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Abstract

Objective: To evaluate a modified emergency severity index (mESI)-based triage of cancer patients with coronavirus disease 2019 (COVID-19) in the emergency department (ED) and determine the associations between mESI level and ED disposition, hospital length of stay, and overall survival.

Methods: Medical records were retrospectively reviewed for all patients who presented to our institution's ED between March 22, 2020, and March 12, 2021, and tested positive for SARS-CoV-2.

Results: A total of 306 cancer patients tested positive for SARS-CoV-2, with 45% of patients triaged to level 2 (emergent) and 55% to level 3 (urgent). Among all patients, 61.8% were admitted to the hospital, 15.7% were admitted to the intensive care unit, 2.9% were sent for observation, and 19.6% were discharged. Although demographic and clinical characteristics did not significantly vary by triage level, we observed significant differences in ED length of stay (urgent=6.67 hours, emergent=5.97 hours; $p<0.01$). Hospital and intensive care unit admission rates were also significantly higher among emergent patients than among urgent patients ($p<0.05$). There were 75 deaths (urgent=32; emergent=43), and the 30-day mortality rate was significantly higher among emergent patients (urgent=8%, emergent=15%; $p<0.05$). The mESI level persisted as a significant factor associated with overall survival (hazard ratio=1.7, 95% confidence interval=1.09-2.81) in multivariable analysis.

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Conclusion: The mESI level is associated with ED disposition, ED length of stay, and overall survival in cancer patients presenting with COVID-19. These results indicate that the mESI triage tool can be effectively used in cancer patients with COVID-19, whose condition can rapidly deteriorate.

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Keywords: Cancer; ESI; emergency severity index; COVID-19; emergency department

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1. Introduction

The novel coronavirus disease 2019 (COVID-19) pandemic has brought many challenges involving the care of COVID-19 patients in the emergency department (ED). Recurrent surges have led to adaptations of ED triage protocols to better manage patient influx and strain on hospital resources[1,2]. Most hospitals in the United States currently use the emergency severity index (ESI) triage protocol, (Figure 1) which provides timely, high-quality emergency care for patients[3]. The ESI has been shown to be predictive of mortality in older adults and have higher sensitivity than the quick sepsis-related organ failure assessment, the systemic inflammatory response syndrome criteria, and the national early warning score in predicting in-hospital mortality and intensive care unit (ICU) admissions.[4] Although the ESI has been validated in general ED populations and for various subgroups, including pediatric[5-8] and cancer patients[3] as well as older adults[9], the use of a modified ESI (mESI) has been advocated for use in the oncologic population[10,11].

Patients with cancer are particularly vulnerable to systemic infections given their compromised immune system[12-15], and timely recognition and treatment of infections can reduce morbidity and mortality[16,17]. As such, our center has adapted the use a modified version of the ESI to triage patients with cancer. The mESI (Figure 2) includes temperature and systolic blood pressure in addition to the other parameters found in the original ESI. Because cancer patients with COVID-19 can present to the ED with a spectrum of symptoms of variable severity[13] and have an increased risk of rapid clinical deterioration[18], we sought to evaluate the association between the mESI level and ED disposition, hospital length of stay (LOS) and overall survival of this population.

2. Methods

2.1 Population

This retrospective observational study included all cancer patients presenting to the ED at The University of Texas MD Anderson Cancer Center between March 22, 2020, and March 12, 2021, for whom reverse-transcriptase polymerase chain reaction analysis of a nasopharyngeal swab or bronchoalveolar lavage specimen revealed SARS-CoV-2 infection. Excluded patients were those without cancer or with a negative SARS-CoV-2 test result.

2.2 Study Setting

MD Anderson is a comprehensive cancer center that established the first academic emergency medicine department in 2010. The ED has 44 beds and serves approximately 26,000 patients annually. There is also an ED-run observation unit for patients needing short stays of less than two midnights. All patients with COVID-19 symptoms had a nasopharyngeal COVID-19 test in the ED. Additionally, those patients admitted to the hospital or placed in the observation unit required a COVID-19 test, even if asymptomatic. At the beginning of the COVID-19 pandemic, when the turnaround time for a SARS-CoV-2 test result was > 24 hours, patients who needed at least an overnight stay and were low suspicion for COVID-19, were placed in the observation unit pending a COVID-19 test result. However, when the turnaround time for SARS-CoV-2 results decreased to 2 hours (on October 16, 2020), patients were only placed in the observation unit upon having a negative COVID-19 test. If the patients were found to have COVID-19 and needed admission, they were placed in a dedicated unit, which was formed as a response to the COVID-19 pandemic. This unit was not only formed specifically for patients who were confirmed to have COVID-19, but also for patients who were under investigation with high

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suspicion of COVID-19, e.g. those with initial negative nasopharyngeal swabs and waiting for confirmatory tests from bronchoalveolar lavage. These units had single-patient negative pressure rooms; had staffing trained in the use of personal protective equipment (PPE); and had protocols that were consistent with existing infection prevention and control recommendations by the Centers for Disease Control and Prevention. Since patients could potentially deteriorate from COVID-19, all rooms had ICU capability in case mechanical ventilation or dialysis was needed. The COVID-19 units are staffed by MD Anderson hospitalists and ICU physicians with 24-hour coverage by nocturnal physicians and advanced practice providers.

2.3 Ethics

The current study was conducted in accordance with a clinical research protocol approved by our hospital's Institutional Review Board. The study conformed to the provisions of the Declaration of Helsinki (as revised in 2013). Written informed consent was waived because this was a retrospective review study.

2.4 Data Collection

Data related to the initial COVID-19 diagnosis were obtained from patient electronic medical records. Variables collected included mESI level, demographic information, comorbidities, chief complaints, vital signs at presentation to the ED, laboratory test results during the ED encounter, ED disposition, and clinical outcomes.

Data were aggregated in the Syntropy platform, Palantir Foundry, as part of the Data-Driven Determinants of COVID-19 Oncology Discovery Effort (D3CODE) protocol at our institution.

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2.5 Main Independent Variable

The ESI triage tool is a 5-level triage process initially developed in 1998 by the Agency for Healthcare Research & Quality[19], and acquired by the Emergency Nurses Association in 2019. The original version of the ESI algorithm (Figure 1) includes heart rate, respiratory rate, and oxygen saturation with age-specific ranges to indicate "danger zone" vital signs, suggesting a high-risk situation prompting a higher-acuity triage level. Figure 2 shows the ESI adapted for use at our center, which expanded these potential "danger zone" vital signs to include consideration of systolic blood pressure and temperature. The ESI algorithm was enhanced at our center to better identify high-risk scenarios commonly seen in cancer patients, such as neutropenic fever and sepsis.

2.6 Outcome Variables

The primary outcome variable was ED disposition. Our electronic medical record data indicated whether the patient was: a) admitted to the hospital, b) observed in the hospital, or c) discharged to home after the ED visit. Our secondary outcome variables included hospital LOS among those admitted to the hospital and overall survival. Survival time was calculated from the date of ED presentation for initial COVID-19 diagnosis to the date of death of any cause or last follow-up/contact date with MD Anderson.

2.7 Other Cofactors (Potential Confounders)

Epidemiologic factors included age, sex, race, ethnicity, smoking status, and body mass index. Clinical factors included comorbidities and medical interventions during the ED stay, including

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use of oxygen. Laboratory values included albumin, lactic dehydrogenase (LDH), and aspartate transaminase, which have previously been shown to be prognostic factors for severity and mortality in patients with COVID-19[20]. We focused on these variables because they were available during the ED encounter.

2.8 Statistical Analyses

We used descriptive statistics to summarize the sociodemographic and clinical characteristics of the study population. Differences in mESI levels among the outcome measures were assessed using an independent *t* test, Pearson chi-square test, or Fisher exact test where appropriate. We generated overall survival curves by mESI level using the Kaplan-Meier method and assessed significant differences between the curves using the log-rank test. Survival time was calculated from the date of ED presentation to the date of death of any cause or last follow-up. Patients who were lost to follow-up or were still alive at the end of the follow-up period were considered right censored in the analyses. Univariate and multivariable Cox proportional hazards regression analyses were used to estimate the strength of association for variables using hazard ratios (HRs) and 95% confidence intervals (CIs). The multivariable model assessed the effect of mESI on overall survival while controlling for epidemiologic and clinical factors. All statistical analyses were performed using SPSS software (SPSS Inc, Chicago, IL). All statistical tests were 2-sided, and $p < 0.05$ was considered statistically significant.

3. Results

3.1 Patient Characteristics

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A total of 306 cancer patients tested positive for SARS-CoV-2 during the study period. Two hundred and forty-five patients (80%) presented with a chief complaint that included one or more COVID-19 related symptoms (fever, shortness of breath, cough, sore throat, myalgia, nasal congestion, vomiting, diarrhea or known COVID-19 infection). The rest of the patients had a COVID-19 test done for admission purposes as mandated by our institution. Table 1 shows the number of patients with selected characteristics. The mean ED LOS for the whole cohort was 6.35 hours (standard deviation 2.40 hours), and the mean hospital LOS was 8.20 days (standard deviation 8.65 days).

3.2 mESI Distribution

The distribution of mESI levels reflected the high acuity of the patient population (Table 1). Most patients were triaged as level3 and no patients were triaged to levels 1, 4, or 5. While demographics, clinical characteristics, and hospital LOS did not significantly vary by triage level (Tables 1 and 2) we observed significant differences in ED LOS by triage level (level 3 = 6.67 hours, level 2 = 5.97 hours; $p < 0.01$).

3.3 Survival

A total of 75 patients in our cohort had died as of June 3, 2021. Mean overall survival was 337 days (95% CI = 310-364 days) among level 3 patients and 255 days (95% CI = 225-284 days) among level 2 patients ($p < 0.01$). Figure 3 shows the Kaplan-Meier curves of overall survival by mESI level. We also assessed 30-day mortality rates (data not shown), and we found that 8% of level 3 patients, compared with 15% of level 2 patients ($p < 0.05$), died within 30 days of the ED visit.

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We conducted univariate and multivariable analyses to assess the extent to which mESI level was associated with overall survival. Of the candidate variables assessed (age, sex, race, ethnicity, smoking status, body mass index, number of comorbidities, albumin, LDH, aspartate aminotransferase, alanine transaminase, disposition, and mESI level), only albumin, LDH, number of comorbidities, and mESI level were significant in the univariate model ($p < 0.05$). In the final multivariable model, mESI level persisted as a significant factor associated with overall survival (mESI level 2: HR = 1.75, 95% CI = 1.09-2.81), along with albumin (high albumin: HR = 1.83, 95% CI = 1.13-2.96), LDH (elevated LDH: HR = 1.79, 95% CI = 1.05-3.05), and number of comorbidities (HR = 1.15, 95% CI = 1.04-1.28; Table 3).

4. Discussion

One of the benefits of the ESI algorithm is its ability to be adapted and enhanced for a specific patient population[19].[19]. Malinovska et al[21] found that a modification of the ESI allowed for improved mortality prediction in patients older than 65 years. In our cancer patient population, the addition of temperature and systolic blood pressure to the "danger zone" vital signs addressed and identified red flags prior to respiratory or hemodynamic deterioration and provided further insight into the degree of illness at the triage junction, suggesting hemodynamic stability, metabolic reserve, and systemic response to the infection[22]. Inclusion of these factors may have also provided a more targeted approach to ESI level assignment, and rapid assessment and evaluation of these relevant vital signs in triage may have helped better determine the severity of illness and effectively prioritize care in cancer patients with COVID-19. However, additional studies with larger populations are needed to validate our findings.

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Most of the patients in our study were classified as a level 2 or 3 at triage when using the mESI tool. These findings are consistent with an early pandemic study[23] that reported that most patients who presented to the ED with COVID-19 were ESI level 2 and 3. Interestingly, we did not have any cancer patients with COVID-19 classified as mESI level 4 or 5, which may indicate that patients with cancer tend to be sicker upon presentation to the ED. These findings are also consistent with a previous study[3] showing that most cancer patients presenting to the ED had an ESI level of ≤3. Furthermore, our analysis showed that ED LOS was slightly longer among level 3 patients than among level 2 patients. This could be due to a potential urgency to transfer level 2 patients out of the ED after stabilization.

A recent study by Adler et al[3] evaluated a cohort of patients with active cancer who presented to the ED and showed that the original ESI was in fact predictive of ED disposition and ED resource utilization. However, they did not find an association between ESI and ED LOS or 30-day overall survival rates. This highlights the need for a re-classification of the triage tools used in cancer patients as previously recommended, owing to their higher acuity and higher risk classification[10,24]. Our study shows that the mESI can better identify high-risk scenarios in cancer patient with COVID-19. This may be due to COVID-19 symptoms being similar to those seen in cancer patients with sepsis and neutropenic fever. Overall, the mESI is strongly associated with ED disposition, ED LOS, and overall survival in our cohort of cancer patients with COVID-19.

Our study has a few important limitations. First, it was a retrospective, single-center study in a well-resourced, cancer-specific hospital, which may limit the generalizability of our findings. We did not evaluate every available laboratory test result obtained in these patients and only focused

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on variables that are available during the ED encounter. Finally, we used overall survival as our outcome rather than COVID-19–specific mortality and did not account for stage of disease in our analyses. Nonetheless, being the first study evaluating the association between mESI level and outcomes in cancer patients with COVID-19, our study further supports the use of the mESI triage tool in cancer patients with COVID-19.

5. Conclusion

The COVID-19 pandemic has raised concern about potential negative outcomes related to ED overcrowding. Our findings suggest that in cancer patients with COVID-19, a significant association exists between mESI and ED disposition, ED LOS, and overall survival. Therefore, the mESI triage tool may be used in cancer patients presenting to the ED with COVID-19.

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References

1. Wallace DW, Burleson SL, Heimann MA, et al. An adapted emergency department triage algorithm for the COVID-19 pandemic. *J Am Coll Emerg Physicians Open*. Aug 10 2020;doi:10.1002/emp2.12210
2. Alhaidari F, Almuhaideb A, Alsunaidi S, et al. E-Triage Systems for COVID-19 Outbreak: Review and Recommendations. *Sensors (Basel)*. Apr 17 2021;21(8)doi:10.3390/s21082845
3. Adler D, Abar B, Durham DD, et al. Validation of the Emergency Severity Index (Version 4) for the Triage of Adult Emergency Department Patients With Active Cancer. *J Emerg Med*. Sep 2019;57(3):354-361. doi:10.1016/j.jemermed.2019.05.023
4. Phungoen P, Khemtong S, Apiratwarakul K, Ienghong K, Kotruchin P. Emergency Severity Index as a predictor of in-hospital mortality in suspected sepsis patients in the emergency department. *Am J Emerg Med*. Sep 2020;38(9):1854-1859. doi:10.1016/j.ajem.2020.06.005
5. Baumann MR, Strout TD. Evaluation of the Emergency Severity Index (version 3) triage algorithm in pediatric patients. *Acad Emerg Med*. Mar 2005;12(3):219-24. doi:10.1197/j.aem.2004.09.023

Journal Pre-proof

6. Travers DA, Waller AE, Katznelson J, Agans R. Reliability and validity of the emergency severity index for pediatric triage. *Acad Emerg Med*. Sep 2009;16(9):843-9. doi:10.1111/j.1553-2712.2009.00494.x
7. Durani Y, Brecher D, Walmsley D, Attia MW, Loiselle JM. The Emergency Severity Index Version 4: reliability in pediatric patients. *Pediatr Emerg Care*. Nov 2009;25(11):751-3.
8. Ghafarypour-Jahrom M, Taghizadeh M, Heidari K, Derakhshanfar H. Validity and Reliability of the Emergency Severity Index and Australasian Triage System in Pediatric Emergency Care of Mofid Children's Hospital in Iran. *Bull Emerg Trauma*. Oct 2018;6(4):329-333. doi:10.29252/beat-060410
9. Baumann MR, Strout TD. Triage of geriatric patients in the emergency department: validity and survival with the Emergency Severity Index. *Ann Emerg Med*. Feb 2007;49(2):234-40. doi:10.1016/j.annemergmed.2006.04.011
10. Manfredini LL, Dos Santos GP, Centrone AFY, Hamerschlak N. Reclassification of risk in an emergency referral center: the need for a specific tool for the classification of onco-hematological patients. A cross-sectional study. *Med Oncol*. May 4 2018;35(6):86. doi:10.1007/s12032-018-1136-1
11. Gilboy N TP, Travers DA, Rosenau AM, Eitel DR. Emergency Severity Index, Version 4: Implementation Handbook. AHRQ Publication No. 05-0046-2. Rockville, MD: Agency for Healthcare Research and Quality. May 2005.
12. Minotti C, Tirelli F, Barbieri E, Giaquinto C, Dona D. How is immunosuppressive status affecting children and adults in SARS-CoV-2 infection? A systematic review. *J Infect*. Jul 2020;81(1):e61-e66. doi:10.1016/j.jinf.2020.04.026
13. Zhang L, Zhu F, Xie L, et al. Clinical characteristics of COVID-19-infected cancer patients: a retrospective case study in three hospitals within Wuhan, China. *Ann Oncol*. Jul 2020;31(7):894-901. doi:10.1016/j.annonc.2020.03.296
14. Dai M, Liu D, Liu M, et al. Patients with Cancer Appear More Vulnerable to SARS-CoV-2: A Multicenter Study during the COVID-19 Outbreak. *Cancer Discov*. Jun 2020;10(6):783-791. doi:10.1158/2159-8290.CD-20-0422
15. Lee LYW, Cazier JB, Starkey T, et al. COVID-19 prevalence and mortality in patients with cancer and the effect of primary tumour subtype and patient demographics: a prospective cohort study. *Lancet Oncol*. Oct 2020;21(10):1309-1316. doi:10.1016/S1470-2045(20)30442-3
16. Koenig C, Schneider C, Morgan JE, Ammann RA, Sung L, Phillips B. Interventions aiming to reduce time to antibiotics (TTA) in patients with fever and neutropenia during chemotherapy for cancer (FN), a systematic review. *Support Care Cancer*. May 2020;28(5):2369-2380. doi:10.1007/s00520-019-05056-w
17. Koenig C, Schneider C, Morgan JE, Ammann RA, Sung L, Phillips B. Association of time to antibiotics and clinical outcomes in patients with fever and neutropenia during chemotherapy for cancer: a systematic review. *Support Care Cancer*. Mar 2020;28(3):1369-1383. doi:10.1007/s00520-019-04961-4
18. Lipe DN, Elsayem A, Cruz-Carreras MT, et al. Characteristics of cancer patients with COVID-19 in a cancer hospital. *Ann Palliat Med*. Feb 2021;10(2):1763-1771. doi:10.21037/apm-20-1447
19. Gilboy N, Tanabe P, Travers D, Rosenau AM. ESI: Emergency Severity Index. A Triage Tool for Emergency Departement Care. Version 4: Implementation Handbook. Accessed August 24, 2021,
20. Izcovich A, Ragusa MA, Tortosa F, et al. Prognostic factors for severity and mortality in patients infected with COVID-19: A systematic review. *PLoS One*. 2020;15(11):e0241955. doi:10.1371/journal.pone.0241955
21. Malinovska A, Pitasch L, Geigy N, Nickel CH, Bingisser R. Modification of the Emergency Severity Index Improves Mortality Prediction in Older Patients. *West J Emerg Med*. Jul 2019;20(4):633-640. doi:10.5811/westjem.2019.4.40031

Journal Pre-proof

22. Morneau K, Chisholm GB, Tverdek F, Bruno J, Toale KM. Timing to antibiotic therapy in septic oncologic patients presenting without hypotension. *Support Care Cancer*. Nov 2017;25(11):3357-3363. doi:10.1007/s00520-017-3754-0
23. Tolia VM, Chan TC, Castillo EM. Preliminary Results of Initial Testing for Coronavirus (COVID-19) in the Emergency Department. *West J Emerg Med*. Mar 27 2020;21(3):503-506. doi:10.5811/westjem.2020.3.47348
24. Minichsdorfer C, Jeryczynski G, Krall C, et al. Impact of COVID-19 lockdown on routine oncology versus emergency care at a high volume cancer centre. *Eur J Clin Invest*. Aug 2021;51(8):e13623. doi:10.1111/eci.13623

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Table 1. Selected characteristics for the whole cohort (n = 306) and by triage level.

	No. (%)		
		Triage level	
Characteristic	**All patients, n=306**	**Level 2 – emergent, n=138**	**Level 3 – urgent, n=168**
Sex			
Female	134 (43.8)	65 (47.1)	69 (41.1)
Male	172 (56.2)	73 (52.9)	99 (58.9)
Race			
White	201 (65.7)	83 (60.1)	118 (70.2)
Black	49 (16.0)	26 (18.8)	23 (13.7)
Other	56 (18.3)	29 (21.0)	27 (16.1)
Ethnicity			
Hispanic	83 (27.1)	43 (31.2)	40 (23.8)
Non-Hispanic	218 (71.2)	92 (66.7)	126 (75.0)
Unknown	5 (1.6)	3 (2.2)	2 (1.2)
Smoking status			
Never smoker	178 (58.2)	78 (56.5)	100 (59.5)
Former smoker	108 (35.3)	57 (41.3)	51 (30.4)
Current smoker	11 (3.6)	6 (4.3)	5 (3.0)
Unknown	9 (2.9)	3 (2.2)	6 (3.6)
Mean body mass index (range)	29.8 kg/m^2 (±6.7 kg/m^2)	30 kg/m^2 (±6.7 kg/m^2)	29.5 kg/m^2 (±6.8 kg/m^2)
Comorbidities			
Hypertension	233 (76.1)	103 (74.6)	120 (71.4)
Cardiac arrythmia	148 (48.4)	68 (49.3)	80 (47.6)
Diabetes mellitus	144 (47.1)	65 (47.1)	79 (47.0)
Chronic kidney disease	103 (33.7)	41 (29.7)	62 (36.9)
Myocardial infarction	54 (17.6)	26 (18.8)	28 (16.7)
Atrial fibrillation	43 (14.1)	18 (13.0)	25 (14.9)
Obstructive sleep apnea	41 (13.4)	24 (17.4)	17 (10.1)
Non-asthma chronic pulmonary disease	39 (12.7)	17 (12.3)	22 (13.1)
Deep vein thrombosis	38 (12.4)	15 (10.9)	23 (13.7)
Asthma	33 (10.8)	14 (10.1)	19 (11.3)
Congestive heart failure	33 (10.8)	15 (10.9)	18 (10.7)
Obesity	33 (10.8)	17 (12.3)	16 (9.5)
Atherosclerosis	30 (9.8)	13 (9.4)	17 (10.1)
End-stage renal disease	17 (5.6)	6 (4.3)	11 (6.5)
Pulmonary hypertension	8 (2.6)	2 (1.4)	6 (3.6)
Coronary artery disease	6 (2.0)	3 (2.2)	3 (1.8)
Human immunodeficiency virus	3 (1.0)	2 (1.4)	1 (0.6)
Mean no. of comorbidities (standard deviation)	3.14 (2.09)	3.10 (0.16)	3.13 (0.17)
Disposition*			
Discharge	60 (19.6)	17 (12.3)	43 (25.6)

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Observation	9 (2.9)	6 (4.3)	3 (1.8)
Inpatient admission*	189 (61.8)	89 (64.5)	100 (59.5)
Intensive care unit admission*	48 (15.7)	26 (18.8)	22 (13.1)
Clinical trajectory			
Mean emergency department length of stay (standard deviation) *	6.35 hours (2.40 hours)	5.97 hours (2.19 hours)	6.67 hours (2.52 hours)
Mean hospital length of stay (standard deviation)	8.20 days (8.65 days)	9.15 days (8.96 days)	7.41 days (8.32 days)
Oxygen requirements*			
Nasal cannula	226 (73.9)	113 (81.9)	113 (67.3)
High-flow nasal cannula	61 (19.9)	37 (26.8)	24 (14.3)
Intubation and mechanical ventilation	23 (7.5)	14 (10.1)	9 (5.4)
Bilevel positive airway pressure	9 (2.9)	3 (2.2)	6 (3.6)

*Significantly different between urgent and emergent patients ($p < 0.05$).

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Table 2. Laboratory values obtained during the emergency department visit, for the entire cohort (n = 306) and by triage level.

	No. (%)		
		Triage level	
Laboratory value	**All patients, n=306**	**Level 2 – emergent, n=138**	**Level 3 – urgent, n=168**
Albumin (reference range 3.5-5.2 gm/dL)*			
High	214 (71.1)	99 (71.7)	115 (70.6)
Low	87 (28.9)	39 (28.3)	48 (29.4)
Lactate dehydrogenase (reference range 135-225 U/L)			
High	174 (56.9)	83 (60.1)	91 (54.2)
Low	132 (43.1)	55 (39.9)	77 (45.8)
Alanine aminotransferase (reference range ≤41 U/L)*			
High	78 (25.9)	33 (23.9)	45 (27.6)
Low	223 (74.1)	105 (76.1)	118 (72.4)
Aspartate aminotransferase (reference range ≤40 U/L)†			
High	104 (34.0)	47 (34.1)	57 (35.2)
Low	196 (65.3)	91 (65.9)	105 (64.8)

*Data were missing for 5 patients (all urgent patients). Percentages reflect the number of patients with data available.

†Data were missing for 6 patients (all urgent patients). Percentages reflect the number of patients with data available.

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Table 3. Predictors of overall survival in the multivariable model. *

Variable	Hazard ratio	95% confidence interval	p
Albumin			
Normal	1.0		
High	1.833	1.132-2.967	.014
Lactate dehydrogenase			
Normal	1.0		
High	1.792	1.051-3.055	.032
No. of comorbidities (0-17)	1.157	1.046-1.280	.005
Modified emergency severity index level			
Level 3: Urgent	1.0		
Level 2: Emergent	1.752	1.091-2.811	.020

*Of the candidate variables assessed (age, sex, race, ethnicity, smoking status, body mass index, number of comorbidities, albumin, lactate dehydrogenase, aspartate aminotransferase, alanine transaminase, disposition, modified emergency severity index level, and COVID-19 chief complaint), only albumin, lactate dehydrogenase, number of comorbidities, and modified emergency severity index level were significant in the univariate model ($p < 0.05$).

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Figure 1. Standard emergency severity index triage algorithm for adults
HR, heart rate; RR, respiratory rate; SpO2, oxygen saturation.

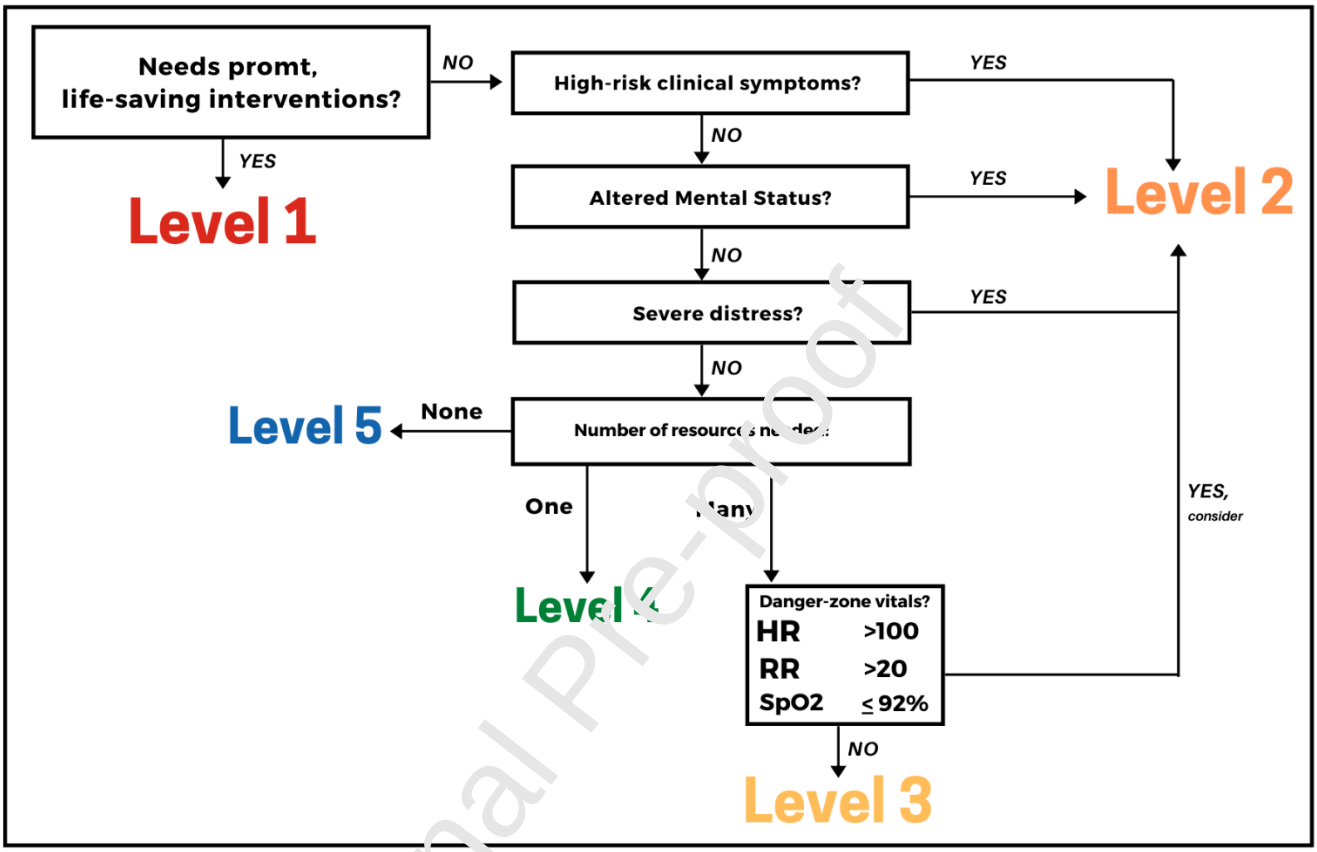

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Figure 2. Modified emergency severity index triage algorithm for adults with oncologic considerations (developed and used by The University of Texas MD Anderson Cancer Center). Abbreviations: HR, heart rate; RR, respiratory rate; SBP, systolic blood pressure; SpO2, oxygen saturation; Temp, temperature.

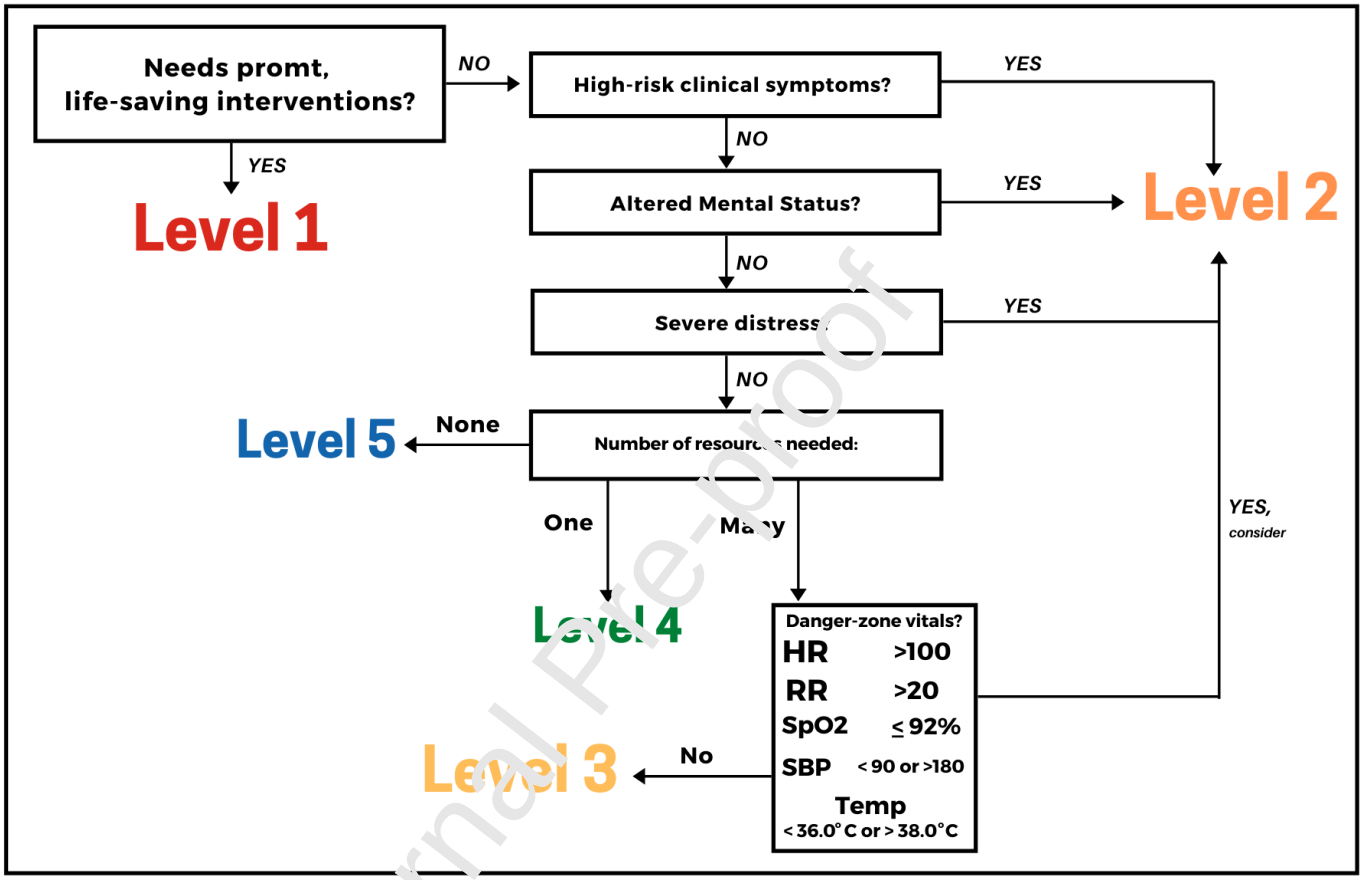

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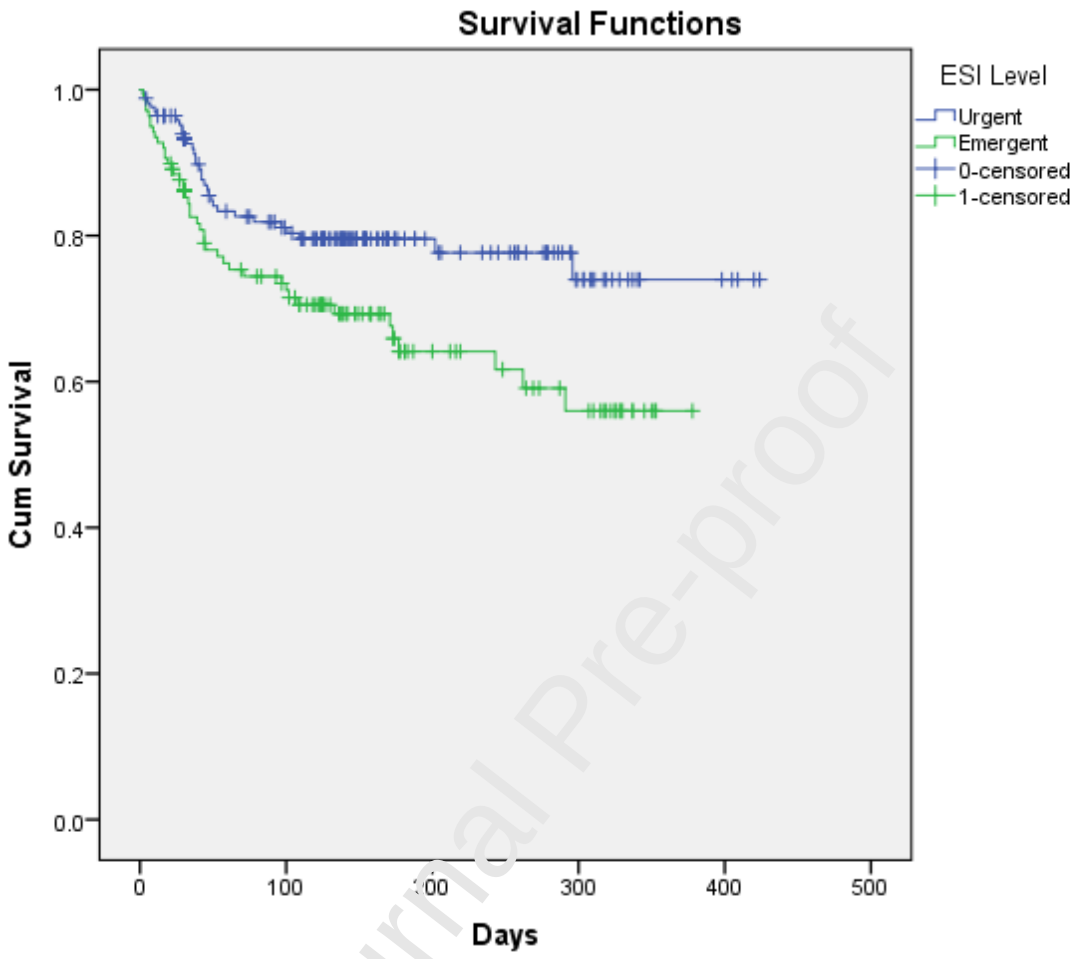
Figure 3. Kaplan-Meier curves for overall survival by modified emergency severity index level for the entire cohort (n = 306).



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