BMC Emergency Medicine

RESEARCH

Open Access

Triage decisions and health outcomes among oncology patients: a comparative study of medical and surgical cancer cases in emergency departments

Anas Alsharawneh[1*], Rami A. Elshatarat[2], Ghaida Shujayyi Alsulami[3], Mahmoud H. Alrabab'a[4], Majed S. Al-Za'areer[5], Bandar Naffaa Alhumaidi[6], Wesam T. Almagharbeh[7], Tahany Fareed Al niarat[8], Khaled M. Al-Sayaghi[2,9] and Zyad T. Saleh[10,11]

Abstract

Background Cancer-related emergencies are a significant challenge for healthcare systems globally, including Jordan. Effective triage is critical in ensuring timely and accurate prioritization of care, especially for surgical cancer patients requiring urgent intervention. However, under-triage—misclassification of high-acuity patients into lower urgency categories—can lead to significant delays and worsened outcomes. Despite the recognized importance of accurate triage, limited research has evaluated its impact on cancer patients in Jordan, particularly those requiring surgical care.

Objectives This study aimed to evaluate the timeliness and prioritization of care for cancer patients admitted through the emergency department (ED) in Jordan. The specific objectives were to examine the association between under-triage and treatment delays and assess its impact on key outcomes, including time to physician assessment, time to treatment, and hospital length of stay.

Methods A retrospective cohort design was used to analyze data from 481 cancer patients admitted through the ED in four governmental hospitals across Jordan. Two cohorts were established: surgical cancer patients requiring emergency interventions and non-surgical cancer patients presenting with other oncological emergencies. Triage accuracy was assessed using the Canadian Triage and Acuity Scale (CTAS), and under-triage was identified when patients requiring high urgency care (CTAS I-III) were misclassified into lower urgency categories (CTAS IV-V). Data were collected from electronic health records and analyzed using multiple linear regression to evaluate the association between under-triage and treatment outcomes.

Results The majority of patients were elderly, with a mean age of 62.6 years (± 10.7), and a significant proportion presented with advanced-stage cancer (83.4% in stages III and IV). Surgical patients frequently exhibited severe symptoms such as acute pain (51.6%) and respiratory discomfort (41.1%). Under-triage rates were 44.1% for surgical

*Correspondence:
Anas Alsharawneh
Anasm@hu.edu.jo

Full list of author information is available at the end of the article

patients and 39.4% for non-surgical patients. Among surgical patients, under-triage significantly delayed time to physician assessment (β = 34.9 min, $p < 0.001$) and time to treatment (β = 68.0 min, $p < 0.001$). For non-surgical patients, under-triage delays were even greater, with prolonged physician assessment times (β = 48.6 min, $p < 0.001$) and ED length of stay (β = 7.3 h, $p < 0.001$). Both cohorts experienced significant increases in hospital length of stay (surgical: β = 3.2 days, $p = 0.008$; non-surgical: β = 3.2 days, $p < 0.001$).

Conclusion Under-triage in Jordanian EDs is strongly associated with significant delays in care for both surgical and non-surgical cancer patients, highlighting systemic gaps in acuity recognition and triage processes. These findings underscore the need for targeted interventions to improve triage accuracy, particularly through oncology-specific training and the integration of evidence-based tools like SIRS criteria. Enhancing ED processes for cancer patients is crucial to reducing delays, optimizing resource allocation, and improving clinical outcomes in this vulnerable population.

Clinical trial number Not applicable.

Keywords Cancer patients, Emergency department, Under-triage, Triage accuracy, Treatment outcomes, Retrospective study

Introduction

Cancer-related emergencies pose significant challenges for healthcare systems worldwide, including in Jordan, particularly when dealing with surgical oncology cases. These emergencies demand immediate intervention, yet the complexity of cancer patients' conditions often complicates the assessment and triage process in the emergency department (ED). Patients with malignancies frequently experience acute oncological emergencies due to the progression of their disease or complications from treatments [1, 2]. Such emergencies require specialized care, yet timely triage and treatment remain critical issues, particularly in Jordan's healthcare context, where ED systems face systemic constraints.

Triage systems play a pivotal role in prioritizing care and managing the influx of patients in EDs. Globally, systems like the Canadian Triage and Acuity Scale (CTAS) and the Emergency Severity Index (ESI) are widely used, offering standardized frameworks to assess patient acuity and ensure timely care [3, 4]. However, these systems often require adaptation to local contexts, such as Jordan's, where resources may be limited, and clinical guidelines may lack specificity for cancer-related emergencies. Studies have shown that triage reliability and validity can be inconsistent, particularly for cancer patients with complex, multi-organ involvement [5–7]. In Jordan, the absence of oncology-specific triage protocols may exacerbate delays, especially for surgical cancer patients who require urgent interventions aimed at curative outcomes.

SIRS is implicit in the triage guidelines and decision-making processes for all ED patients with cancer disorders. In this particular setting, nurses are expected to use the Complaint Oriented Triage (COT 2012 [English-Canada Version 02.02]) to triage all patients in the ED. The COT is an interactive computerized tool utilized in Canadian EDs to triage patients. As part of this system, nurses are required to assess whether patients appear septic at presentation, particularly if they are immunocompromised (e.g., cancer patients undergoing active treatment) [3, 4, 7, 8]. This evaluation is performed using the systemic inflammatory response syndrome (SIRS) criteria. SIRS criteria serve as an essential early detection tool that allows triage nurses to identify sepsis and systemic complications, which are common in oncology patients [3, 8]. By incorporating SIRS into triage protocols, nurses can better recognize high-acuity patients, ensuring that those at risk for rapid deterioration receive timely medical intervention. This standardized approach not only improves triage accuracy but also minimizes the risk of under-triage for cancer patients presenting with ambiguous or complex symptoms [8–10].

ED visits among cancer patients in Jordan are frequent, with advanced or terminal-stage cases representing a substantial portion of admissions [7, 11, 12]. Many of these visits are linked to supportive or palliative care needs, which can overshadow the urgency required for cases involving surgical interventions. While palliative patients often benefit from symptom management, surgical patients frequently present with acute symptoms like severe pain and respiratory distress, requiring immediate attention to prevent complications [7, 11, 13]. Despite this, research indicates that triage nurses may underappreciate the urgency of surgical oncology cases, leading to misclassification and delays in care [7].

Under-triage in Jordanian EDs is compounded by systemic issues, including overcrowding, staff shortages, and a lack of specialized training for oncology emergencies. These challenges mirror findings in other healthcare systems, where under-triage has been associated with significant delays in treatment initiation, extended hospital stays, and worse outcomes [7, 14, 15]. Surgical cancer patients, in particular, are at risk of severe morbidity and mortality when their care is delayed [7, 14, 15].

This study focuses on the triage system in Jordan, evaluating its effectiveness in identifying and prioritizing surgical cancer patients in the ED. It examines whether triage decisions align with the clinical urgency of surgical cases and assesses how delays impact critical outcomes such as time to treatment, admission, and hospital length of stay. By comparing these patients with non-surgical cancer cases, the study aims to identify disparities in care pathways and outcomes.

The findings from this research aim to uncover gaps in the current triage processes for cancer-related emergencies in Jordan. Identifying these gaps will contribute to the development of targeted interventions to improve triage accuracy, reduce delays, and enhance patient outcomes. By emphasizing the importance of timely and accurate triage decisions, this study seeks to inform policy changes and guide future improvements in Jordan's ED systems, ultimately supporting better care for cancer patients with acute and surgical needs.

Research purpose and objectives

The purpose of this study is to examine how effectively cancer patients requiring surgical intervention are managed in the ED, particularly focusing on whether they receive timely care and are prioritized correctly according to their clinical needs. With cancer-related emergencies being both frequent and complex, the study aims to determine whether triage decisions in the ED accurately reflect the urgency of these cases and contribute to prompt treatment initiation.

This study first seeks to assess if surgical cancer patients admitted from the ED receive the necessary care without delays. Given the high acuity of these cases, timely intervention is crucial to reduce complications and improve outcomes. Second, the study examines whether triage practices in the ED accurately identify and prioritize these patients, ensuring that their conditions are appropriately classified for urgent care. By investigating the prioritization process, the study aims to uncover any potential gaps in identifying critical cases within the broader oncology population in the ED.

Lastly, the study explores how triage decisions impact the outcomes of surgical oncology patients, including metrics such as time to treatment, length of hospital stay, and overall patient experience. By understanding the effects of triage decisions on these outcomes, the study intends to highlight opportunities to refine emergency triage processes, ultimately enhancing the care quality for surgical cancer patients in urgent settings. Through this investigation, the study hopes to contribute valuable insights into the ED management of cancer patients, paving the way for evidence-based improvements in emergency triage and care pathways.

Methodology

Research design

This study employed a retrospective cohort design to examine the timeliness and prioritization of emergency care for cancer patients admitted through the ED for surgical purposes. Two distinct cohorts were assembled: one comprised cancer patients admitted from the ED specifically for surgical interventions, while the second included patients admitted due to other oncological emergencies.

Cohort assembly

To assemble the cohorts, data linkages were created between the hospital's tumor registry, surgical logs, and ED database to accurately identify eligible patient records. The medical records department provided discharge summaries for all qualifying cases, which two blinded research co-authors reviewed to determine admission purpose. The surgical oncology cohort included patients admitted primarily for surgical operations, while the comparison group consisted of eligible non-surgical oncology patients admitted for other oncological emergencies.

Further classification of patients was based on triage appropriateness. Each patient's clinical presentation was re-evaluated using an electronic triage (e-Triage) tool, with the SIRS criteria applied to assess sepsis risk. Patients accurately triaged to high-urgency levels represented the unexposed group, whereas those misclassified to lower-urgency levels were designated as the undertriaged or exposed group.

Setting and sample

The study was conducted in four large governmental hospitals located across three major cities in Jordan—Amman (the capital), Zarqa, and a northern region. Each selected hospital, with a capacity of over 200 beds, provides comprehensive emergency services as well as specialized medical and surgical care for cancer patients. These hospitals were randomly selected from a list of eligible facilities within the chosen cities, identified through an online search.

The sample comprised cancer patients admitted through the ED for both surgical and non-surgical oncological emergencies. The sample size was calculated to ensure the detection of meaningful differences in the timeliness of care between two patient cohorts: those admitted for surgical interventions and those admitted for other oncological emergencies. Using the G*Power software application, the sample size was determined with a significance level (alpha) set at 0.05, a power of 90%, and a moderate effect size of 0.30, based on multiple linear regression analyses with six predictors.

The study included adult patients with a confirmed cancer diagnosis who were admitted from the ED. Those

admitted for surgical intervention comprised the surgical cohort, while patients admitted for non-surgical oncological emergencies made up the comparison cohort. Exclusion criteria were applied to omit any patients under 18 years of age, those not admitted through the ED, and patients whose primary reason for admission was unrelated to oncological conditions.

Data collection procedure

Data collection for this study involved a thorough review of patients' electronic health records (EHRs) conducted by two research co-authors. To ensure data accuracy and consistency, a random sample of cases underwent additional validation checks. Patient anonymity and confidentiality were maintained by assigning deidentified numbers to each case, with all data securely stored in compliance with institutional protocols.

To evaluate triage accuracy, the co-authors—trained in the use of the e-Triage system—re-triaged each patient based on clinical data from their ED visit. This included vital signs, hemodynamic parameters, and SIRS criteria. Blinded to the study's purpose, the co-authors utilized the e-Triage tool, which integrates SIRS to identify high-risk patients and assess acuity levels. This process minimized bias and ensured objective reassessment of patient triage decisions.

Discrepancies between the original nurse-assigned triage level and the re-triage assessment were documented and flagged for further analysis. Cases of under-triage—where high-acuity patients were misclassified into lower urgency categories—were reviewed by the co-authors, who cross-referenced e-Triage outputs with physician assessments and chart reviews. This comprehensive approach allowed for a reliable evaluation of triage performance and provided insights into potential areas for improvement in emergency care for cancer patients.

Study tools

This study employed standardized tools to assess triage accuracy and care timeliness for cancer patients in the ED. Key tools included e-Triage for automated acuity assessment, triage urgency classification, SIRS criteria for sepsis risk, and timeliness measures to evaluate treatment delays, ensuring a comprehensive evaluation of ED triage processes.

E-triage tool The e-Triage system served as a critical tool for assessing the appropriateness of triage decisions made for patients upon arrival at the ED. This system enabled the standardized evaluation of clinical presentations, identifying patients at high risk for sepsis and ensuring their urgent needs were promptly addressed. The e-Triage tool is an automated, computerized system designed to assist triage nurses by integrating clinical guidelines, patient symptoms, and vital signs to generate acuity scores. This system utilizes predefined algorithms that align with international triage scales, such as the CTAS and the ESI, allowing for the consistent and objective classification of patients. Incorporating the SIRS criteria, the e-Triage system flags patients who exhibit physiological signs of sepsis, including abnormal heart rate, temperature, respiratory rate, and white blood cell counts. By automating this process, the tool minimizes human error, ensuring that critical conditions are not overlooked during busy ED hours. Additionally, e-Triage continuously updates as new clinical data becomes available, providing dynamic reassessments of patient conditions. The outputs of the e-Triage system were cross-referenced with additional clinical indicators to validate its accuracy in determining urgency levels. This cross-validation process involved comparing e-Triage classifications with physician evaluations and retrospective chart reviews, reinforcing the reliability and effectiveness of the tool in identifying high-risk patients. In this study, e-Triage was instrumental in distinguishing between surgical and non-surgical cancer patients, contributing to the overall assessment of triage accuracy and under-triage rates.

Triage urgency classification Patient urgency was classified using the CTAS, which stratifies conditions into five categories based on severity and immediacy. Categories I (resuscitation), II (emergent), and III (urgent) were designated as high urgency and indicated critical conditions requiring immediate or prompt care. Conversely, categories IV and V (less urgent and non-urgent) were classified as low urgency [4, 16, 17]. Under-triage occurred when patients who should have been categorized as high urgency were misclassified into lower categories.

The co-authors reviewed the triage decisions made by nurses and compared them against patients' clinical data, including SIRS criteria, vital signs, and hemodynamic parameters. If a patient classified as high urgency by clinical criteria was correctly categorized as such by the triage nurse, the decision was coded as (correct triage = 1). Incorrect classification into lower urgency levels, indicating under-triage, was coded accordingly as (under-triage = 0).

Based on a literature review of triage guidelines and protocols, particularly regarding oncology patients, the e-Triage system incorporates the SIRS criteria as a key factor in categorizing patients' urgency. In alignment with these guidelines, patients with a SIRS score of 2 or higher were classified as high urgency, reflecting their increased risk of sepsis and the need for immediate medical attention. However, SIRS criteria were not the sole determinant in the triage decision-making process. The research assistants also considered additional clinical indicators, such as patient presentations, vital signs, and

overall hemodynamic stability, to ensure a comprehensive assessment. This multifaceted approach ensured that patients with acute oncological conditions were accurately prioritized based on the full scope of their clinical status.

SIRS criteria The assessment process incorporated SIRS criteria to evaluate patients' physiological conditions, which were vital in identifying high-risk cases and guiding clinical decisions. These criteria included elevated heart rates above 90 beats per minute, abnormal temperatures exceeding 38 °C or falling below 36 °C, respiratory rates above 20 breaths per minute, and abnormal white blood cell counts either above 12,000/μL or below 4,000/μL. Each of these criteria was individually coded to indicate their presence (= 1) or absence (= 0) in the patient's presentation. Positive findings served as critical markers for the urgency of intervention, particularly for oncological complications. Patients meeting two or more SIRS criteria (≥ 2) were categorized as high urgency (CTAS I-III), especially immunocompromised cancer patients at risk for sepsis. Those with fewer than two criteria were classified by clinical presentation and vital signs. This ensured timely prioritization and reduced under-triage risks in emergency care.

Timeliness of care measures (outcome variables) Timeliness of care was evaluated through several process indicators. These included the time from arrival at the ED to the initial assessment by a physician, referred to as time to initial physician assessment (PIA). Another measure was time to treatment (TTT), which captured the duration from arrival to the initiation of medical intervention. Sorting time assessed the period taken by the assigned treating physician to make an admission decision, while boarding time measured the interval between the admission decision and the patient's transfer from the ED to an inpatient unit. Finally, the length of stay (LOS), encompassing both ED-specific and total hospital durations, was tracked to gauge efficiency in patient management.

For the purposes of this study, patient arrival time was recorded based on the official registration time documented in the EHRs. This reflects the point at which patients were formally registered at the ED reception. Registration time was consistently used as the standard reference for arrival, as it provided a reliable and uniformly recorded time point across all cases. This approach ensured consistency in measuring intervals from arrival to subsequent care milestones, minimizing variability and enhancing the accuracy of timeliness assessments.

Contextual and demographic variables The study also considered various contextual and demographic variables to account for potential confounding factors. These included patient-specific details such as age, sex, and comorbidities, as well as ED-specific metrics like crowding levels, arrival time, and mode of arrival. These factors provided essential context for understanding how external variables could influence the timeliness and appropriateness of care delivery.

Through this comprehensive data collection process, the study sought to assess the factors impacting the accuracy of triage decisions and the timeliness of care provided to cancer patients in emergency settings. The insights gained aimed to identify areas for improvement in the management of this vulnerable patient population.

Ethical considerations

This study adhered to rigorous ethical standards and received approval from The Hashemite University Institutional Review Board (Approval #: 2022 – 182) and the Jordanian Ministry of Health Research Board. Formal approvals were also obtained from the medical and nursing administration departments of the participating healthcare facilities.

The data collection involved secondary data analysis of EHRs, with no direct or indirect interaction with patients. All data were anonymized before being accessed by the research team, ensuring that no personal identifiers were available to the data collectors. As such, the study did not involve obtaining informed consent from patients, as it was deemed unnecessary according to national regulations and approved by the IRB.

The study followed the ethical research code in Jordan, as outlined by the Ministry of Health and the ethical regulations of The Hashemite University. Patient confidentiality was strictly maintained, with all data securely stored in compliance with established protocols to prevent unauthorized access. These measures reflect the study's commitment to upholding the highest ethical standards in research.

Data analysis

In this study, missing data were systematically managed to maintain the integrity of the results. For variables that were crucial to the inclusion criteria or necessary for comparing results between groups, cases with missing data were excluded from the analysis. For other variables, the frequency and percentage of missing data were calculated, and cases with missing data were excluded from the corresponding analysis. All data analyses were conducted using SAS software (version 9.4; SAS Institute Inc., Cary, NC, USA). Categorical variables were summarized using frequencies and percentages, while continuous variables, such as time to treatment (TTT) and length of stay (LOS), were presented as means and standard deviations. ED overcrowding was assessed by measuring boarding

time, defined as the duration between the admission decision and the patient's transfer from the ED to an inpatient unit. This metric reflects the level of crowding in the ED and was incorporated as a continuous variable in the regression models to evaluate its effect on patient outcomes.

To assess the impact of under-triage on timeliness of care outcomes, multiple linear regression analyses were performed for each outcome measure separately. These analyses controlled for potential confounders, including age, sex, arrival day and time, arrival mode, triage decision, vital signs, and ED overcrowding. A stepwise selection method was applied to identify significant predictors, with statistical significance set at $p < 0.05$. Each outcome was evaluated independently, and adjustments were made for other relevant factors to clarify the specific impact of under-triage on the timeliness of care.

Table 1 Patients' demographics and clinical data ($N = 481$)

Demographics and clinical data	*n* (%)
Gender	
Female	280 (58.2%)
Male	201 (41.8%)
Age (mean [± SD] = 62.6 [± 10.7])	
< 45 years	64 (13.3%)
45–59.9 years	292 (60.7%)
60–70 years	73 (15.2%)
> 70 years	52 (10.8%)
Classification of diagnosis at admission to emergency room	
Surgical cancer patient	93 (19.3%)
Non- Surgical cancer patient	388 (80.7%)
Type of Cancer	
Colorectal cancer	232 (48.2%)
Lung cancer	72 (15.0%)
Breast cancer	53 (11.0%)
Bladder cancer	31 (6.4%)
Prostate cancer	29 (6.0%)
Gastric cancer	34 (7.1%)
Gynecological cancer	13 (2.7%)
Other	17 (3.6%)
Cancer Stage	
Stage 1 or 2	80 (16.6%)
Stage 3	207 (43.1%)
Stage 4	194 (40.3%)
Mode of Arrival	
Ambulance	33 (6.9%)
Other*	448 (93.1%)
Arrival Time	
Morning shift (07:00 H-14:59 H)	387 (80.4%)
Evening shift (1500 H-22:59 H)	61 (12.7%)
Night shift (2300 H-06:59 H)	33 (6.9%)
Day of Arrival	
Weekdays	358 (74.4%)
Weekends	123 (25.6%)
Admission Site	
Oncology Ward	457 (95.0%)
Critical Care Unit	24 (5.0%)
Admission Reason	
Supportive/Palliative	208 (43.2%)
Treatment	223 (46.4%)
Evaluation and monitoring	50 (10.4%)

* Walk-in or personal/other's car

Results

Patients' demographics and clinical data

The analysis of demographic and clinical data for 481 cancer patients admitted through the ED reveals key characteristics that emphasize the vulnerability of this population (Table 1). The mean age of the patients was 62.6 years (± 10.7), with the majority being middle-aged or elderly. Specifically, 60.7% were between 45 and 59.9 years, and 26% were aged 60 years or older. This indicates a predominance of older adults, who are more likely to have acute illnesses requiring emergent assessment and care due to age-related vulnerabilities and potential comorbidities.

Gender distribution showed a higher proportion of females (58.2%) compared to males (41.8%). The majority of patients (80.7%) were admitted as non-surgical cancer patients, while 19.3% required surgical intervention. Colorectal cancer was the most common diagnosis (48.2%), followed by lung cancer (15.0%) and breast cancer (11.0%). A significant proportion of patients presented with advanced-stage cancer, with 40.3% in stage 4 and 43.1% in stage 3, highlighting the critical nature of their condition.

Most patients arrived at the ED by their own means (93.1%), and only 6.9% used ambulance services, which may reflect a lack of immediate access to emergency transport. A substantial number of admissions occurred during the morning shift (80.4%), with fewer during the evening (12.7%) and night shifts (6.9%). Most patients were admitted on weekdays (74.4%), suggesting a potential disparity in access to ED care during weekends.

The majority of admissions (95.0%) were to the oncology ward, with only 5.0% requiring critical care unit placement. Regarding the purpose of admission, 46.4% of patients required treatment, while 43.2% were admitted for supportive or palliative care, and 10.4% for evaluation and monitoring.

Patients' clinical manifestation at admission to emergency room

The clinical manifestations of cancer patients at admission to the ED differed between surgical and non-surgical cohorts (Table 2). Among surgical patients, the most common chief complaints were acute pain (51.6%) and respiratory discomfort (41.1%). Other notable complaints

Table 2 Patients' clinical manifestation at admission to emergency room

Patients' chief complaints*	Surgical patients (*N* = 93) *n* (%)	Non- surgical patients (*N* = 388) *n* (%)
Acute pain	48 (51.6%)	160 (41.2%)
Vascular complaints	15 (16.1%)	68 (17.5%)
Nausea and vomiting	29 (31.2%)	112 (28.9%)
Neurological complaints	12 (12.9%)	63 (16.2%)
Respiration discomfort	44 (41.1%)	103 (26.5%)
Other complaints (e.g. bleeding, diarrhea, constipation, skin problems, etc.)	34 (36.6%)	98 (25.3%)
Positive SIRS Criteria		
SIRS1: HR > 90 (beat per minute)	91 (97.8%)	366 (94.3%)
SIRS2: Temperature > 38° or < 36°	29 (29.2%)	121 (31.2%)
SIRS3: respiratory rate > 20 (breath per minute)	67 (72.0%)	255 (65.7%)
SIRS4: WBCs: > 12,000 cell/microliter (μL) or < 4000 cell/μL	33 (35.5%)	142 (36.6%)
≥ 2 of SIRS criteria	24 (25.8%)	76 (19.6%)

* The total percentages of chief complaints exceed 100% because patients could present with and report more than one chief complaint at the time of admission

included nausea and vomiting (31.2%) and various conditions such as bleeding or gastrointestinal issues (36.6%). Neurological complaints were less frequent (12.9%), and vascular complaints were reported by 16.1%.

In the non-surgical cohort, acute pain remained the most common complaint, reported by 41.2% of patients, followed by nausea and vomiting (28.9%) and respiratory discomfort (26.5%). Other issues, including bleeding and skin problems, accounted for 25.3% of complaints, while neurological and vascular complaints were reported at 16.2% and 17.5%, respectively.

Positive SIRS criteria were prevalent in both groups, indicating significant physiological stress. Elevated heart rate (SIRS1) was observed in 97.8% of surgical patients and 94.3% of non-surgical patients. Abnormal respiratory rates (SIRS3) were reported in 72.0% of surgical and 65.7% of non-surgical patients, while abnormal white blood cell counts (SIRS4) were observed in 35.5% and 36.6% of surgical and non-surgical patients, respectively. Approximately 25.8% of surgical patients and 19.6% of non-surgical patients met at least two SIRS criteria, highlighting the presence of acute systemic inflammatory responses.

Acuity recognition of study cohorts based on triage nurse scoring

Among surgical cancer patients ($N = 93$), none were classified into CTAS I (severely ill), and only 6.5% were categorized into CTAS II (emergent care). The majority were assigned to lower urgency categories, with 25.8% in CTAS III (urgent care), 46.2% in CTAS IV (less-urgent care), and 21.5% in CTAS V (non-urgent care). This misclassification led to an under-triage rate of 44.1%, indicating that nearly half of the surgical patients who required high-priority care were not accurately recognized as such. Among non-surgical cancer patients ($N = 388$), only 0.2% were classified into CTAS I, and 12.9% were categorized into CTAS II. Most non-surgical patients were assigned to lower urgency categories, with 18.0% in CTAS III, 55.7% in CTAS IV, and 13.1% in CTAS V. The under-triage rate for non-surgical patients was 39.4%, indicating a significant proportion of patients with potentially severe conditions were misclassified into lower urgency categories (Table 3).

The association between Under-Triage and treatment outcomes in cancer patients

The multiple linear regression analysis assessed the impact of under-triage on various treatment outcomes for both surgical and non-surgical cancer patients (Table 4). The analysis was conducted separately for each outcome measure, and the regression models controlled for the influence of other variables, including age, sex, arrival time, and vital signs. For surgical patients, under-triage significantly delayed the time to physician initial assessment (β = 34.9 min, 95% CI [10.2, 59.7], $p < 0.001$) and time to treatment (β = 68.0 min, 95% CI [38.1, 97.9], $p < 0.001$). Delays also extended to sorting time (β = 4.9 h, 95% CI [3.6, 6.3], $p < 0.001$) and boarding time (β = 2.4 h, 95% CI [1.7, 2.9], $p < 0.001$). Furthermore, under-triage prolonged both the ED length of stay (β = 4.9 h, 95% CI [3.6, 6.3], $p < 0.001$) and the hospital length of stay (β = 3.2 days, 95% CI [0.8, 5.5], $p = 0.008$).

For non-surgical patients, under-triage had an even more pronounced impact. Delays in physician initial assessment were longer (β = 48.6 min, 95% CI [39.9, 57.2], $p < 0.001$), as were time to treatment (β = 72.0 min, 95% CI [59.5, 84.5], $p < 0.001$) and sorting time (β = 7.3 h, 95% CI [2.6, 12.0], $p < 0.001$). Boarding time (β = 2.1 h, 95% CI [1.8, 2.4], $p < 0.001$), ED length of stay (β = 7.3 h, 95% CI [2.6, 12.0], $p < 0.001$), and hospital length of stay (β = 3.2

Table 3 Acuity recognition of study cohorts based on triage nurse scoring

Classification of diagnosis	Classification of triage urgency based on CATS (Categories [*n* (%)])					Under-Triaged by triage nurses
	1	2	3	4	5	
Surgical cancer patient (*N* = 93)	0	6 (6.5%)	24 (25.8%)	43 (46.2%)	20 (21.5%)	41 (44.1%)
Non- Surgical cancer patient (*N* = 388)	1 (0.2%)	50 (12.9%)	70 (18.0%)	216 (55.7%)	51 (13.1%)	153 (39.4%)

Table 4 Multiple linear regression to identify the association between Under-Triage and treatment outcomes in Cancer patients

Outcome variables	Surgical patients (β) [95% CI] *p*-value *	Non- surgical patients (β) [95% CI] *p*-value *
Physician Initial Assessment (Minutes)	β = 34.9 [10.2, 59.7] **p < 0.001***	β = 48.6 [39.9, 57.2] **p < 0.001***
Time to Treatment (Minutes)	β = 68.0 [38.1, 97.9] **p < 0.001***	β = 72.0 [59.5, 84.5] **p < 0.001***
Sorting Time (Hours)	β = 4.9 [3.6, 6.3] **p < 0.001***	β = 7.3 [2.6, 12.0] **p < 0.001***
Boarding Time (Hours)	β = 2.4 [1.7, 2.9] **p < 0.001***	β = 2.1 [1.8, 2.4] **p < 0.001***
Emergency department length of stay (Hours)	β = 4.9 [3.6, 6.3] **p < 0.001***	β = 7.3 [2.6, 12.0] **p < 0.001***
Hospital length of stay (Day)	β = 3.2 [0.8, 5.5] **p = 0.008***	β = 3.2 [1.9, 4.6] **p < 0.001***

Note. The multivariate analysis was conducted separately for each outcome measure, and the regression models controlled for the influence of other variables, including under-triage, age, sex, time of arrival, mode of arrival, day of arrival, and boarding time. * significant p value (< 0.05) is bold

days, 95% CI [1.9, 4.6], $p < 0.001$) were also significantly prolonged.

Discussion

This study underscores the critical challenges in the emergency care of cancer patients, particularly the delays in care that result from under-triage. The findings highlight the importance of improving triage accuracy and adapting ED processes to better meet the needs of this vulnerable population. Patients with advanced-stage disease, acute symptoms, and age-related vulnerabilities, such as frailty and multi-morbidity, often face significant delays in receiving appropriate care [8, 15]. These delays can exacerbate their conditions and potentially lead to worse outcomes.

The predominance of elderly patients in this study emphasizes the growing demand for specialized care for older adults with cancer. The complexity of managing this population is compounded by their increased susceptibility to adverse events during acute episodes, as older patients often experience a higher burden of comorbidities [7, 8]. Previous studies have acknowledged that delays in care, particularly in frail or multi-morbid patients, contribute to prolonged and complicated hospital admissions [5]. The fact that a large proportion of patients presented with advanced-stage cancer highlights the acute nature of their conditions and their need for urgent intervention [2].

Despite the severity of these patients' needs, logistical challenges such as low ambulance use and limited access to emergency services contribute to treatment delays. The finding that only a small fraction of patients arrived by ambulance aligns with previous research, which has indicated that transportation barriers and limited awareness about emergency care options are significant factors delaying timely access to services [18]. Additionally, the concentration of ED arrivals during daytime hours further suggests that delays in treatment are more pronounced during off-peak hours when care availability may be reduced. Addressing these access-related issues is critical for improving the timeliness and quality of care for elderly cancer patients [18].

The analysis of clinical presentations revealed significant differences between surgical and non-surgical cancer patients, with surgical patients exhibiting more severe symptoms overall. Surgical patients most commonly reported acute pain, respiratory discomfort, and a range of other complaints, such as vascular issues, bleeding, diarrhea, constipation, and skin problems. These symptoms were more prevalent among surgical patients compared to non-surgical patients, reflecting the more acute and complex nature of their conditions. Non-surgical patients also reported symptoms, including acute pain and nausea and vomiting, but the prevalence of these complaints was somewhat lower than in the surgical group. Additionally, neurological complaints were more frequently reported by non-surgical patients, suggesting a distinct clinical presentation profile. This assessment of symptom severity was based on the frequency and types of complaints reported, with acute pain and respiratory discomfort being key indicators of overall symptom severity. These findings align with those of Oatley, Fry, and Mullen (2016), who identified pain and respiratory distress as primary factors driving EDvisits among cancer patients [6].

The presence of SIRS markers in a significant portion of the cohort further emphasizes the acute physiological compromise of these patients. Recognizing these markers during triage could help prioritize patients at risk of rapid deterioration, improving the overall efficiency of emergency care. Integrating SIRS criteria into triage protocols could help prevent under-triage and ensure that high-acuity cases receive appropriate and timely attention [19–21].

The study also identified critical gaps in triage accuracy, with a substantial proportion of patients being under-triaged, which resulted in significant delays in care. The misclassification of patients into lower urgency categories was evident across both surgical and non-surgical groups, which highlights the need for improvements in triage protocols. This under-triage not only delayed care but also increased the risk of adverse outcomes, a finding

consistent with previous research that points to the detrimental effects of inadequate triage in emergency settings [3]. This under-triage not only delayed care but also increased the risk of adverse outcomes, a finding consistent with previous research that points to the detrimental effects of inadequate triage in emergency settings [9].

The delays in physician assessments, treatment initiation, and overall hospital stays further reflect systemic inefficiencies that exacerbate the challenges faced by these patients. These findings point to the urgent need for targeted interventions to streamline care pathways and prioritize high-acuity cases. Delays in care not only affect the immediate treatment of patients but also contribute to increased healthcare resource utilization, which could further strain emergency services [10, 22–24].

This study underscores the necessity of improving triage systems and emergency care for cancer patients, particularly those with advanced disease or age-related vulnerabilities. Strengthening training programs for triage nurses, incorporating oncology-specific criteria into triage protocols, and addressing barriers to timely access to emergency care are essential steps toward improving the care of these patients [25–27]. Moreover, enhancing public awareness and expanding access to ambulance transport could mitigate delays in ED arrival, ensuring that patients receive the care they need without unnecessary delays [10, 22, 28, 29].

This study emphasizes the delays in care resulting from under-triage and highlights the need for interventions aimed at improving triage accuracy in emergency departments, rather than focusing on health outcomes, as the data does not specifically examine those outcomes. The findings call for systemic improvements to reduce delays in care and enhance the timeliness of interventions for cancer patients [10, 22, 29, 30].

Overall, this study highlights the pressing issue of treatment delays in the emergency care of cancer patients, with under-triage being a key contributor. By addressing these gaps through targeted interventions, healthcare systems can improve care delivery, reduce delays, and enhance the outcomes of cancer patients in emergency settings. Future research should explore the implementation and effectiveness of these strategies in diverse clinical settings to further enhance triage accuracy and improve care pathways.

Research implications and recommendations

The findings of this study shed light on the critical impact of inappropriate triage on health outcomes for surgical cancer patients admitted through EDs. These results highlight the urgent need to reassess and improve triage practices to ensure that cancer patients receive timely, appropriate care in ED settings [28, 31]. Given the complexity of cancer-related emergencies, inadequate triage decisions can significantly affect patient prognosis, lead to treatment delays, and diminish the overall quality of life for these patients [10, 22, 27].

To address these challenges, it is essential to focus on improving triage systems in EDs. Healthcare providers must be equipped to recognize cancer-specific complications, enabling them to prioritize patients based on the urgency of their condition [9, 10, 22]. One way to achieve this is by developing and implementing cancer-specific triage protocols that guide clinicians in appropriately categorizing patients, particularly those with advanced cancer or those requiring surgical intervention [9, 10, 15]. By integrating cancer care knowledge into the triage process, EDs can ensure that these patients are promptly identified and treated according to their specific needs.

In addition to enhancing triage protocols, fostering stronger collaboration between emergency physicians and oncology specialists is crucial. By facilitating early consultation with oncology teams, EDs can ensure that cancer patients receive the appropriate care and timely interventions. This collaborative approach will help mitigate the risks associated with delayed or improper triage, ultimately improving patient outcomes [10, 22, 25, 32].

The adoption of technology, such as EHRs and decision support systems, also plays a pivotal role in improving triage accuracy. By ensuring that a cancer patient's medical history and current health status are readily accessible upon their arrival to the ED, healthcare providers can make more informed decisions. EHRs can be programmed to alert clinicians to potential complications specific to cancer patients, further enhancing the triage process [10, 15, 22].

On a policy level, healthcare systems must prioritize the development of cancer-sensitive triage protocols in emergency settings. Policymakers should advocate for the integration of these protocols into routine ED practices, particularly in hospitals that see a high volume of cancer patients [31, 33, 34]. In addition, investment in specialized training for ED staff, focusing on the unique needs of cancer patients, is necessary to ensure effective care. By aligning policy with the needs of cancer patients, healthcare systems can improve the quality of care delivered in EDs [9, 33, 34].

Moreover, adequate resource allocation is vital to support the care of surgical cancer patients in emergency settings. Hospitals may need to adjust their resources to accommodate the specialized needs of this patient group, ensuring that there are sufficient staffing levels and specialized equipment for cancer-related emergencies [33–35].

Looking ahead, future research should focus on examining the long-term effects of inappropriate triage on health outcomes, such as survival rates, recurrence of cancer, and overall quality of life. Longitudinal studies

could provide more insight into the enduring impact of triage decisions on cancer patients. Additionally, evaluating the effectiveness of cancer-specific triage tools in EDs would be beneficial. Research could explore whether these tools help reduce treatment delays and improve patient outcomes [10, 22, 35].

It would also be valuable to conduct comparative studies across different healthcare settings, including urban, rural, and under-resourced environments. Such studies could provide a broader understanding of how variations in triage practices influence patient outcomes and inform more equitable healthcare policies. Finally, intervention trials assessing the impact of training programs for ED staff or changes in triage protocols would provide evidence for best practices and help establish guidelines that enhance the quality of care for surgical cancer patients [36–38].

Study limitations

This study has several limitations that should be considered when interpreting the findings. The retrospective design, which relied on data from EHR, may have led to incomplete or inconsistent documentation, potentially affecting the accuracy of key variables. Additionally, the use of the CTAS to assess triage accuracy may not account for all factors influencing triage decisions, which could further impact the consistency of the findings. The study's inclusion of four hospitals in major Jordanian cities may restrict its generalizability to rural areas with varying healthcare resources and triage systems. Furthermore, variations in triage practices across the hospitals included in the study could affect the consistency and applicability of the findings.

Moreover, the study focused on cancer patients requiring emergency care in governmental hospitals, which may not reflect the conditions in other healthcare settings or regions. The study did not investigate the underlying causes of under-triage, such as limited oncology-specific training or resource constraints within emergency departments. Future research should explore these contributing factors and assess interventions to improve triage accuracy and enhance patient outcomes in oncology care settings.

Conclusion

This study reveals significant issues in the emergency care of cancer patients in Jordan, particularly concerning the accuracy of triage decisions and their impact on treatment delays. Under-triage was common among both surgical and non-surgical cancer patients, leading to prolonged times to physician assessment, delayed treatment, and extended ED and hospital stays, negatively affecting patient outcomes. The findings emphasize the need for improvements in triage processes, including oncology-specific training for triage nurses and the use of evidence-based tools like SIRS criteria to improve acuity recognition.

To address these issues, targeted interventions are needed to reduce under-triage, optimize resource allocation, and enhance care delivery for cancer patients in emergency settings. Refining triage protocols, increasing public awareness of emergency transport services, and improving ED processes will be crucial in better meeting the needs of cancer patients. By implementing these strategies, healthcare systems in Jordan can ensure timely, accurate, and effective care, ultimately improving clinical outcomes and the quality of life for cancer patients requiring emergency interventions.

Author contributions

Study conception and design: A.A., R.A.E., G.S.A., Z.T.S., and B.N.A.; data collection: A.A. and Z.T.S.; analysis and interpretation of results: A.A., R.A.E., G.S.A., Z.T.S., and B.N.A.; drafting of the manuscript: A.A., R.A.E., G.S.A., M.H.A., M.S.A., W.T.A., T.F.A., K.M.A., and Z.T.S.; critical revision for significant intellectual content: A.A., R.A.E., G.S.A., M.H.A., M.S.A., W.T.A., T.F.A., K.M.A., and Z.T.S. All authors reviewed and approved the final version of the manuscript.

Funding

The authors received no financial support for publication of this article.

Data availability

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

This study adhered to ethical standards and received approval from The Hashemite University Institutional Review Board (Approval #: 2022 – 182) and the Jordanian Ministry of Health Research Board, with additional formal approvals from the participating healthcare facilities. Data collection involved secondary analysis of anonymized EHRs, with no direct or indirect interaction with patients, and informed consent was deemed unnecessary according to national regulations and IRB approval. Patient confidentiality was maintained by deidentifying all data and securely storing it in compliance with ethical research codes in Jordan, ensuring the study upheld the highest ethical standards. Research involving animals is not applicable to this study as it is a secondary data analysis of electronic patient records. No experimental procedures on vertebrates or invertebrates were conducted as part of this research.

Consent for publication

Not Applicable. Also, the issue of lacking appropriate permission and/or credit for reproduced images is not applicable, as this study does not include any reproduced images.

Competing interests

The authors declare no competing interests.

Author details

[1]Department of Adult Health Nursing, Faculty of Nursing, The Hashemite University, Zarqa, Jordan
[2]Department of Medical and Surgical Nursing, College of Nursing, Taibah University, Madinah, Saudi Arabia
[3]Department of Clinical Nursing Practices, Faculty of Nursing, Umm Al-Qura University, Makkah, Saudi Arabia
[4]Prince Al-Hussein Bin Abdullah II Academy for Civil Protection, Al-Balqa Applied University, Salt, Jordan
[5]College of Health Science and Nursing, Al- Rayan Colleges, Madinah, Saudi Arabia

[6]Department of community health nursing, College of Nursing, Taibah University, Madinah, Saudi Arabia
[7]Medical Surgical Nursing Department, Faculty of Nursing, University of Tabuk, Tabuk, Saudi Arabia
[8]Nursing Department, Faculty of Nursing, Applied Science Private University, Amman, Jordan
[9]Nursing Division, Faculty of Medicine and Health Sciences, Sana'a University, Sana'a, Yemen
[10]Department of Clinical Nursing, School of Nursing, The University of Jordan, Amman, Jordan
[11]Department of Nursing, Vision College, Riyadh, Saudi Arabia

Received: 23 November 2024 / Accepted: 18 February 2025
Published online: 20 April 2025

References

1. M Bosscher, B van Leeuwen, Hoekstra H. Mortality in emergency surgical oncology. Ann Surg Oncol. 2015;22:1577–84.
2. M, Sadik K, Ozlem M, Huseyin B, AliAyberk S, Ahmet, Ozgur O. Attributes of cancer patients admitted to the emergency department in one year. World J Emerg Med. 2014;5:85.
3. MJ, Bullard D, Melady M, Emond E, Musgrave B, Unger E, van der Linde, et al. Guidance when applying the Canadian triage and acuity scale (CTAS) to the geriatric patient: executive summary. Can J Emerg Med. 2017;19:S28–37.
4. MJ, Bullard E, Musgrave D, Warren B, Unger T, Skeldon R, Grierson et al. Revisions to the Canadian emergency department triage and acuity scale (CTAS) guidelines 2016. Can J Emerg Med, 2017;19:S18-S27.
5. K, Barnett SW, Mercer M, Norbury G, Watt S, Wyke, Guthrie B. Epidemiology of Multimorbidity and implications for health care, research, and medical education: a cross-sectional study. Lancet. 2012;380:37–43.
6. M, Oatley M, Fry, Mullen L. A cross-sectional study of the clinical characteristics of cancer patients presenting to one tertiary referral emergency department. Int Emerg Nurs. 2016;24:35–8.
7. A, Alsharawneh, Hasan AA-H. Cancer related emergencies with the chief complaint of pain: incidence, ED recognition, and quality of care. Int Emerg Nurs. 2021;56:100981.
8. A, Alsharawneh. Effect of undertriage on the outcomes of cancer patients with febrile neutropenia, sepsis, and septic shock. Clin Nurs Res. 2021;30:1127–34.
9. A, Alsharawneh J, Maddigan A, Gaudine H, Etchegary, Gao Z. The impact of emergency department triage on the treatment outcomes of cancer patients with febrile neutropenia: A retrospective review. Int Emerg Nurs. 2020;51:100888.
10. A, Alsharawneh M, Sawalha NA, Tabar RA, Elshatarat AM, Almarwani ZT, Saleh, et al. Impact of triage nurses' recognition of acute coronary syndrome on patients' clinical outcomes: A retrospective study. Heart Lung. 2024;68:60–7.
11. H, Abdel-Razeq A, Al-Ibraheem K, Al-Rabi O, Shamiah M, Al-Husaini, Mansour A. Cancer care in Resource-Limited countries: Jordan as an example. JCO Global Oncol. 2024;10:e2400237.
12. AF, Elsayem HE, Elzubeir PA, Brock, Todd KH. Integrating palliative care in oncologic emergency departments: challenges and opportunities. World J Clin Oncol. 2016;7:227.
13. M, Abunasser H, Abu-Fares S, Abdel-Razeq O, Shamieh O, Salama K, Ashouri et al. Aggressiveness of Cancer care at end of life in patients with metastatic breast Cancer in Jordan. J Multidisciplinary Healthc, 2023;2873–81.
14. MM, Alnaeem A, Islaih SH, Hamaideh, Nashwan AJ. Using primary healthcare facilities and patients' expectations about triage system: patients' perspective from multisite Jordanian hospitals. Int Emerg Nurs. 2024;75:101476.
15. A, Alsharawneh. The multinational association for supportive care in cancer criteria. An evaluation and recommendations for the management of neutropenia in the emergency department. Int Emerg Nurs. 2025;78:101542.
16. MJ Bullard, T Chan, C Brayman, D Warren, E Musgrave, B Unger, et al. Revisions to the Canadian emergency department triage and acuity scale (CTAS) guidelines. Can J Emerg Med. 2014;16:485–9.
17. A, Mirhaghi A, Heydari R, Mazlom, Ebrahimi M. The reliability of the Canadian triage and acuity scale: meta-analysis. North Am J Med Sci. 2015;7:299.
18. Z, Cooper A, Courtwright A, Karlage A, Gawande, Block S. Pitfalls in communication that lead to nonbeneficial emergency surgery in elderly patients with serious illness: description of the problem and elements of a solution. Ann Surg. 2014;260:949–57.
19. M Hilditch. Can pre-hospital recognition and intervention improve outcome for patients with severe sepsis? J Paramedic Pract. 2015;7:168–75.
20. J, Uffen J, Oosterheert V, Schweitzer K, Thursky H, Kaasjager, Ekkelenkamp M. Interventions for rapid recognition and treatment of sepsis in the emergency department: a narrative review. Clin Microbiol Infect. 2021;27:192–203.
21. DC, Duguay. Integration of Recognition, Diagnostic, and Treatment Strategies between Prehospital Emergency Medical Services and Hospital Emergency Departments in the Management of Patients with Acute Sepsis and Septic Shock, Boston University, 2019. Available.
22. ZT Saleh, A Aslanoglu, R Al-Dgheim, MA Sawalha, RA Elshatarat, HY Al-Akash, et al. Effectiveness of triage professionals' knowledge and experience on their ability in early diagnosis and consequent treatment of acute coronary syndrome: A literature review study. Res J Pharm Technol. 2024;17:4075–82.
23. G, Savioli IF, Ceresa MA, Bressan G, Bavestrello Piccini V, Novelli S, Cutti, et al. Geriatric population triage: the risk of Real-Life Over-and Under-Triage in an overcrowded ED: 4-and 5-Level triage systems compared: the CREONTE (Crowding and RE organization National TriagE) study. J Personalized Med. 2024;14:195.
24. A, García-Martínez M, Carbó V, Aniyar A, Antolín Ò, Miró, Gómez-Angelats E. Undertriage of patients requiring direct admission to intensive care from the emergency department for medical conditions: impact on prognosis and associated factors, Emergencias, 2021;33:361-7.
25. G, Gebrael KK, Sahu B, Chigarira N, Tripathi V, Mathew Thomas N, Sayegh et al. Enhancing triage efficiency and accuracy in emergency rooms for patients with metastatic prostate cancer: a retrospective analysis of artificial intelligence-assisted triage using ChatGPT 4.0, Cancers, 2023;15:3717.
26. MM Jeyaraman, RN Alder, L Copstein, N Al-Yousif, R Suss, R Zarychanski, et al. Impact of employing primary healthcare professionals in emergency department triage on patient flow outcomes: a systematic review and meta-analysis. BMJ Open. 2022;12:e052850.
27. NK Rathi, SA Haque, F Morales, B Kaul, R Ramirez, S Ovu, et al. Variability in triage practices for critically ill cancer patients: A randomized controlled trial. J Crit Care. 2019;53:18–24.
28. A, Thind R, Hsia J, Mabweijano ER, Hicks A, Zakariah, Mock CN. Prehospital and emergency care. Disease Control Priorities, 2015;1:245– 62.
29. TW, Rice A, Klotz HL, Neville-Webbe S, Ahn, Adkins EJ. Models of care for cancer emergencies, Oncologic Emergency Medicine: Principles and Practice, 2016;3–12.
30. S- Zagalioti, B Fyntanidou, A Exadaktylos, K Lallas, Ziaka M. The first positive evidence that training improves triage decisions in Greece: evidence from emergency nurses at an academic tertiary care emergency department. BMC Emerg Med. 2023;23:60.
31. BG, Lubejko D, Burbage C, Cantril LH, Hōgg, Sheldon LK. Novice oncology nurse navigator: core elements in Establishing training needs and Building on competencies. Clin J Oncol Nurs, 2019;23.
32. EA, Delaney, Browning K. Development and evaluation of an Evidence-Based telephone triage orientation education program for oncology registered nurses DNP final project. DNP Final Project Ohio State Univ, 2017.
33. JL, Nates M, Nunnally R, Kleinpell S, Blosser J, Goldner B, Birriel, et al. ICU admission, discharge, and triage guidelines: a framework to enhance clinical operations, development of institutional policies, and further research. Crit Care Med. 2016;44:1553–602.
34. D, Stacey G, Macartney M, Carley, Harrison MB. Development and Evaluation of Evidence-Informed Clinical Nursing Protocols for Remote Assessment, Triage and Support of Cancer Treatment-Induced Symptoms, Nursing research and practice, 2013;2013:171872. Metahttps://pubmed.ncbi.nlm.nih.gov/23476759/
35. RJ, DeBoer TA, Fadelu LN, Shulman, Van Loon K. Applying lessons learned from low-resource settings to prioritize cancer care in a pandemic. JAMA Oncol. 2020;6:1429–33.
36. LA, Wolf AM, Delao C, Perhats MD, Moon, Zavotsky KE. Triaging the emergency department, not the patient: united States emergency nurses' experience of the triage process. J Emerg Nurs. 2018;44:258–66.
37. B, McBrien. Translating change: the development of a person-centred triage training programme for emergency nurses. Int Emerg Nurs. 2009;17:31–7.

38. SS, Faheim SS, Ahmed EF, Aly, Hegazy SM. Effect of triage education on nurses' performance in diverse emergency departments. Evidence-Based Nurs Res. 2019;1:11–11.