: Life-Sustaining Treatment.

Table 1

Baseline characteristics, hospital course, and care orders for inpatients hospitalized through the emergency department by age group.

Values represent mean $\pm$ standard deviation or number (percentage).		Age Group			
	All patients	Young <65	Elderly 65-84	Very Elderly 85	
<i>Number</i>	227,525	105,711	88,107	33,707	
Characteristics					
Age	64 $\pm$ 19	48 $\pm$ 13	74 $\pm$ 6	89 $\pm$ 4	
Male	107,283 (47.2)	52,635 (49.8)	41,804 (47.5)	12,844 (38.1)	
COPS2 ¹	34 $\pm$ 37	23 $\pm$ 30	42.9 $\pm$ 41.5	44 $\pm$ 38	
Charlson Score	1.3 $\pm$ 1.4	0.8 $\pm$ 1.1	1.7 $\pm$ 1.5	1.8 $\pm$ 1.5	
LAPS2 ²	70 $\pm$ 39	57 $\pm$ 35	76.3 $\pm$ 39.2	94 $\pm$ 39	
Hospitalized in prior year	25,923 (11.4)	8,351 (7.9)	12,497 (14.2)	5,075 (15.1)	
Hospital Course					
Length of stay, days	4.2 $\pm$ 6.6	3.9 $\pm$ 6.8	4.5 $\pm$ 6.9	4.3 $\pm$ 5.0	
ICU admission at any time	40,287 (17.7)	18,630 (17.6)	16,996 (19.3)	4,691 (13.9)	
In-hospital mortality	14,602 (6.4)	3,189 (3.0)	7,107 (8.1)	4,297 (12.8)	
Care Orders					
On admission					
Full	187,664 (82.5)	102,453 (96.9)	69,758 (79.2)	15,453 (45.9)	
Partial	3,494 (1.5)	452 (0.4)	1,922 (2.2)	1,120 (3.3)	
DNR	34,757 (15.3)	2,582 (2.4)	15,770 (17.9)	16,407 (48.7)	
Comfort Care	1,610 (0.7)	224 (0.2)	657 (0.8)	729 (2.2)	
Prior non-Full Code order	19,514 (8.6)	1,499 (1.4)	8,817 (10.0)	9,198 (27.3)	

p<0.01 for all comparisons across the 3 age groups.

DNR: Do Not Resuscitate; COPS2: Comorbidity Point Score, version 2; LAPS2: Laboratory Acute Physiology Score, version 2; ICU: intensive care unit.

¹ See text and citation 42 for description of the Laboratory Acute Physiology Score, version 2. The univariate relationship of an admission LAPS2 with 30 day mortality is as follows: 0 – 59, 1.0%; 60 – 109, 5.0%, 110+, 13.7%.

² See text and citation 42 for description of the COMorbidity Point Score, version 2. The univariate relationship of COPS2 with 30 day mortality is as follows: 0 – 39, 1.7%; 40 – 64, 5.2%, 65+, 9.0%.

Table 2

Adjusted odds ratios and 95% confidence intervals for patient-level factors associated with adding new LST limitations and reversing prior LST limitations, by age group.

a. Addition of new LST limitations.

	Young (age <65)	Elderly (age 65-84)	Very Elderly (age 85)
	Odds Ratio (95% CI)	Odds Ratio (95% CI)	Odds Ratio (95% CI)
Male	1.00 (0.93-1.08)	0.89 ** (0.84-0.93)	0.90 ** (0.83-0.97)
LAPS2 (quartile)			
1 [reference]	--	--	--
2	2.05 ** (1.70-2.46)	1.77 ** (1.55-2.01)	1.70 ** (1.39-2.09)
3	4.48 ** (3.77-5.31)	3.42 ** (3.03-3.85)	2.65 ** (2.19-3.21)
4	16.21 ** (13.66-19.23)	8.98 ** (7.97-10.12)	6.64 ** (5.49-8.03)
COPS2 (quartile)			
1 [reference]	--	--	--
2	0.91 (0.67-1.24)	1.09 (0.96-1.24)	0.82 * (0.69-0.96)
3	1.54 ** (1.37-1.73)	1.26 ** (1.17-1.36)	1.06 (0.95-1.18)
4	4.58 (4.11-5.11)	2.45 ** (2.27-2.65)	1.35 ** (1.21-1.51)
Prior limited LST order	18.42 ** (14.43-12.51)	13.96 ** (12.32-15.82)	12.63 ** (10.66-14.96)
Prior hospitalization, 1 year			
None [reference]	--	--	--
1 to 2	1.33 ** (1.20-1.47)	1.11 * (1.03-1.17)	0.81 ** (0.73-0.89)
> 2	1.53 ** (1.32-1.78)	1.13 * (1.02-1.27)	0.55 ** (0.44-0.69)
Diagnosis category			
Neoplastic [reference]	--	--	--
Circulatory	0.09 ** (0.08-0.11)	0.12 ** (0.11-0.13)	0.20 ** (0.16-0.26)
Respiratory	0.09 ** (0.07-0.10)	0.15 ** (0.13-0.17)	0.25 ** (0.20-0.32)
Neurologic/Psychiatric	0.08 ** (0.06-0.09)	0.15 ** (0.12-0.17)	0.18 ** (0.13-0.25)
Infectious	0.12 ** (0.10-1.14)	0.17 ** (0.15-0.19)	0.27 ** (0.21-0.35)
Digestive	0.07 ** (0.06-0.08)	0.10 ** (0.08-0.11)	0.15 ** (0.12-0.19)
Endocrine	0.02 ** (0.02-0.03)	0.09 ** (0.08-0.11)	0.15 ** (0.11-0.21)
Other	0.06 ** (0.05-0.07)	0.11 ** (0.10-0.13)	0.22 ** (0.17-0.28)

b. Reversal of prior LST limitations.

	Young (age <65)	Elderly (age 65-84)	Very Elderly (age 85)
Male	0.74 * (0.59-0.93)	1.08 (0.97-1.20)	1.23 ** (1.08-1.41)
LAPS2 (quartile)			
1 [reference]	--	--	--
2	0.83 (0.56-1.21)	0.71 ** (0.58-0.86)	0.79 (0.59-1.06)

a. Addition of new LST limitations.

	Young (age <65)	Elderly (age 65-84)	Very Elderly (age 85)
	Odds Ratio (95% CI)	Odds Ratio (95% CI)	Odds Ratio (95% CI)
3	0.69 (0.48-1.00)	0.64 ** (0.53-0.77)	0.67 * (0.51-0.87)
4	0.69 (0.48-1.01)	0.54 ** (0.45-0.65)	0.48 ** (0.36-0.63)
COPS2 (quartile)			
1 [reference]	--	--	--
2	0.41 (0.16-1.06)	1.26 (0.99-1.60)	0.98 (0.74-1.30)
3	0.77 (0.55-1.10)	1.04 (0.90-1.22)	0.96 (0.80-1.15)
4	0.69 * (0.51-0.93)	0.77 ** (0.66-0.90)	1.00 (0.83-1.21)
Prior limited LST order	0.69 * (0.50-0.96)	0.73 ** (0.63-0.84)	0.81 * (0.67-0.97)
Prior hospitalization, 1 year			
None [reference]	--	--	--
1 to 2	0.83 (0.62-1.11)	1.01 (0.88-1.17)	1.01 (0.84-1.22)
> 2	1.07 (0.71-1.61)	1.13 (0.91-1.41)	0.77 (0.55-1.08)
Diagnosis category			
Malignancy [reference]	--	--	--
Circulatory	1.24 (0.83-1.86)	1.00 (0.78-1.26)	0.48 ** (0.33-0.69)
Respiratory	0.69 (0.42-1.12)	0.63 ** (0.48-0.83)	0.44 ** (0.29-0.66)
Neurologic/Psychiatric	0.61 (0.34-1.10)	0.38 ** (0.25-0.58)	0.08 ** (0.03-0.24)
Infectious	1.12 (0.76-1.66)	0.92 (0.72-1.19)	0.61 ** (0.42-0.90)
Digestive	1.40 (0.92-2.12)	1.05 (0.80-1.38)	0.82 (0.56-1.22)
Endocrine	0.39 * (0.18-0.85)	0.47 ** (0.32-0.70)	0.22 ** (0.12-0.43)
Other	1.34 (0.91-1.97)	1.12 (0.88-1.43)	1.24 (0.87-1.77)

*
p<0.05**
p<0.01

Models adjusted for hospital-level differences using hospital dummy variables, admission time (according to nursing shift), weekend vs. weekday admission, season of admission, teaching status of the hospital, hospital volume, and volume of intensive care unit at each hospital.

LST: Life-Sustaining Treatment; ICU: Intensive Care Unit; DNR: Do Not Resuscitate; COPS: Comorbidity Point Score; LAPS: Laboratory Acute Physiology Score.

Table 3

The impact of age on the odds of adding new LST limitations and reversing prior LST limitations from each sensitivity analysis (p-value <0.01 for each adjusted odds ratio).

Addition of new LST limitations				
	Original Model Adjusted OR ^I (95% CI)	Sensitivity 1 ^a Adjusted OR (95% CI)	Sensitivity 2 ^b Adjusted OR (95% CI)	
Age				
<65 [reference]	-	-	-	
65-84	2.27 (2.16-2.39)	2.34 (2.23-2.47)	2.57 (2.43-2.71)	
85	6.43 (6.05-6.84)	6.29 (5.92-6.69)	7.51 (7.04-8.01)	
Reversal of prior LST limitations				
	Original Model Adjusted OR (95% CI)	Sensitivity 1 ^a Adjusted OR (95% CI)	Sensitivity 2 ^b Adjusted OR (95% CI)	Sensitivity 3 ^c Adjusted OR (95% CI)
Age				
<65 [reference]	-	-	-	-
65-84	0.73 (0.65-0.83)	0.75 (0.66-0.85)	0.69 (0.60-0.81)	0.76 (0.67-0.86)
85	0.46 (0.41-0.53)	0.48 (0.42-0.55)	0.45 (0.38-0.52)	0.47 (0.41-0.54)

^aDisregarded the initial order and considered the next order to be the true index code status if a second order had been placed within 2 hours of the initial order (n=2,031, 0.89% of total sample).

^bExcluded patients who had a partial code order placed at any time during their hospitalization (n=7170, 3.2% of total sample).

^cExcluded patients who changed from comfort care to Do-Not-Resuscitate in the reversal subgroup (n=214, 7.1% of the original reversal subgroup). Sensitivity 3 does not apply to the addition of new LST limitations analysis.

^IModel adjusted for gender, acute severity of illness (LAPS2) and comorbidity scores (COPS2), prior hospitalizations within the past year (none, 1-2, or >2), prior hospitalization with order to limit LST, direct intensive care unit admission, admitting time of day (overnight, daytime, and evening), weekend versus week-day admission, season, admitting diagnosis, admission time (according to nursing shift), weekend vs. weekday admission, season of admission, teaching status of the hospital, hospital volume, and volume of intensive care unit at each hospital, and hospital facility.

LST: Life-Sustaining Treatment