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Variability in triage practices for critically ill cancer patients: A randomized controlled trial

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ABSTRACT

Purpose: Intensive care triage practices and end-user interpretation of triage guidelines have rarely been assessed. We evaluated agreement between providers on the prioritization of patients for ICU admission using different triage guidelines.
Materials and methods: A multi-centered randomized study on providers from 18 different countries was conducted using clinical vignettes of oncological patients. The level of agreement between providers was measured using two different guidelines, with one being cancer specific.
Results: Amongst 257 providers, 52.5% randomly received the Society of Critical Care Prioritization Model, and 47.5% received a cancer specific flowchart as a guide. In the Prioritization Model arm the average entropy was 1.193, versus 1.153 in the flowchart arm ($P = .095$) indicating similarly poor agreement. The Fleiss' kappa coefficients were estimated to be 0.2136 for the SCCMPM arm and 0.2457 for the flowchart arm, also similarly implying poor agreement.
Conclusions: The low agreement amongst practitioners on the prioritization of cancer patient cases for ICU admission existed using both general triage guidelines and guidelines tailored only to cancer patients. The lack of consensus on intensive care unit triage practices in the oncological population exposes a potential barrier to appropriate resource allocation that needs to be addressed.

1. Introduction

Rising limitations in intensive care unit (ICU) bed availability coupled with a heightened focus on appropriate resource utilization often require critical care providers to make tough triage decisions [32,39]. The most widely known guideline for triaging critically ill patients is published by the Society of Critical Care Medicine (SCCM). These guidelines were created to help promote fair and appropriate allocation of resources, as well as reduce the unwanted disparity that often exists between providers and institutions.

The SCCM prioritization model uses prognosis and disease reversibility to help stratify patients according to the predicted degree of benefit from admission to a critical care unit [1,24]. A cornerstone of this guideline is that a lower priority level for ICU admission is appropriate for patients with a “decreased or minimal likelihood of recovery” [5,29]. Standardizing ICU triage practices, however, is contingent upon providers approaching and interpreting these guidelines in a similar fashion. Previous reports have suggested that there is a broad inconsistency in the application of ICU triage guidelines [3,4,39], but this has not yet been extensively studied.

One notably challenging population for intensivists and other providers are critically ill oncology patients with advanced malignancies. Assessment of a patient with progressive or refractory cancer for

Abbreviation: SCCM, Society of Critical Care Medicine; SCCMPM, Society of Critical Care Prioritization Model; LACCTIN, Latin American Critical Care Trial Network; ONCCC-R-NET, Oncological Critical Care Research Network; ECOG, Eastern Cooperative Oncology Group.

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potential ICU admission has become a daunting task as oncological data on life expectancies are swiftly evolving in response to new clinical trials and novel targeted therapies [2,4,9,10]. Functional status and quality of life are also important metrics that influence triage decisions, but these are often vulnerable to subjectivity and not always readily available at the time of ICU referral.

To better understand the level of consensus amongst providers on ICU triage practices for a complex group of patients, we used use vignettes of critically ill cancer patients representing real-life clinical situations that would necessitate urgent triage decisions. Participants randomly received either the original Society of Critical Care Prioritization Model (SCCMPM) or a cancer-specific flowchart (based on the SCCMPM) to guide them in the decision making process.

2. Materials and methods

The study was a prospective, multicentered, randomized study originating from The University of Texas MD Anderson Cancer Center after institutional IRB approval. Study recruitment was via the Latin American Critical Care Trial Network (LACCTIN) and the Latino-American section of the Oncological Critical Care Research Network (ONCCC-R-NET), and participants were providers from 18 different countries throughout Latin America plus Spain.

An identical set of 15 clinical vignettes representing both medical and surgical ICU referrals were distributed electronically to all survey participants in English and Spanish (see Supplement A). The vignettes were loosely based on real-life clinical scenarios, and each included information such as the patient's age, cancer diagnosis, stage of disease and treatment response (unless “unknown”), pertinent co-morbidities, reason for ICU admission, pertinent vital signs, and organ failures (if any). The cases chosen were intended to present a wide variation in illness severity and prognosis/disease reversibility. Additionally, some cases were also randomly modified to introduce other challenges sometimes encountered when triaging patients including code status disagreements, external pressures (administrative, family, etc.), and lack of availability of surrogate decision makers. Pre-study validation of the vignettes and flowchart were performed on two separate occasions by two groups of physicians identified as subject matter experts but otherwise uninvolved in the study. During the validation process, physicians provided written feedback on 1) clarity of the vignettes 2) sufficiency of information to assign prioritization levels 3) clarity of the flowchart 4) clarity of written instructions to providers, and 5) overall relevance of the survey to the study question. The vignettes and flowchart were edited according to feedback and re-presented until no further changes were suggested.

The primary objective of the study was to evaluate overall agreement in triage practices between providers on prioritization of oncological patients for ICU admission. Randomization to two different types of guidelines was to determine if format and specificity of the guidelines affected level of agreement. Secondary objectives were to determine the percent of time actual practices aligned with the guidelines, and solicit reasons for any deviations in practice. All responses were anonymous. Participants were randomized electronically in a 1:1 ratio to receive either the original SCCMPM [1] or a flowchart corresponding to the SCCMPM but with cancer-specific decision points (see Fig. 1). They were instructed to use the assigned guideline to choose a priority level (1, 2, 3, 4a or 4b) for admission to the ICU (based on the 5-point likert scale in the SCCMPM) [1]. Patients were to be prioritized independently (without comparison to one another), but to assume limited ICU bed availability for each case. Participants then prioritized each patient a second time based on their “actual practices”. If the guideline-based and actual practice prioritization levels differed, they selected reason(s) for the discrepancy. Demographic data collected included medical credentials, gender, primary and secondary specialties, years in primary specialty, country of main practice, oncological triage experience, hospital and ICU size. Participants also rated level of usefulness of the assigned guide.

2.1. Statistical analysis

We estimated the information entropy for each patient case. The definition for entropy is as follows: $S = -\sum p_i \log p_i$, where p_i is the proportion of clinicians choosing category i in the 5-point likert-scale, $i = 1, 2, 3, 4a, \text{or } 4b$. In this study, the entropy may range from 0 to 1.550. Entropy of 0 indicates perfect agreement and entropy of 1.550 indicates the worst agreement.

With 50 clinicians, a two-sided 95% confidence interval for p_i for a particular patient case using the large sample normal approximation will extend 0.139 the most from the observed proportion. After the entropy was calculated for each patient case, the mean entropy was calculated for each triage tool. With 15 patient case scenarios for each triage tool, the study has 80% power to detect an effect size in mean entropy of 1.06 between the triage tools using a two group *t*-test with a two-sided type I error rate of 0.05 (computed from nQuery Advisor 7.0).

In addition, the agreement amongst 257 ICU clinicians was estimated with the Fleiss' kappa coefficient. Fleiss' kappa is a statistical measure for assessing the reliability of agreement between a fixed number of raters when assigning categorical ratings to a number of items. It can be interpreted as expressing the extent to which the observed amount of agreement amongst raters exceeds what would be expected if all raters made their ratings completely randomly. In this study, we used Fleiss' kappa to measure the inter-physician (rater) reliability giving the 5-level categorical ratings (priority levels 1, 2, 3, 4, and 5) to the 15 patient case scenarios. Fleiss's general guidelines were used to characterize kappa coefficients of <0.40 as poor agreement, 0.41–0.75 as fair to good, and > 0.75 as excellent [15].

Frequencies and percentages were reported for categorical variables (such as credential and priority level). The chi-squared test and Fisher's exact test were used to evaluate the association between two categorical variables. Wilcoxon's signed rank test was used to compare the distributions of paired entropy difference between the two tools (SCCMPM vs. flowchart). All tests were two sided. *P* values <.05 were considered statistically significant. All analyses were conducted using SAS (version 9.3, Cary, NC) statistical software.

3. Results

A total of 257 participants completed the survey. Of those, 52.5% ($n = 135$) were randomized to receive the SCCMPM as a guide, and 47.5% ($n = 122$) received the cancer-specific flowchart. Respondents were from 19 different countries, with the highest numbers being from Chile (23%), Argentina (19%), Ecuador (18%) and Spain (12.5%). A complete list of the stratified baseline data can be found in Table 1. There were no significant differences in baseline characteristics between the two groups.

3.1. Entropy

Statistically, an entropy of 0 indicates perfect agreement and entropy of 1.550 indicates the worst agreement. Overall entropy ranged from 0.785 to 1.507. Scenarios 1, 5, and 10 had the lowest entropy (highest relative agreement) (entropy = 0.849, 0.785, and 0.790 respectively). Scenario 15 had the highest entropy (worst agreement) (entropy = 1.506). The average entropy across all 15 patient cases was 1.192 (see Fig. 2).

For the providers randomized to receive the SCCMPM (n = 135), entropy ranged from 0.810 to 1.480 (see Fig. 2). Scenarios 1, 5 and 10 again had the highest agreement (entropy = 0.853, 0.810, and 0.840 respectively). Scenario 15 again had the worst agreement (entropy = 1.480). The average entropy was 1.193.

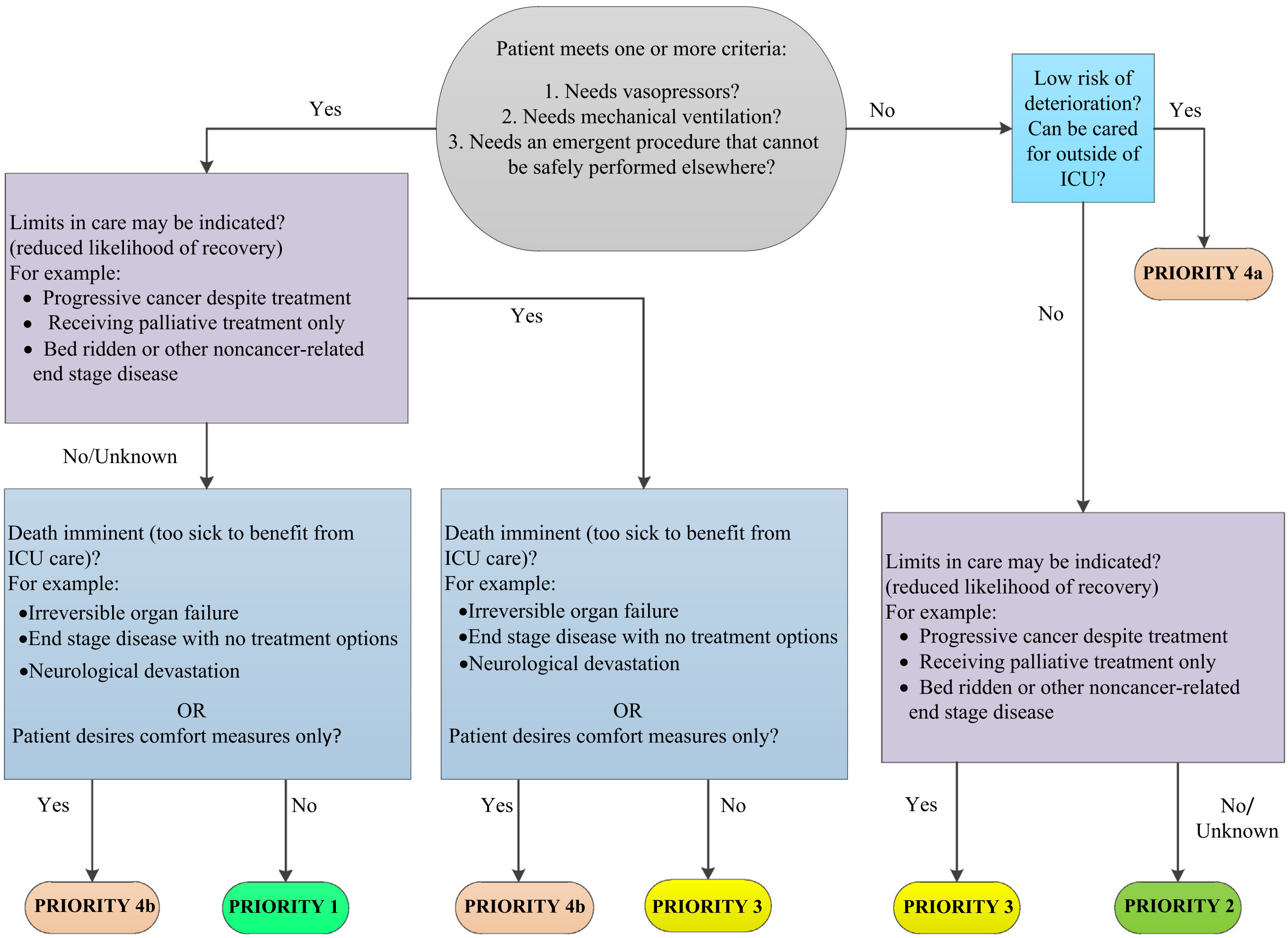

Fig. 1. ICU triage guidelines for cancer patients. Flowchart based on the SCCM Prioritization model likert scale (Priority 1, 2, 3, 4a. and 4b) but uses cancer-specific decision points such as Pallliative (versus) curative.

For providers guided by the cancer-specific flowchart ($n = 122$), entropy ranged from 0.716 to 1.530 (see Fig. 2). Again, scenarios 1, 5 and 10 had the highest agreement (entropy =0.806, 0.758, and 0.716, respectively). Scenario 15 had the worst agreement (entropy = 1.530). The average entropy was 1.153.

Though there was a slight difference in entropy values between the SCCMPM and flowchart (based on paired Wilcoxon's signed rank test with the clinicians in the algorithm arm having a trend towards a lower entropy compared to the clinicians in the SCCMPM arm ($p = .0946$)), this did not reach statistical significance.

3.2. Fleiss' kappa coefficients

The Fleiss' kappa coefficients (see Fig. 3) were estimated to be 0.2136 (95% confidence interval 0.2108 to 0.2163 ($0.2136 \pm 1.96 * 0.00138$) for the SCCMPM arm and 0.2457 (95% confidence interval 0.2427 to 0.2487 ($0.2457 \pm 1.96 * 0.00154$) for the flowchart arm, implying poor agreement amongst these participants for each arm. The Fleiss's Kappa was tested to be significantly different from zero ($p < .0001$).

For individual priority levels, agreement was strongest on priority level 5 (Kappa coefficient = 0.437 in the SCCMPM group and 0.445 in the flowchart group, indicating fair to good agreement) and agreement was the lowest on priority level 3 (Kappa coefficient = 0.097 in the SCCMPM group and 0.070 in the flowchart group, indicating poor agreement).

3.3. Actual practice vs. guideline-based practice

Table 2 describes the percentage of time per scenario providers stated they would prioritize patients differently in actual practice as compared to guideline recommendations. When using the SCCMPM as a guide, discrepancies ranged from 11.1% to 35.6% (average of 17.3%). When using the flowchart as a guide, discrepancies ranged from 10.7% to 39.3% (average of 19%). The most common reasons chosen for deviation from guideline-driven prioritization was clinical judgment (33%), followed by pressure from patients or family members (17%) and legal risks or consequences (14%).

4. Discussion

In this prospective, multi-centered, randomized study that utilized clinical vignettes of critically ill cancer patients, we found poor agreement amongst practitioners on the prioritization of patients for ICU admission. We also identified theoretical discrepancies between guideline-based practices versus actual practices and possible reasons for this inconsistency.

Physician variation in practice is a widespread phenomenon, and occurs despite the availability of widely published clinical guidelines [7,14,23,34]. Though standardizing care in every situation is neither possible nor always appropriate, large variations in practice can be associated with unwanted disparities in care and increased costs [34]. A

Table 1
Baseline data of participants.

	SCCMPM (n = 135)	Flowchart (n = 122)	*p* value
Credentials (%)			
Nurse	8 (5.9%)	4 (3.3%)	0.7603
Physician	108 (80%)	102 (83.6%)	
Physician in Training	13 (9.6%)	10 (8.2%)	
Physician Assistant	3 (2.2%)	2 (1.6%)	
Nurse Practitioner	2 (1.5%)	1 (0.8%)	
Other	1 (0.7%)	3 (2.5%)	
Primary Specialty (%)			
Critical Care	93 (68.9%)	81 (66.4%)	0.621
Oncology	4 (3%)	1 (0.8%)	
Emergency Medicine	7 (5.2%)	4 (3.3%)	
Anesthesia	2 (1.5%)	2 (1.6%)	
Pulmonary Medicine	0 (0%)	2 (1.6%)	
Internal Medicine	17 (12.6%)	19 (15.6%)	
Other	12 (8.9%)	13 (10.7%)	
Years in Primary Specialty (%)			
< 1 year	10 (7.4%)	8 (6.6%)	0.3843
1–5 years	34 (25.2%)	24 (19.8%)	
6–10 years	23 (17%)	33 (27.3%)	
11–15 years	15 (11.1%)	13 (10.7%)	
> 15 years	53 (39.3%)	43 (35.5%)	
Prior ICU triage experience? (%)			
Yes	126 (93.3%)	114 (94.2%)	0.7711
No	9 (6.7%)	7 (5.8%)	
Average no. of cancer patients referred or admitted to ICU per month (%)			
<2	49 (38.9%)	39 (34.2%)	0.8482
2 to 5	45 (35.7%)	46 (40.4%)	
6 to 10	17 (13.5%)	14 (12.3%)	
>10	7 (5.6%)	9 (7.9%)	
Majority or all	8 (6.3%)	6 (5.3%)	
Total beds (main hospital) (%)			
<100	22 (16.3%)	15 (12.3%)	0.3996
100–250	48 (35.6%)	51 (41.8%)	
250–500	42 (31.1%)	30 (24.6%)	
>500	23 (17%)	26 (21.3%)	
Total ICU beds (%)			
<5	4 (3%)	3 (2.5%)	0.7859
5 to 10	47 (34.8%)	40 (32.8%)	
11 to 15	22 (16.3%)	23 (18.9%)	
16 to 20	14 (10.4%)	14 (11.5%)	
21 to 25	11 (8.1%)	12 (9.8%)	
26 to 30	12 (8.9%)	8 (6.6%)	
31 to 35	7 (5.2%)	2 (1.6%)	
36 to 40	5 (3.7%)	3 (2.5%)	
>40	13 (9.6%)	17 (13.9%)	

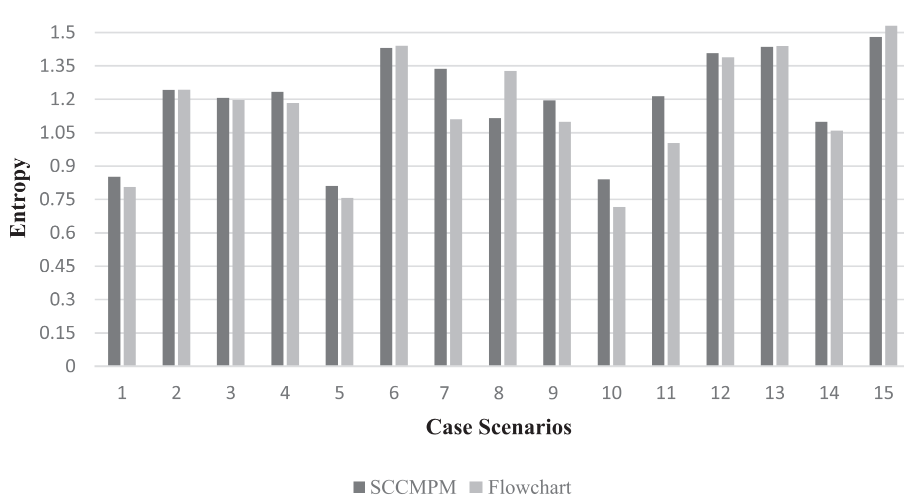

Fig. 2. Entropy per case scenario. Shows the entropy (0–1.5) for each case scenario (1–15) for both the SCCCM Prioritization Model and Flowchart groups. Entropy was high (indicating poor agreement) in all cases, with the exception of case scenarios 1, 5, and 10 which showed moderate agreement.

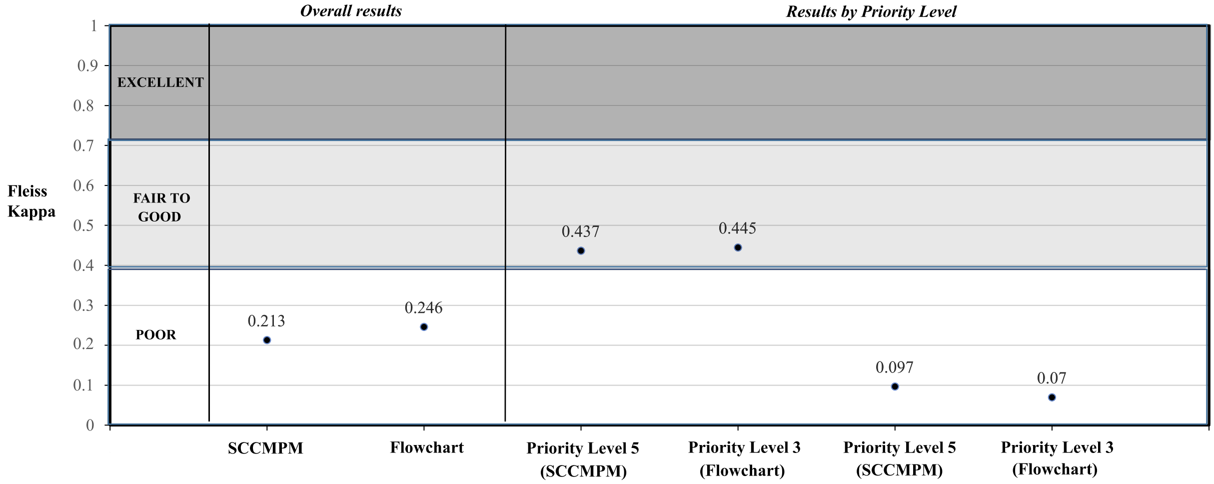

Fig. 3. Fleiss Kappa. Shows the Fleiss Kappa coefficient (0–1) for the SCCM Prioritization Model and Flowchart groups (poor agreement) as well as for priority levels 3 (poor agreement) and 5 (fair to good agreement).

substantial amount of resources are invested in creating consensus statements or clinical practice guidelines, however the level of adherence at the provider level is infrequently assessed.

The variation in approach to ICU utilization has previously been described in a handful of studies [3,6,39,40,42]. Researchers from the Eldicus study (ICU triage for the elderly) theorized that although clinicians may agree on broad triage principles, they are less willing to agree when patient-specific decisions need to be made [37,38]. For example, Sprung and co-workers found that though agreement was obtained on 54 of 62 guidelines that prioritized ICU admission for those likely to benefit, 23% of the same clinicians stated they would not exclude patients with a < 0.1% chance of survival from ICU admission [39]. Algorithms and decision-aid tools are one potential way to improve consensus between physicians when performing ICU triage and potentially reduce inappropriate ICU admissions. This has been studied in non-oncology patients similarly using the SCCPM as a basis for prioritization using both case scenarios and actual patients [30,31].

Clinical vignettes have been shown to be a practical and effective means of eliciting physician practice variation. Vignettes, as opposed to statements or survey questions, better mimic real-life situations where multiple variables contribute simultaneously to the decision-making process [12,13,18,22,27,28,30,41,44]. Our vignettes were deliberately succinct in order to mimic the typical amount of basic and pertinent information conveyed during an initial ICU referral, when urgent dispositions are required. Additional information such as functional status and code status preferences would be ideal at the time of triage, but these details are often ambiguous or unavailable when quickly dispositioning a sick patient.

Understanding and optimizing how providers triage critically ill cancer patients will likely become increasingly more relevant in an era where the projected incidence of cancer is expected to increase by 45% from 2010 to 2030, [33], and oncological admissions to the ICU due to drug-related toxicities, organ failures, and infectious complications are likely to escalate [4]. The study was actually geared towards providers working in general, non-specialty hospitals since these facilities will likely see increasing numbers of critically ill cancer patients, and will need to be able to make appropriate and urgent triage decisions, with or without oncology expertise. When using either the SCCMPM or cancer-specific algorithm as guide, one must be able to appropriately answer two principle questions: 1) What is the likelihood of benefit from ICU care? and 2) What is the degree of reversibility of the acute and/or chronic disease processes? [1] The provider is therefore simultaneously charged with both prognostication as well as appropriately defining limitations of care (if any). These tasks have grown progressively challenging over the past decade as mortality rates for critically ill cancer patients have promisingly declined, [9-11,17,19-21,35,43,45] and stage of malignancy alone may not be an accurate predictor of ICU mortality [8,21]. Expanded treatment options such as targeted and immunological therapies and other new clinical trials have also altered perspectives on some cancers previously thought to be refractory or untreatable. An exception may be cases involving more obvious irreversibility, such as patients with neurological devastation (ie; Cases 5 and 10) or severe underlying end-stage disease states (Case 1). Not surprisingly, cases 1, 5, and 10 had the lowest entropy (highest agreement), with the majority choosing priority Level 5. Priority Level 5 also the strongest Fleiss kappa coefficient at 0.437 for the SCCMPM arm and 0.445 for the algorithm arm (indicating fair agreement) compared to the other Priority levels.

The etiology of the poor consensus in our study is likely multifactorial. Triage guidelines such as the SCCMPM are geared towards a generalized patient population with qualitative decision points and some expected subjectivity. Our flowchart was created to test if using more refined cancer-specific decision points such as palliative (versus curative) treatment modalities and refractory (versus responsive) malignancies could affect consensus. A low level of agreement persisted, however, despite its use. Perhaps incorporating more quantitative data in the algorithm, such as performance status scores like the Eastern Cooperative Oncology Group (ECOG) or Karnofsky scores could help reduce variability [26].

The secondary objective of our study was to evaluate if guideline-based decisions truly aligned with actual practices and understand

Table 2
Percentage of time actual practices differ from guideline-based practices.

Clinical scenario	SCCM (%)	Flowchart (%)	P value
Case 1	18.5%	14.8%	0.4195
Case 2	18.5%	25.4%	0.1814
Case 3	14.8%	16.4%	0.7274
Case 4	11.1%	18.9%	0.0808
Case 5	14.1%	13.1%	0.8228
Case 6	14.8%	20.5%	0.2318
Case 7	27.4%	39.3%	0.0422
Case 8	13.3%	18.9%	0.2276
Case 9	17.8%	19.7%	0.6972
Case 10	35.6%	32.8%	0.6404
Case 11	12.6%	13.9%	0.7512
Case 12	17.8%	15.6%	0.6364
Case 13	14.8%	13.1%	0.6950
Case 14	14.1%	12.3%	0.6742
Case 15	14.8%	10.7%	0.3196

reasons for any discrepancies. It is not well known how external pressures alter clinical decisions. Code status disagreements, for example, were depicted in a few of our vignettes. Understanding how often these external pressures affect clinical decisions is essential. An ethics or palliative care consultation, if rapidly available, may help navigate these variances in opinion [16,25]. One limitation that should be noted, however, is that respondents were first asked to prioritize based on the assigned guideline. Therefore, it is unclear whether or not visualization of the guideline would have modified subsequent answers on actual practices.

There are some limitations of this study that should be taken into consideration. First, though clinical vignettes have been validated as a useful and pragmatic way of measuring practice variation, [18,27,28,36], they are still a surrogate for real-life clinical situations. Though the vignettes were generally based on actual scenarios with typical amounts of information presented during initial ICU referrals, it remains possible that the vignettes themselves may not be sufficiently sensitive or specific to elicit a consistent response from providers. A follow up study using real or even standardized patients, would be a future consideration. Additionally, the SCCMPM has since been updated since this study was conducted [24]. Though the principles regarding prioritization of patients to those who would more likely benefit remain the same, a follow up study will be needed to determine if consensus would improve using the latest version of these guidelines. It is possible some of the disagreement amongst providers are related to only the original version of the guideline. Lastly, some vignettes had a lower entropy (better agreement) as compared to the other scenarios, indicating that in some cases physicians do agree on prioritization. This study was not designed to determine which specific factors (complex refractory disease states, poor functional status, code status issues) contributed to levels of agreement, but this would be appropriate in a follow-up study.

5. Conclusions

Understanding ICU utilization practices within and between hospitals is desired inside any health care system where the demands are quickly outweighing the supplies. Standardizing triage practices would presumably lead to more appropriate use of limited resources [38]. This is especially necessary in the oncological population, as the number of patients living with cancer escalates [4,17]. This study underscores the idea that integrating clinical judgment, patient and family wishes, ethical considerations, and proper resource allocation is a daunting task. We demonstrated that a lack of consensus on interpretation of triage guidelines as well as deviations in practice due to external pressures exists across institutions. The lack of consensus using guidelines persisted despite the use of a cancer-specific flowchart. Thus, a more refined flowchart with objective metrics such as functional status scores may be required to help improve agreement. An overall deeper understanding of the reasons for practice variability, possible refinement of the current guidelines, and continued assessment of end-user adherence to such guidelines are needed to decrease variability, and ultimately optimize fair and appropriate use of the intensive care unit. The lack of consensus on ICU triage practices in the oncological population is a potential barrier to appropriate resource allocation that needs to be addressed.

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Disclaimers

The authors declare no conflicts of interest.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jcrc.2019.05.012.

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