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Authors
Neville, Thanh H
Wiley, Joshua F
Kardouh, Miramar
et al.

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Change in Inappropriate Critical Care Over Time

Thanh H. Neville, MD, MSHS,
David Geffen School of Medicine, UCLA, Department of Medicine, Division of Pulmonary and Critical Care Medicine

Joshua F. Wiley, PhD,
Turner Institute for Brain and Mental Health and School of Psychological Sciences Monash University

Miramar Kardouh, BS,
David Geffen School of Medicine, UCLA, Department of Medicine

J. Randall Curtis, MD, MPH,
University of Washington, Department of Medicine, Division of Pulmonary, Critical Care, and Sleep Medicine

Myrtle C. Yamamoto, RN,
David Geffen School of Medicine, UCLA, Department of Medicine, Quality Improvement

Neil S. Wenger, MD, MPH
David Geffen School of Medicine, UCLA, Department of Medicine, Division of General Internal Medicine and Health Services Research

Abstract

Purpose—Intensive care interventions that prolong life without achieving meaningful benefit are considered clinically “inappropriate”. In 2012, the frequency of perceived-inappropriate critical care was 10.8% at one academic health system; and we aimed to re-evaluate this frequency.

Methods—For 4 months in 2017, we surveyed critical care physicians daily and asked whether each patient was receiving appropriate, probably inappropriate, or inappropriate critical care. Patients were categorized into three groups: 1) patients for whom treatment was never inappropriate, 2) patients with at least one assessment that treatment was probably inappropriate,

Address correspondence to: Thanh H. Neville, MD, MSHS, Department of Medicine, Division of Pulmonary and Critical Care Medicine, Box 951690, 43-229 CHS, Los Angeles, CA 90095-1690., Phone number: 310-825-5316, Fax 310-206-8622., neville@mednet.ucla.edu.

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but no inappropriate treatment assessments, and 3) patients who had at least one assessment of inappropriate treatment.

Results—Fifty-five physicians made 10,105 assessments on 1424 patients. Of these, 94 (6.6%) patients received at least one assessment of inappropriate critical care, which is lower than 2012 (10.8% ($p<0.01$)). Comparing 2017 and 2012, patient age, MS-DRG, length of stay, and hospital mortality were not significantly different ($p>0.05$). Inpatient mortality in 2017 was 73% for patients receiving inappropriate critical care.

Conclusions—Over five years the proportion of patients perceived to be receiving inappropriate critical care dropped by 40%. Understanding the reasons for such change might elucidate how to continue to reduce inappropriate critical care.

Keywords

critical care; inappropriate treatment; mortality; intensive care unit

INTRODUCTION

Intensive care medicine saves lives during episodes of acute decompensation, but it is also capable of prolonging the dying process in patients with poor long-term prognoses and sustaining life in conditions that most people would not want. Studies demonstrate that many patients receive intensive care unit (ICU) treatments without the chance of meaningful benefit.[1–4] Healthcare providers often consider such ICU treatment to be “futile” or “inappropriate.”[5–7] Such treatment can be viewed as contrary to professional values and the goals of medicine,[8,9] and can result in treatments that are inconsistent with the patient’s goals.[10] In 2012, we demonstrated that approximately 10.8% of ICU patients in a large academic health system were perceived as receiving inappropriate treatment by their critical care physician.[6] These patients had an 85% 6-month mortality (with survivors remaining in severely compromised health states) and the inappropriate critical care resulted in substantial financial and opportunity costs.[6,11]

Considerable efforts from health systems, payers and professional societies have aimed to increase awareness of high value, preference-concordant, end-of-life care.[12–16] The Institute of Medicine (IOM) report *Dying in America* emphasized a pressing need to improve end-of-life care and recommended that it become a national priority.[12] In 2015, the American Thoracic Society, American Association for Critical Care Nurses, American College of Chest Physicians, European Society for Intensive Care Medicine, and Society of Critical Care released a multi-society statement recommending that institutions implement strategies to improve communication to prevent intractable treatment conflicts in the ICU, to change the terminology from “futile” to “potentially inappropriate” treatment, and to resolve differences between clinician recommendations and patient/family wishes using a conflict resolution process.[13] Furthermore, a recent study has shown an increase in palliative practices at the end-of-life in European ICUs in the past decade.[17] In the context of these efforts, findings, and building on baseline data from 2012, we sought to re-evaluate the prevalence of patients perceived to be receiving inappropriate critical care in the same tertiary healthcare system five years later.

METHODS

This study evaluated the prevalence of critical care physician reports of patients receiving inappropriate critical care and compared these findings to 2012. The study was approved by the UCLA institutional review board (IRB#17-000058).

Daily Clinician Questionnaires

We used a questionnaire that was previously developed from a focus group of critical care clinicians to identify patients perceived as receiving inappropriate critical care.[6] Every day from August 28, 2017 through December 28, 2017, a research assistant administered the questionnaire to each attending critical care specialist providing care in five ICUs in the academic health system: the Medical ICU (MICU), the Neurocritical Care Unit (Neuro-ICU), the Cardiac Care Unit (CCU), the Cardiothoracic ICU (CT-ICU) and a community hospital mixed-use ICU. Except for the CT-ICU where surgeons also co-manage, intensivists are considered the primary team for all ICUs and lead all decisions including admission and discharge. The MICU, Neuro-ICU, and CT-ICU has 24-beds, the CCU has 14 beds, and the community hospital has 22 beds. For each ICU patient under their care, the physician indicated whether the patient was receiving appropriate treatment, probably inappropriate treatment, or inappropriate treatment. For patients judged to be receiving inappropriate treatment, the physician was asked to provide the reason(s) that the treatment was inappropriate from among the reasons previously derived from the focus group: burdens grossly outweigh benefits, patient will never survive outside of an ICU, patient is permanently unconscious, treatment cannot achieve the patient's goals, or death is imminent. Physicians could also write in a reason. Because physicians made daily assessments, one physician typically had several assessments for one patient, and because physicians rotated off service regularly, one patient may be assessed by more than one physician. One month after the study started, based on clinician feedback, an additional question was added: "If you feel that aggressive critical care is inappropriate for this patient, why is critical care being continued?" This question was asked concerning the last 68 patients rated as receiving inappropriate treatment. Answer choices included patient/family preference, patient/family disagreed with physician's prognosis, family unable to reach a decision, religion/culture, difference in opinion with different physician, waiting for proxy/no proxy, and other (write in). Physicians provided informed consent and completed a brief provider characteristics questionnaire.

Data Sources and Statistical Analysis

Patient demographics and clinical characteristics were obtained from the hospital Financial Decision Support office, including age, gender, ethnicity and race, insurance, and zip code (used to compute distance from the hospital); source of admission; length of stay; and Medicare Severity Diagnosis Related Group (MS-DRG) weights. Distance from residence to the hospital was dichotomized at less than or greater than 20 miles. MS-DRG weights, determined from diagnoses and the resources required during the hospital stay, were used as a reflection of severity of illness during hospitalization. The date of hospital admission was subtracted from the date of the physician assessment to compute the hospital day of each physician assessment. Physician characteristics including gender, race and age were

obtained from the survey. Hospital and 6-month mortality were abstracted from the electronic medical record and publicly available death records.

Patient characteristics, inpatient mortality and 6-month mortality were compared between 2017 and 2012 patients using *t*-test or χ^2 tests, as appropriate. Physician age and years of practice were also compared between 2012 and 2017. All statistical analyses were performed using STATA 14.

By collapsing all of a patient's assessments, patients were categorized into three groups: 1) patients for whom treatment was never inappropriate, 2) patients with at least one assessment that treatment was probably inappropriate, but no inappropriate treatment assessments, and 3) patients who had at least one assessment of inappropriate treatment. Hospital and 6-month mortality for the three patient groups were compared using ANOVA. Bivariate differences between the three groups were evaluated for patient characteristics, ICU unit and day of assessment using χ^2 tests and *t*-tests, as appropriate.

Predictors of Inappropriate Treatment—An analysis at the assessment level was performed using a multilevel multivariable ordered probit model that included patient and clinician characteristics. The ordered probit model assumes approximately equal effects of the predictors on moving from appropriate to probably inappropriate treatment as from probably inappropriate to inappropriate treatment. Because each assessment was clustered with both patients and physicians, random intercepts for patients and physicians were included. Models were estimated using the MCMCglmm function in *R* 3.5.1. To examine how accurately the model classified inappropriate treatment, the model generates a predicted probability that at any given assessment care is appropriate, probably inappropriate, or inappropriate. We chose whichever type of care type had the highest predicted probability as the model prediction. Next, we compared the type of care predicted by the model at each assessment (e.g., appropriate) to the actual physician assessment made (e.g., probably inappropriate). We calculate the percentage of assessments where the model prediction and physician assessment agree as the overall accuracy of our model.

In order to understand differences in patient characteristics between groups of patients in the appropriate, probably inappropriate and inappropriate groups, we presented the average marginal change in predicted probability.[18] This represents the change in probability of receiving a particular treatment type (e.g., appropriate) for a one-unit change in a predictor, on average in the sample. The results of the assessment level model were compared between 2017 and 2012. We also conducted a multilevel ordered probit model to evaluate whether the differences in level of inappropriate care provided between 2012 and 2017 were explained by predictors by combining the datasets, entering all predictors and study year.

Cost Analyses

Daily charges were obtained from the hospital Financial Decision Support office. To evaluate the total charges for inappropriate treatment, we summed charges for each day that the patient was classified by physicians as receiving inappropriate treatment and subsequent unassessed days until the end of the hospitalization (or 3 months after study conclusion, whichever came first). Charges for subsequent unassessed days were only included in the

total charges if care on the last assessment was perceived as inappropriate. Cost was estimated using the 2017 publicly available cost-to-charge ratio, which was 0.43.[19,20]

RESULTS

Description of the study sample

During the 4-month study, 1,572 patients were treated in the five studied adult ICUs (Figure 1). Fifty-five clinicians evaluated 1516 patients (56 patients were "boarders", were not under the critical care physician's care, and excluded). Thirteen patients were assessed as receiving inappropriate critical care but only on the day they were transitioned to comfort care and were dropped from the study sample. After excluding 526 missing assessments (4.8%) among 79 patients, the study sample consisted of 10,105 daily assessments on 1,424 patients.

Comparing the 2017 and 2012 ICU patient samples, patient age, MS-DRG, median length of stay overall and among decedents, and hospital mortality were not significantly different (all $p>0.05$) (Table 1). In 2017, more patients were categorized as "Other" for race (21% vs 7%, $p<0.01$), fewer patients were uninsured (1% vs 5%, $p<0.01$), and fewer patients were transferred from a skilled nursing facility (SNF) or long term acute care (LTAC) facility (1% vs 4%, $p<0.01$). Six-month mortality was higher among ICU patients in 2017 (22% v 18%, $p<0.01$).

The 55 critical care physicians in the 2017 sample had a mean age of 42 years, 29% were female and they had a mean of 7.7 years in practice. The 36 critical care physicians in 2012 had a mean age of 44 years, 36% were female and they had a mean of 9.6 years of practice experience. These physician characteristics did not differ statistically between 2017 and 2012.

After collapsing the assessments into groups, there were 1245 (87%) patients who received appropriate treatment, 85 (6%) who received probably inappropriate treatment, and 94 (6.6%) patients who received inappropriate treatment (Figure 1). The proportion of patients receiving probably inappropriate critical care was significantly lower in 2017 compared to 2012 (6.0% v 8,7%, $p<0.01$) and the percentage of patients receiving inappropriate critical care was significantly lower in 2017 compared to 2012 (6.6% v 10.8%, $p<0.001$). Compared to 2012, assessments of inappropriate critical care in 2017 accounted for a significantly smaller proportion of all assessments during the study (3.5% in 2017 vs 6.7% in 2012, $p<0.001$). Characteristics of the 2017 study sample comparing patients who received never inappropriate, probably inappropriate and inappropriate critical care is available in the e-supplement (eTable 1).

Reasons why critical care was inappropriate and why it was continued

Among the 94 patients who received critical care perceived to be inappropriate by the critical care physician, for 58 (62%) patients, treatment was judged to be unable to achieve the patient's goal and for 49 (52%) patients the burdens of treatment grossly outweighed the benefits. Forty-four (47%) patients were anticipated to never be able to survive outside of an ICU, 33 (35%) were permanently unconscious, and 20 (21%) were imminently dying. The

majority of patients had more than one reason listed and the permutations of these reasons are displayed in eTable 2 of the e-supplement. For 51 patients, physicians gave reasons why they provided or continued treatment that they perceived to be inappropriate. The most common reason was that it was the patient's and/or family's preference (N=41, 60%). Less common reasons were: patient and/or family disagreed with the physician's prognosis (N=19, 28%), family was unable to reach a decision (N=17, 25%), religion and/or culture (N=11, 16%), difference in opinion with another physician (N=6, 9%), and waiting for proxy or no proxy (N=5, 7%). More than one reason was listed for the majority of patients (eTable 3).

Comparing factors related to inappropriate treatment between 2017 and 2012

The multilevel multivariate probit ordinal model (eTable 4) correctly classified 92.8% of inappropriate treatment assessments. Table 2 displays the factors associated with physicians perceiving that a patient received inappropriate critical care in 2017 (table e4) compared to 2012[6] and shows that these factors were similar in most cases. Older age and later hospital day of the assessment were associated with greater likelihood of inappropriate critical care and female gender, outpatient source of admission and treatment in the CT-ICU and CCU were associated with lower likelihood of inappropriate treatment. These factors all had the same directionality and magnitude in 2017 and 2012. Higher MS-DRG, "other" race, being transferred from an outside hospital, and treatment in the Neuro-ICU were associated with an increased probability of receiving inappropriate critical care in 2017, but not in 2012. Transfer from a SNF or LTAC was associated with inappropriate treatment in 2012, but not 2017, although there were fewer transfers in 2017.

In a multilevel ordered probit model that adjusted for all predictors and included observations from 2012 and 2017, the average probability of inappropriate care was estimated to be lower in 2017 compared to 2012 by 3.95%, [95% CI −5.52%, −2.34%], $p < .001$ (Table e5).

Patient outcome and cost of care

In-hospital and six-month mortality was significantly higher for patients receiving probably inappropriate and inappropriate treatment compared to patients who received appropriate treatment (Table 3). For the 94 patients who were assessed as receiving inappropriate treatment, in-hospital mortality was 73% and 6-month mortality was 85%. In 2012, the in-hospital mortality of patients who received inappropriate treatment was 68% and the 6-month mortality was 85%. Another 3 patients died within 9 months of discharge. One patient is still hospitalized and is ventilator-, tube-feed-, and dialysis-dependent. The remainder of the patients were left in severely compromised health states (Table 4). Compared with patients in the same group in 2012, patients who never received inappropriate critical care and patients who received probably inappropriate critical care had higher mortality. There was no significant difference in mortality between 2012 and 2017 for the group perceived as receiving inappropriate critical care.

The average cost for a day of inappropriate treatment in the ICU in 2017 was $7490, which was higher than the cost per day of $4275 in 2012 (adjusted for inflation). Despite the higher

cost per day, the 94 patients identified during the 4-month study period accrued costs of $700,000 per month. This compares to $933,000 per month (inflation adjusted) in 2012, which constitutes a decrease in cost of 33%.

DISCUSSION

Over 5 years at one American health system the proportion of patients perceived to receive inappropriate critical care dropped by 40% (from 10.8% to 6.6%). The outcomes of patients who were perceived as receiving inappropriate critical care remained similar, with 85% mortality at six months after ICU care in both groups and the others left in severely compromised health states. Our findings, like the recent finding that there are more limitations of life-sustaining treatments prior to death in European ICUs, suggest that there may be less non-beneficial treatment in the ICU at the EOL.[17,21] Understanding the reason for this decrease in perceived inappropriate treatment and associated reduction in resources dedicated to inappropriate ICU care may facilitate future efforts to reduce inappropriate critical care.

The ICU patient population in the studied health system in 2017 does not appear to be significantly different from five years before: average MS-DRG, length of stay, and overall hospital mortality were not significantly different. Furthermore, the predictors of an assessment of inappropriate critical care in the multivariate model were similar between 2012 and 2017. The 6-month mortality was lower in 2012, which suggests that patients admitted to the ICU in 2017 were possibly sicker than in 2012. These characteristics suggest that the reduction in critical care physicians labeling patients as receiving inappropriate treatment is not related to changes in the patient population. Additionally, physician characteristics were similar between the two time periods and their characteristics were unrelated to ratings of inappropriate treatment. These findings support the notion that in 2017, compared to 2012, there were fewer days in which patients received intensive care treatments from which they were unlikely to benefit.

The reason behind the decrease in the perception of inappropriate critical care is unclear, however, there have been several initiatives—both at the local and the national level—that focused attention to this issue between these two measurements. The results of the study in 2012 at this institution[6] led to the rollout of a comprehensive initiative on advance care planning. The Society of Critical Care Medicine Ethics Committee released a policy statement defining inappropriate treatment as situations where there is “no reasonable expectation that the patient will improve sufficiently to survive outside the acute care setting, or when there is no reasonable expectation that the patient’s neurological function will improve sufficiently to allow the patient to perceive the benefits of treatment.”[22] During this period, the IOM recommended that improvements in end of life care become a national priority.[12] The American Thoracic Society released a policy statement on how to manage “conscientious objections in intensive care medicine,” which called for institutional procedures that respect diverse values in the ICU.[14] It is possible that attention to inappropriate treatment at the end of life led to a decrease in its provision. This could have occurred by fewer patients with poor prognosis being admitted to the ICU at the triage level or treatment limitations imposed in the ICU. Lastly, there have been several advances in

critical care during the last five years, including improved triage,[23] early mobilization,[24] better outcomes using extracorporeal membrane oxygenation,[25] that may have influenced our findings. The finding that 6-month mortality was not significantly different, but hospital mortality increased may suggest that critical care physicians limited more care.

There were a few differences in the predictors of inappropriate treatment between the two time periods: source of admission, MS-DRG weight, and Neuro ICU were significant predictors in 2017 but not in 2012. Source of admission may have changed because of variation in how the data were collected between time periods. In 2017, MS-DRG weight, which is a marker of sickness, was a significant predictor of whether a patient was perceived as receiving inappropriate critical care, suggesting that physicians were taking into consideration a patient's "salvageability." It is unclear why Neuro ICU patients were more at risk of receiving inappropriate critical care, but there was increasing emphasis on clinical outcomes being meaningful to the patient during the studied period[22] and patients with significant head injuries may have a higher incidence of disagreements between physicians and families.

There are several limitations to our study. Although multiple studies have shown that physicians are able to identify cases where critical care appears to be inappropriate[5,6,26–28], the language surrounding this topic remains problematic and controversial.[29–31] In the study in 2012, physicians identified which patient was receiving "futile treatment" and in 2017, the label was changed to "inappropriate treatment" due to the recommendations from the multi-center consensus statement.[13] Physicians were given similar instructions prior to each study, but it is unknown whether this change in terminology affected the assessments. Also, beyond clinician age and gender, we do not have more descriptive physician characteristics to further evaluate whether physician attributes changed over time and affected assessments. We cannot be sure that the changes seen do not reflect differences in the ways that physicians rated, although organizational emphasis on matching treatment with prognosis and goals might be expected to increase ratings of inappropriate treatment. We excluded 13 patients who were assessed as receiving inappropriate critical care but only on the day they were transitioned to comfort care. This group was excluded to keep our estimates conservative, as it is possible that the patient is rapidly downgraded from ICU-level care within 24 hours or that the patient is simply receiving aggressive treatments (i.e. mechanical ventilation until the family arrives by the bedside). As such, it would be difficult to consider their care futile or inappropriate. This group was similarly excluded in our 2012 study. Surprisingly, patient race was significantly different in 2017 because there were more patients who marked "other race." It is possible that this was due to a change in how the variable was collected or used in society; there were more response options available in 2017 so patients who were from a minority race may have chosen "other" rather than marking a broader category. Also, we utilized the MS-DRG weight as a reflection of disease severity rather an ICU severity-of-disease scoring system because of data availability and this was the same measurement utilized in 2012. It is unknown whether the availability and use of APACHE II or SAPS II scores may change the analysis.

Our study suggests that the amount of physician-perceived inappropriate critical care has decreased over a 5-year period. This decrease likely represents an improvement in

professional behavior as physicians are better able to withhold inappropriate ICU care. This would translate into a significant reduction in the proportion of resources utilized for treatments that are thought be to non-beneficial and highlights the opportunity to continue improving the value of critical care.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Highlights

- "Inappropriate treatments" are aggressive interventions that prolong life without achieving meaningful benefit for the patient.
- Our evaluation shows that the frequency of inappropriate treatment in the intensive care unit has decreased by 40% at one American health system.
- Understanding the reasons for such change might elucidate how to continue to reduce inappropriate critical care

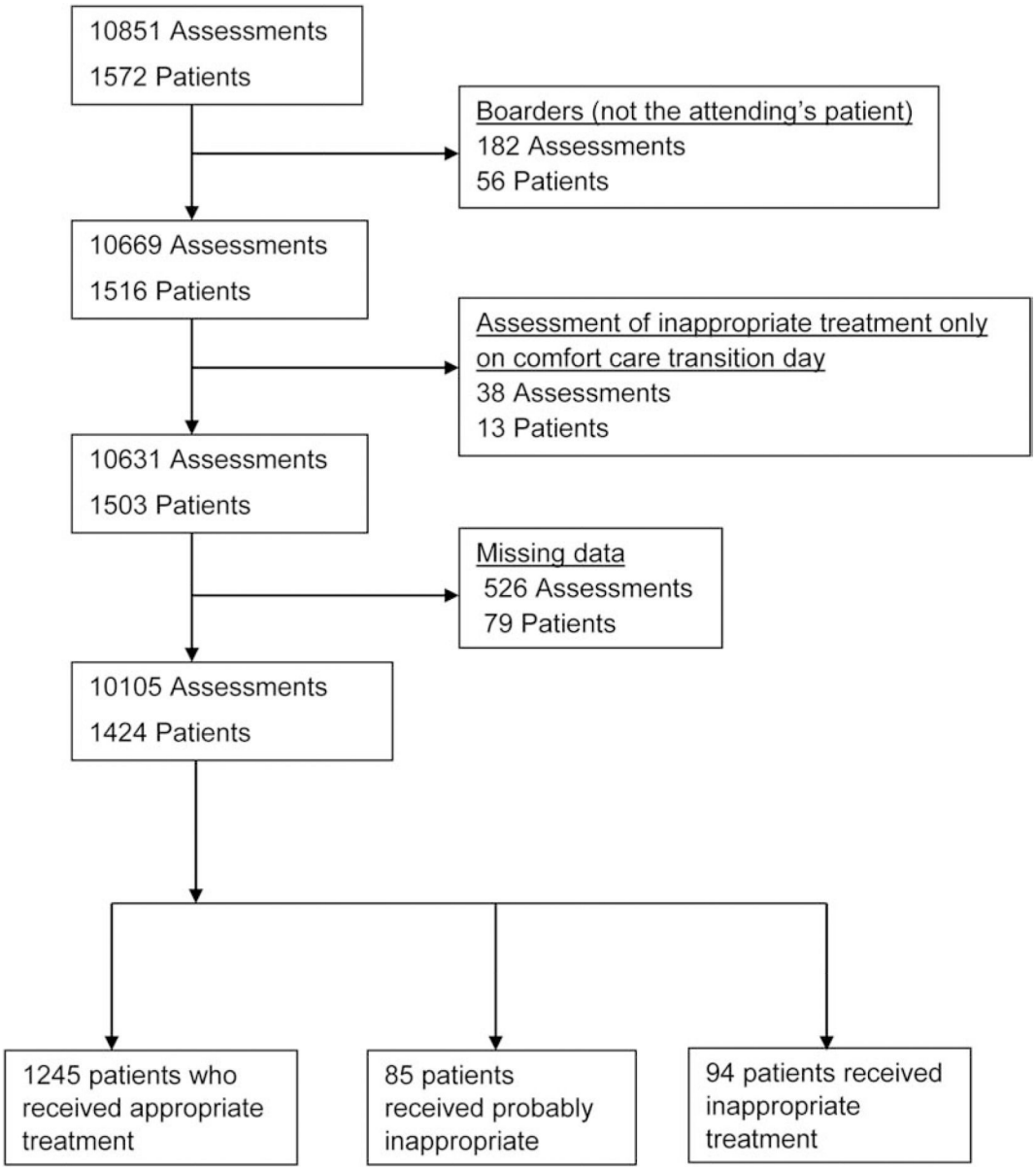

Figure 1.
Derivation of the Study Sample

Table 1.

Characteristics of the study sample in 2012 and 2017

Characteristics	2012	2017
Length of study	3 months	4 months
Number of patients, N	1125	1424
Male, N (%)	519 (55%)	837 (59%)
Female, N (%)	506 (45%)	587 (41%)
Age in years, median (range)	64 (17–99)	63 (17–100)
Race, N (%)		
White	839 (75%)	847 (60%) †
Asian	91 (8%)	125 (9%)
Black	114 (10%)	155 (11%)
Other	81 (7%)	297 (21%) †
Ethnicity, N (%)		
Hispanic	189 (17%)	279 (20%)
Non-hispanic	936 (83%)	1145 (80%)
Insurance, N (%)		
Medicare	448 (40%)	563 (40%)
Medicaid	114 (10%)	86 (6%) †
Private	144 (13%)	331 (23%) †
HMO	358 (32%)	430 (30%)
Uninsured	61 (5%)	14 (1%) †
Lives >20 miles from hospital, N (%)	491 (44%)	526(37%) †
Source of Admission, N (%)		
Outpatient setting	285 (25%)	326 (23%)
Transferred from outside hospital	127 (11%)	190 (13%)
Transferred from SNF/LTAC	41 (4%)	19 (1%) †
Emergency room	672 (60%)	889 (62%)
Intensive care unit, N (%)		
Medical ICU	231 (21%)	287 (20%)
Neuro ICU	264 (23%)	342 (24%)
Cardiac Care Unit	137 (12%)	134 (9%)
Cardiothoracic ICU	250 (22%)	272 (19%)
Community hospital ICU	243 (22%)	389 (27%)
MS-DRG weight, median (range)	2.9 (0.6–24)	3.1 (0–27)

Characteristics	2012	2017
Length of stay, overall, median (range)		
ICU	3 (1–103)	3 (1–121)
Hospital	9 (1–303)	8 (0–238)
Length of stay among inpatient decedents, median (range)		
ICU	6 (1–98)	7 (1–152)
Hospital	14 (1–98)	12 (1–220)
Overall Mortality		
Hospital	149 (13%)	215 (15%)
6-month	203 (18%)	321 (23%)†

† p-value < 0.05

SNF = skilled nursing facility, LTAC = long term acute care hospital, MS-DRG = Medicare Severity Diagnosis-Related Group, ICU = intensive care unit

Table 2.

Characteristics associated with probability of patient being assessed as receiving inappropriate critical care, 2017 v 2012, from multi-level multivariate probit model

Characteristics	2012	2017
Patient sex: Female	↓*	↓*
Patient Age	↑***	↑***
Patient race		
White	Ref	Ref
Asian	—	—
African American	—	—
Other	—	↑**
Patient ethnicity: Hispanic	—	—
Insurance		
Medicare	Ref	Ref
Medicaid	—	—
Private	—	—
HMO	—	—
Uninsured	—	—
Distance from residence	—	—
Source of Admission		
Emergency department	Ref	Ref
Outpatient setting	↓*	↓*
Transferred from outside hospital	—	↑***
Transferred from SNF/LTAC	↑***	—
MS-DRG Weight	—	↑**
Hospital day of futility assessment	↑***	↑***
Female physician	—	—
Physician race		
White	Ref	Ref
Asian	—	—
Other	—	—
Physician Age	—	—
ICU type		
Medical ICU	Ref	Ref
Neurocritical care unit	—	↑*
Cardiac Care Unit	↓***	↓***
Cardiothoracic ICU	↓*	↓***
Academic community hospital mixed-used ICU	—	—

In 2012, 904 (80%) never received inappropriate treatment, 98 (8.7%) received probably inappropriate treatment and 123 (10.8%) received inappropriate treatment. In 2017, 1245 (87%) never received inappropriate treatment, 85 (6%) received probably inappropriate treatment and 94 (6.6%) received inappropriate treatment.

— : variable was not significantly associated with assessment of inappropriate critical care

↓: variable was significantly associated with a decrease in likelihood of an assessment of inappropriate critical care

↑: variable was significantly associated with an increase in likelihood of an assessment of inappropriate critical care

* $p<0.05$

** $p<0.01$

*** $p<0.001$

Multivariable probit model is shown in eTable 4 in the eSupplement

Table 3.

Hospital and 6-month mortality of patients in 2012 and 2017

	2012			2017		
Mortality	**Never received inappropriate treatment (N=904)**	**Received probably inappropriate treatment (N=98)**	**Received inappropriate treatment (N=123)**	**Never received inappropriate treatment (N=1245)**	**Received probably inappropriate treatment (N=85)**	**Received inappropriate treatment (N=94)**
In hospital death, N (%)	42 (4.6%)	23 (23%) *	84 (68%) *	109 (8.8%) †	37 (44% *†	69 (73%) *
Death within 6 months, N (%)	66 (7.3%)	33 (34%) *	104 (85%) *	196 (16%) †	45 (53% *†	80 (85%) *

* p-value <0.05 when compared to group that never received inappropriate treatment, within year

† p-value < 0.05 when compared to the same group in 2012

Table 4.

Outcome of patients who were perceived as receiving inappropriate critical care

Outcomes of Patients Perceived as Receiving Inappropriate Critical Care	**N=94**
Died	
During hospitalization	69
Died within 6 months of ICU care	11
Died within 9 months of ICU care	3
Remain hospitalized since study; ventilator and tube feed dependent, on dialysis	1
Discharged to long term acute care hospital	
Severe cognitive impairment, blind, dependent total parental nutrition, has tracheostomy	1
Persistent coma, dependent on mechanical ventilation and tube feeding	2
Locked-in syndrome, unresponsive, dependent on mechanical ventilation and tube feeding	1
Persistent vegetative state, multiple infections, dependent on mechanical ventilation and tube feeding	1
Discharged to skilled nursing facility	
Severe cognitive impairment after intracranial hemorhage, tracheostomy and requires tube feeding	1
Anoxic brain injury in persistent vegetative state, has tracheostomy and tube feeding	1
Transferred to another hospital and lost to follow-up	
Treated for subarachnoid hemorrhage, received tracheostomy and feeding tube, transferred back to outside hospital for continued care	1
Discharged home	
Severe dementia, dependent on ventilator and tube feeds, multiple ICU admissions since discharge	1
Severe cognitive impairment, discharged with home ventilator and tube feeds	1