BMC Emergency Medicine

SYSTEMATIC REVIEW

Open Access

Understanding oncologic emergencies and related emergency department visits and hospitalizations: a systematic review

Sule Yilmaz[1*†], Komal Aryal[2†], Jasmine King[3], Jason J. Bischof[4], Arthur S. Hong[5], Nancy Wood[6], Bonnie E. Gould Rothberg[7], Matthew F. Hudson[8], Sara W. Heinert[9], Monica K. Wattana[10], Christopher J. Coyne[11], Cielito Reyes-Gibby[10], Knox Todd[10], Gary Lyman[12,13], Adam Klotz[14], Beau Abar[6], Corita Grudzen[14], Aveh Bastani[15], Christopher W. Baugh[16], Daniel J. Henning[17], Steven Bernstein[18], Juan Felipe Rico[19], Richard J. Ryan[20], Sai-Ching Jim Yeung[10], Aiham Qdaisat[10], Aasim Padela[21], Troy E. Madsen[22], Raymond Liu[23,24] and David Adler[6]

Abstract

Background Patients with cancer frequently visit the emergency department (ED) and are at high risk for hospitalization due to severe illness from cancer progression or treatment side effects. With an aging population and rising cancer incidence rates worldwide, it is crucial to understand how EDs and other acute care venues manage oncologic emergencies. Insights from other nations and health systems may inform resources necessary for optimal ED management and novel care delivery pathways. We described clinical management of oncologic emergencies and their contribution to ED visits and hospitalizations worldwide.

Methods We performed a systematic review of peer-reviewed original research studies published in the English language between January 1st, 2003, to December 31st, 2022, garnered from PubMed, Web of Science, and EMBASE. We included all studies investigating adult (≥ 18 years) cancer patients with emergency visits. We examined chief complaints or predictors of ED use that explicitly defined oncologic emergencies.

Results The search strategy yielded 49 articles addressing cancer-related emergency visits. Most publications reported single-site studies ($n = 34/49$), with approximately even distribution across clinical settings- ED ($n = 22/49$) and acute care hospital/ICU ($n = 27/49$). The number of patient observations varied widely among the published studies (range: 9 – 87,555 patients), with most studies not specifying the cancer type ($n = 33/49$), stage ($n = 41/49$), or treatment type ($n = 36/49$). Most studies ($n = 31/49$) examined patients aged ≥ 60 years. Infection was the most common oncologic emergency documented ($n = 22/49$), followed by pain ($n = 20/49$), dyspnea ($n = 19/49$), and gastrointestinal (GI) symptoms ($n = 17/49$). Interventions within the ED or hospital ranged from pharmacological management with opioids ($n = 11/49$), antibiotics ($n = 9/49$), corticosteroids ($n = 5/49$), and invasive procedures (e.g., palliative stenting; $n = 13/49$) or surgical interventions ($n = 2/49$).

[†]Sule Yilmaz and Komal Aryal Co-first authors.

*Correspondence:
Sule Yilmaz
Sule_yilmaz@urmc.rochester.edu
Full list of author information is available at the end of the article

Conclusion Limited research specifically addresses oncologic emergencies despite the international prevalence of ED presentations among cancer patients. Patients with cancer presenting to the ED appear to have a variety of complaints which could result from their cancers and thus may require tailored diagnostic and intervention pathways to provide optimal acute care. Further acute geriatric oncology research may clarify the optimal management strategies to improve the outcomes for this vulnerable patient population.

Keywords Emergency department, Acute care, Oncologic emergencies, Systematic review, Older adults

Introduction

Patients with cancer are frequent users of the emergency department (ED), often incurring multiple visits per patient in a given year [1–3]. Approximately one-third of patients with cancer have unplanned ED visits and hospitalizations for symptom management of oncologic emergencies [4], including pain, dyspnea, infection, nausea or vomiting, and other disease- and treatment-related complications [5, 6]. Patients with cancer present to the ED with high triage acuity, many of whom exhibit other comorbidities, thus requiring particularly complex care coordination [7–9]. Case complexity may particularly motivate ED visits, as unique constellations of social determinants, clinical conditions, health care infrastructure, and local/regional/federal policy interactions may encourage urgent care seeking [9, 10]. In the US, among patients with cancer, higher ED usage is associated with non-White and African American race/ethnicity, older age, male gender, Medicaid or uninsured status, and receipt of < 100 days of palliative care in advanced cases [9, 11]. Additionally, studies observe a diagnosis of depression, comorbidities, combinations of cancer treatments, delays to treatment initiation, and end-of-life (EOL) predict ED visit frequency with a greater proportion of encounters resulting in admission (58–62%) compared to the general population [9, 10, 12–17]. The ED, required to address a spectrum of conditions and acuteness, is a centralized setting that frequently provides care for patients with oncologic emergencies.

EDs are essential to addressing patients' acute medical needs, yet the structure, financing, and resources of acute unscheduled care delivery vary. In the US, settings range from highly resourced, large-volume (> 50,000 annual visits) urban EDs of tertiary academic medical centers to smaller community-based rural EDs [18, 19]. Internationally, systems of emergency medicine (EM) differ vastly. For example, the National ED Inventories (NEDI) project analyzed EDs in Beijing, China, and Quito, Ecuador; the study revealed all surveyed sites were located in a hospital, with the majority having a contiguous layout (i.e., providing medical and surgical care in one area) and triage to service (i.e., ED patients directed to emergency care from non-EM specialties) [20, 21]. Conversely, many Slovenian EDs are non-hospital-based (i.e., located in health centers rather than a hospital) and may be within other specialty units [19, 22]. Despite these different settings, most EDs report a contiguous design, with only 39% using triage to service [19, 22]. Apart from structural variation, disparities in resources exist across the world [23, 24]. Despite international differences, EDs across the globe share the prevalence of high frequency of ED use among patients with cancer [9, 25–27]. Essentially, EDs worldwide face oncologic emergencies subject to the ED's native infrastructure, practice culture, and community policy.

An international increase in cancer cases underscores the need for care assessment and improvement in oncologic emergency treatment. Therefore, we undertook a systematic review to describe the global management of common oncologic emergencies and related hospital care.

Materials and methods

Study design

We conducted a systematic review of the literature, which was reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines [28].

Eligibility criteria

We included original research articles that examined oncological emergencies and interventions. We included all cancer types and did not require the publications to articulate strict diagnostic criteria or treatment interventions. We excluded non-English-language publications.

Search strategy

Figure 1 illustrates the detailed search strategy. We searched PubMed, Web of Science, and EMBASE healthcare databases for literature published between January 1st, 2003, to December 31st, 2022. A liaison librarian (JM), in collaboration with the research team, developed the publication search strategy to identify publication abstracts corresponding to the following Medical Subject Headings (MeSH) and keywords: oncologic emergencies, emergency medicine, acute care, and cancer. This search strategy was adapted for each database (e.g., EMBASE). A second liaison librarian (DC) performed a peer review of

Database	Search Strategy
PubMed	(("Pharmacological Phenomena"[Mesh] AND "Pharmacological Phenomena/adverse effects"[Mesh] OR ("Pharmacological Phenomena/drug effects"[Mesh] OR "Pharmacological Phenomena/etiology"[Mesh] OR "Pharmacological Phenomena/poisoning"[Mesh] OR "Pharmacological Phenomena/prevention and control"[Mesh] OR "Pharmacological Phenomena/radiation effects"[Mesh] OR "Pharmacological Phenomena/therapeutic use"[Mesh] OR "Pharmacological Phenomena/therapy"[Mesh] OR "Pharmacological Phenomena/toxicity"[Mesh] OR "Palliative Care"[Mesh] OR "Palliative Care/adverse effects"[Mesh] OR "Palliative Care/methods"[Mesh] OR "Palliative Care/mortality"[Mesh] OR "Palliative Care/pharmacology"[Mesh] OR "Disease Management"[Mesh])) AND ("Neoplasms"[MeSH] OR "neoplas*"[tiab] OR tumor*[Mesh] OR "tumour" OR neoplas*[MeSH] OR cancer*[MeSH] OR malign*[MeSH] OR "carcin*" OR oncolog*[MeSH]) AND ("Emergencies"[MeSH] OR "Critical Care"[Mesh] OR "Emergency Treatment"[MeSH] OR "First Aid"[MeSH] OR emergency department[tiab] OR emergency service[tiab] OR "Emergency Service, Hospital"[MeSH] OR "Emergency Medical Services"[MeSH] OR acute care[tiab] OR urgent care[tiab] OR unplanned hospitalization[tiab] OR intensive care[tiab]))
Embase	(('immunopharmacology'/exp OR 'drug contamination'/exp OR 'pharmacology'/exp) OR 'pharmacognostics' OR 'pharmacological and toxicological phenomena' OR 'pharmacological and toxicological phenomena and processes' OR 'pharmacovigilance' OR 'pharmacological phenomena' OR 'pharmacological phenomenon' OR 'pharmacological process' OR 'pharmacological processes':ab,ti) AND ('cancer palliative therapy'/exp OR 'palliative therapy'/exp OR 'disease management'/exp) AND (('neoplasm'/exp) OR 'cancer*' OR 'neoplas*' OR 'tumo?r*' OR 'carcin*' OR 'oncolog*' OR 'acral' OR 'malignan*' OR 'neoplas*'NEAR/2 'disease*' OR 'entity' OR 'mass':ab,ti) AND (('emergenc*'/exp OR 'emergency care'/exp OR 'emergency health service'/exp) OR 'trauma center*' OR 'emergency health?care service' OR 'emergency medical services' OR 'acute care' OR 'acute medical care' OR 'emergency health care' OR 'emergency medical care' OR 'patient care':ab,ti)
Web of Science	((immunopharmacology/ OR drug contamination/ OR pharmacology/) OR pharmacognostics OR pharmacological and toxicological phenomena OR pharmacological and toxicological phenomena and processes OR pharmacovigilance OR pharmacological phenomena OR pharmacological phenomenon OR pharmacological process OR pharmacological processes) AND (cancer palliative therapy/ OR palliative therapy/ OR disease management/) AND ((neoplasm/) OR cancer* OR neoplas* OR tumo?r* OR carcin* OR oncolog* OR acral OR malignan* OR neoplas*NEAR/2 disease* OR entity OR mass) AND (((emergenc*/ OR emergency care/ OR emergency health service/) OR trauma center* OR emergency health?care service OR emergency medical services OR acute care OR acute medical care OR emergency health care OR emergency medical care OR patient care))

Fig. 1 Detailed search strategy for each database

electronic search strategies (PRESS) to refine the search further. Investigators applied the refined search strategy to additional databases which identified 12,491 citations. Investigators imported these results in Covidence (https://www.covidence.org), a web-based software platform for conducting systematic reviews that additionally eliminates duplicate records

Study selection

Studies were included if they were (1) empirical, peer-reviewed original research, (2) focused on adult (≥18 years) patients with cancer, (3) on cancer as a primary disease in the ED, ICU, hospital, other urgent or acute care settings, (4) included chief complaints at ED or predictors of ED use and had explicitly defined oncologic emergencies [4]. Investigators excluded: (1) abstracts, literature reviews, editorial reviews/commentaries, conceptual papers, or case reports; (2) studies that explored pediatric populations (as part of or the entire sample), and (3) referenced oncologic emergencies without subsequent clinical address or care focus. A group of 12 reviewers (SY, AH, KA, JK, NW, MH, JB, MW, BGR, SH, CRG, CC) screened records from the initial search of the databases and agreed on studies for inclusion. Each record underwent an initial title/abstract screening and a subsequent full-text screening, with each reference reviewed by at least two coders. The research team resolved discrepancies or ambiguities in coding during consensus meetings.

Data extraction and analysis

A study-specific abstraction coding sheet was developed a priori. The study design, country where the study was conducted, number of sites, whether it was an ED or any other acute care setting (e.g., ICU), number of patients, cause of the ED visit/hospitalization (i.e., oncologic emergency specified), intervention(s) used to treat that oncologic emergency, and the outcomes studied were abstracted. Other extracted data included aim and objectives, methods, study population, nature of oncologic emergencies and intervention used in the ED/hospital, outcome measures, results, and conclusions. Given our focus on various types of empirical studies and the exploratory nature of this review, quality assessment was not performed. However, studies were included only if the publication reported specific oncologic emergencies and/or interventions used in the ED. Figure 2 illustrates the review process.

Results

Description of studies

Table 1 notes study characteristics and Table 2 describes the articles in detail [29–77]. The search strategy identified 12,491 citations about cancer-related emergency visits, of which 49 met inclusion criteria (Fig. 2): 28 retrospective cohort studies, 13 prospective cohort studies, four randomized controlled trials (RCTs), three cross-sectional, and one case–control design. Of the papers reviewed, 18 originated from the Americas, 13 were from Europe, 12 were from Asian countries, two from Australia, and four from multi-national studies (Fig. 3). Most studies were conducted in a single site ($n=34/49$), with comparable proportions of ED visits ($n=22/49$) and acute care hospital/ICU visits ($n=27/49$). The study population size varied widely among the identified studies (range 9 – 87,555 participants), with most studies not

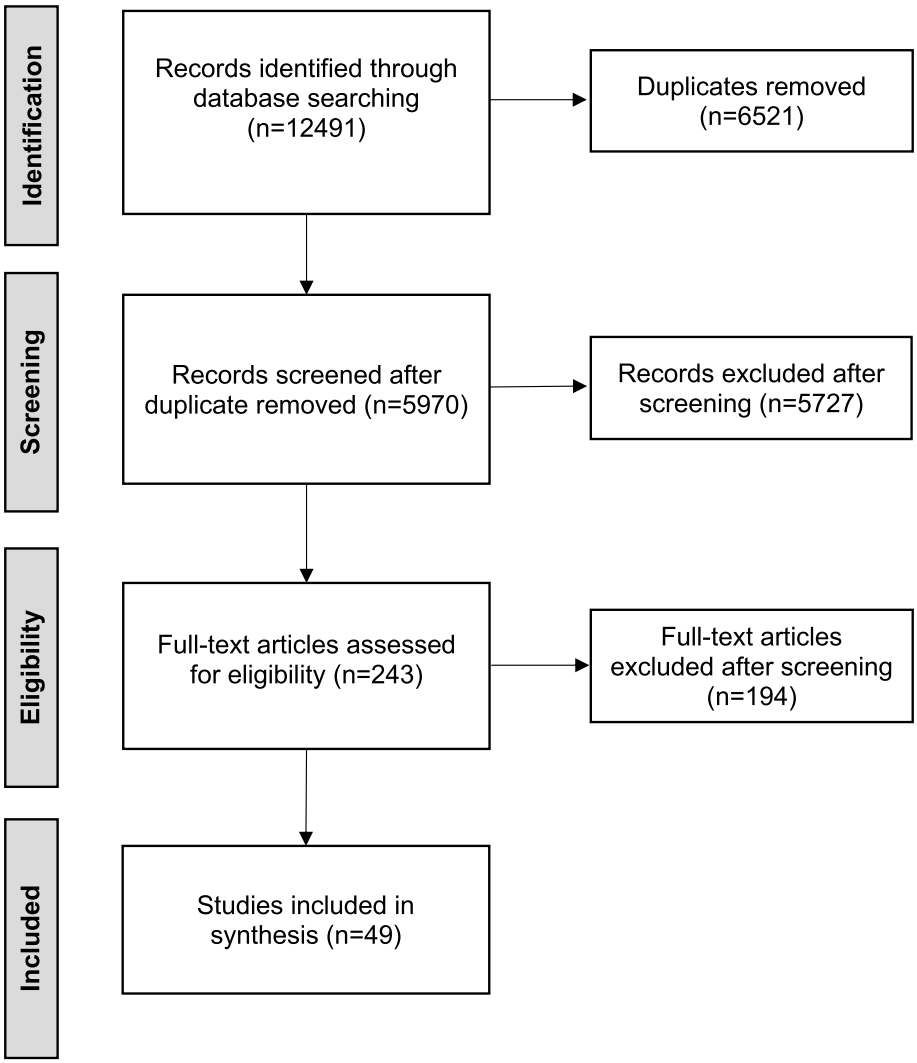

Fig. 2 PRISMA flow diagram

specifying the cancer type, stage, or treatment types, and over 63% of studies had an average age ≥ 60 years. The earliest publication meeting the study criteria appeared in 2003, with 84% of the remaining papers published after 2010.

Oncologic emergencies

The most common oncologic emergencies or predictors of ED use/hospitalization included infection ($n=22/49$), pain ($n=20/49$), dyspnea or respiratory symptoms ($n=19/49$), gastrointestinal (GI) symptoms, including bowel obstructions ($n=17/49$), and treatment-related toxicities ($n=13/49$). Interventions within the ED or hospital ranged from pharmacological management with opioids ($n=11/49$), antibiotics ($n=9/49$), corticosteroids ($n=5/49$), and invasive procedures (e.g., palliative stenting; $n=13/49$) or surgical interventions ($n=2/49$).

Management of infection

Infections included sepsis, febrile neutropenia, and pneumonia. Isolated cytokine release syndrome and sepsis caused by pneumonia, enterocolitis, and skin infections in patients with hematological malignancies were managed with life-saving treatments such as vasoactive drugs, non-invasive ventilation, and corticosteroid therapy [31]. Bou Chebl et al. [34] also addressed sepsis, utilizing interventions including IV fluids, vasopressors, and intubation. Some studies which focused on febrile neutropenia in patients with hematological malignancies [35, 56] did not specify ED interventions, while other studies [42, 65] highlighted antibiotic therapy as a crucial treatment. In patients with bacterial pneumonia, Gudiol et al. (2016) [46] noted the necessity for ICU admission, mechanical ventilation, and targeted antibiotic therapy. Additionally, Grewal et al. [45] emphasized the need for specialty

Table 1 Demographics and clinical characteristics of studies ($n=49$)

Age in Years (Median or Mean as reported)		
	<60	12
	60–64	10
	65–69	15
	70+	6
	Age Range not reported	6
Cancer Type	Specific cancer type	8[a]
	Hematological	4
	Solid	4
	Cancer type not specified	33
Cancer Stage	Advanced	8
	Cancer stage not specified	41
Treatment Type	Chemotherapy	7
	Immunotherapy	3
	Radiotherapy	1
	Surgery	2
	Treatment type not specified	36

[a] There were two studies on colorectal cancer, four on lung cancer, one on lymphoma, and one on prostate cancer

consultations and hospital admissions for infections in cancer patients.

Addressing pain

Pain is a common and debilitating symptom in oncological emergencies, often managed with various analgesic strategies. Mercadante et al. (2010, 2017) [53, 54] reported on the management of pain using opioids such as intravenous morphine, oral morphine, transdermal fentanyl, and oral oxycodone. When comparing the efficacy of intranasal fentanyl (INF) versus intravenous hydromorphone (IVH) for severe pain relief, they report that IVH provided superior pain management [32]. Coyne et al. (2021) [40] and Patel et al. (2017) [58] both discussed opioid therapy for pain management, with Coyne et al. (2021) [40] also mentioning acetaminophen as an adjunct treatment. The use of various medications, including opioids and corticosteroids, provided acute symptom management [52]. When explicitly addressing the palliation of malignant large-bowel obstruction in colorectal cancer, palliative stenting or stoma creation was used by Abelson et al. [29]

Assessment of dyspnea and respiratory symptoms

Dyspnea was a focus of several studies. Chou et al. (2012) [38] examined sepsis-related respiratory failure in stage III and IV lung cancer patients, managing the condition with mechanical ventilation and transferring patients to long-term respiratory care if necessary. Cooksley et al. (2020) [39] addressed dyspnea related to immune checkpoint inhibitor toxicity, using steroids and antibiotics as interventions. In patients with advanced lung cancer, Kim et al. (2014) [50] identified multiple causes of dyspnea, such as obstructive pneumonia and chemo-induced lung toxicity, managed through vasoactive agents, hemodialysis, and mechanical ventilation. Additionally, Yilmaz et al. [77] explored the management of dyspnea in lung cancer patients with salbutamol and magnesium sulfate. Peyrony et al. (2021) [59] reported various supportive measures, including oxygen therapy and mechanical ventilation.

Addressing GI symptoms & bowel obstruction

GI symptoms included bowel obstruction, diarrhea, colitis, and nausea. Abelson et al. [29] and Frago et al. (2010) [43] both studied malignant large-bowel obstruction in colorectal cancer, which was treated with palliative stenting or chemotherapy regimens. Castillo et al. (2021) [36] focused on immune-related adverse events such as colitis and diarrhea, which were managed with corticosteroids including dexamethasone and prednisone. Teimouri et al. [68] also highlighted the use of steroids for managing GI toxicities, including colitis and hepatitis. In patients experiencing GI symptoms in the ED, Delgado-Guay et al. (2015) [41] noted the importance of palliative care consultations. Waddle et al. [71] reported on managing various GI symptoms and associated complications without specifying particular interventions.

Other treatment-related toxicities

Treatment-related toxicities are critical oncological emergencies, often requiring immediate intervention due to their potential severity and impact on patients' quality of life. Castillo et al. (2021) [36] explored immune-related adverse events (irAEs) such as colitis, diarrhea, hyperglycemia, and shortness of breath, managed with irAEs-specific treatments, primarily corticosteroids. Similarly, Teimouri et al. [68] focused on managing toxicities like diarrhea/colitis, hepatitis, pneumonitis, nephrotoxicity, and cardiotoxicity with steroids. In patients experiencing dyspnea, diarrhea, and fever related to treatment toxicity, Cooksley et al. (2020) [39] employed corticosteroids and antibiotics as treatment modalities.

Kim et al. (2014) [50] demonstrated a range of toxicities in lung cancer patients, including chemo-induced lung toxicity and radiation pneumonitis, addressing these conditions with interventions including vasoactive agents, hemodialysis, and mechanical ventilation. They emphasized that this comprehensive approach is vital to managing the acute and potentially life-threatening effects of cancer treatments. Xia and Wang (2016) [74] also reported on severe treatment-related toxicities in solid tumor patients, such as respiratory failure, septic shock,

Table 2 Detailed description of studies included ($n=49$)

Author, year	Country	Methods	Population	Sample Size	Age, years (Mean, SD, or Median)	% Male	Cancer Studied	Oncologic Emergency Studied	Intervention Used in the ED/Hospital
Abelson et al., 2017 [29]	United States	Retrospective Observational Cohort Study	Patients admitted to the ED with MLBO who were treated with palliative stent ($n=172$) or stoma ($n=173$)	345	69.9 (14.4) (stoma group), 70.9 (16.8) (stent group)	87 (50.3%, stoma); 90 (52.3% stent)	Colorectal	palliation of malignant large-bowel obstruction (MLBO)	Palliative stenting or stoma creation
Alsirafy et al., 2016 [30]	Other: Egypt	Retrospective Observational Cohort Study	Patients with terminal cancer who died at KAMC-HC during the 13-month period	154	Median (range): 60 (16–91)	69 (44.8%)	All	Pain, dyspnea, vomiting	n/a
Azoulay et al., 2021 [31]	Other: France, Spain, USA, UK, Russia, Canada, Germany, Austria	Retrospective Observational Cohort Study	Patients who received CAR T-cell therapy in the past 30 days had been admitted to the ICU for any reason	241	Median (range): 58 (43–66)	144 (60%)	All hematological malignancies	Isolated cytokine release syndrome, sepsis (due to pneumonia, enterocolitis, and skin and soft tissue infections), frailty	Life-saving treatments (vasoactive drugs), non-invasive ventilation or high-flow nasal oxygen, steroid therapy,
Banala et al., 2020 [32]	United States	Randomized Clinical Trial	Adult patients with cancer presenting with severe pain to the ED	84	Median (range): IV Hydromorphone group: 51 (29–78); Intranasal Fentanyl group)55 (22–84)	36 (43.9%)	All	Severe pain	Intranasal fentanyl (INF) vs intravenous hydromorphone (IVH)
Bosscher et al., 2016 [33]	Other: The Netherlands	Prospective Observational Cohort Study	Adult cancer patients (age [18 years) in the University Medical Center Groningen who required surgical consultation for oncologic emergencies	207	Not reported	101 (48.8%)	All	Obstruction, infection, clinical deterioration, gastrointestinal perforation, bleeding/thrombosis, pathological fractures	Referral to surgery within 30 days after emergency evaluation or non-surgical treatment
Bou Chebl et al., 2021 [34]	Other: Lebanon	Retrospective Observational Cohort Study	All patients > 18 years of age admitted with sepsis	442	67.92 (13.32, solid tumor); 55.37 (20.85, hematological malignancy)	190 (62.3% solid); 97 (70.8% hematological)	All	Sepsis	IV fluids, Vasopressor use, steroid use, intubation

Table 2 (continued)

Author, year	Country	Methods	Population	Sample Size	Age, years (Mean, SD, or Median)	% Male	Cancer Studied	Oncologic Emergency Studied	Intervention Used in the ED/Hospital
Bow et al., 2006 [35]	Other: USA, Canada, Australia	Randomized Clinical Trial	Patients at high risk for medical complications who were > = 18 years old, severely neutropenic, hospitalized for the management of a febrile episode complicating the course of cytotoxic therapy for a hematological malignancy or for a hematopoietic stem cell transplant (HSCT), and who had provided written, informed consent according to institutional protocol	264	50.2 (15.1, Piperacillin-tazobactam recipients); 50.1 (14.5, Cefepime recipients)	166/265 (62.6% Piperacillin-tazobactam recipients); 146/263 (54.4% Cefepime recipients)	All Hematological malignancies	Febrile neutropenic episodes	n/a
Castillo et al., 2021 [36]	United States	Retrospective Observational Cohort Study	Patients receiving ICI therapy within 6 weeks before ED presentation who had a contemporary evaluation in the Mayo Clinic Hospital ED between May 1, 2017, and April 30, 2018	67	Median (range): 65 (24–88)	36 (53.7%)	All	Immune-related adverse events (abdominal pain, colitis, diarrhea, hyperglycemia, shortness of breath, dizziness, chest pressure/tightness, nausea and vomiting)	Corticosteroids (dexamethasone 10 mg, prednisone 60 mg)

Table 2 (continued)

Author, year	Country	Methods	Population	Sample Size	Age, years (Mean, SD, or Median)	% Male	Cancer Studied	Oncologic Emergency Studied	Intervention Used in the ED/Hospital
Cauley et al., 2015 [37]	United States	Retrospective Observational Cohort Study	Patients included in this study were at least 18 years old, had a preoperative diagnosis of disseminated cancer and Patients who underwent an emergency operation for intestinal obstruction or perforation by the primary DRG International Classification of DiseasesV9th Rev. (ICD-9) code	875	Not reported	52% (in intestinal perforation group); 51% (in Obstruction group)	All	Intestinal Obstruction or Perforation	Emergency Operation
Chou et al., 2012 [38]	Other: Taiwan	Retrospective Observational Cohort Study	Consecutive patients with stage III to stage IV lung cancer, who were admitted to ICU for sepsis-related respiratory failure	70	71.7 (12.3, survived to hospital discharge); 76.4 (11.6, died)	23 (79.3% survived to hospital discharge); 37 (90.2% died)	Lung, stage III and IV	Sepsis-related respiratory failure	Intubated via mechanical ventilator support. If patients failed to be weaned from the ventilator, they were transferred to a respiratory care facility for long-term ventilator support
Cooksley et al., 2020 [39]	UK	Prospective Observational Cohort Study	All emergency presentations in patients treated with ICIs within 6 months before admission were seen at a specialist oncology hospital in England from 20th May 2018 to 19th May 2019	300	Median (range): 67 (28–88)	185 (61.7%)	All	Dyspnea, diarrhea, and fever related to ICI toxicity	Steroids, antibiotics

Table 2 (continued)

Author, year	Country	Methods	Population	Sample Size	Age, years (Mean, SD, or Median)	% Male	Cancer Studied	Oncologic Emergency Studied	Intervention Used in the ED/Hospital
Coyne et al., 2021 [40]	United States	Prospective Observational Cohort Study	Adults 18 years or older with active cancer presenting to the ED	1075	Median (range): 64 (19–90)	518 (48.2%)	All	Pain	Opioids, acetaminophen
Delgado-Guay et al., 2015 [41]	United States	Retrospective Observational Cohort Study	Patients with advanced cancer aged 18 years or older who visited the ED after their first visit to an outpatient palliative care clinic	200	56.5 (13.6)	104 (52%)	All	pain, GI symptoms, altered mental status, other neurologic symptoms, infection, dyspnea, fever/chill, bleeding, edema/swelling, constipation, general weakness, fell down	received palliative care consultation in the ED or admitted to the hospital
DeSilva, Jackson, and Steer, 2018 [42]	Australia	Retrospective Observational Cohort Study	Patients ≥ 18 years of age who were admitted under the oncology unit at Albury Wodonga Health during a 12-month period and who had a microbiological test performed for suspected infection during their admission	208	Median (range): 67 (19–89, with febrile neutropenia); 68 (19–89, without febrile neutropenia)	28 (56% with febrile neutropenia); 99 (62.7%, without febrile neutropenia)	All	Infection, neutropenic fever episodes	Antibiotic therapy
Frago et al., 2010 [43]	Other: Spain	Retrospective Observational Cohort Study	Patients with stage IV obstructing CRC presenting to the ED	55	65.5 (50–77, surgery group); 65.9 (19–84, stent group)	9/12 (75% surgery group); 32/43 (74.41%, stent group)	Colorectal, stage IV	Bowel obstruction	Colonic stenting or palliative chemotherapy (consisting of a combi-nation of 5-fluorouracil (5-FU), leucovorin (LV), and irino-tecan (FOLFIRI) or oxaliplatin (FOLFOX))

Table 2 (continued)

Author, year	Country	Methods	Population	Sample Size	Age, years (Mean, SD, or Median)	% Male	Cancer Studied	Oncologic Emergency Studied	Intervention Used in the ED/Hospital
Giustozzi et al., 2021 [44]	Other: Italy, USA, Belgium, France, Germany, Israel, Netherlands, UK, Poland, and Spain	Randomized Clinical Trial	Patients with cancer with symptomatic or incidental acute proximal deep vein thrombosis or pulmonary embolism were randomized in a 1:1 ratio to receive oral apixaban or subcutaneous dalteparin	1155	67.3 (11.0, incidental VTE); 68 (11.2, Symptomatic VTE)	115 (50%, incidental VTE); 453 (49%, symptomatic VTE)	All	Incidental or symptomatic acute proximal deep venous thromboembolism (VTE)	Lab testing, diagnostic imaging
Grewal et al., 2020 [45]	Canada	Retrospective Observational Cohort Study	Patients aged 18 years and older with a cancer diagnosis and who received chemotherapy in the 30 days before being seen in an emergency department between 2013 and 2017	87,555	66 (56–74)	39,383(45%)	All	Infection, fever, gastrointestinal diagnoses	Specialty consultation, hospital admission
Gudiol et al., 2016 [46]	Other: Spain	Prospective Observational Cohort Study	Advanced solid neoplasm was considered in patients with confirmed metastatic disease (stage IV) and some tumors in stage III (lung, pancreas, gastric, esopha-geal and urothelial) not suitable for curative treatment	795	64 (29–89)	35 (63.6%)	All	Bacteremic pneumonia in neutropenic cancer patients, fever, cough, septic shock,	ICU admission, invasive mechanical ventilation, antibiotic therapy, targeted antibiotic therapy

Table 2 (continued)

Author, year	Country	Methods	Population	Sample Size	Age, years (Mean, SD, or Median)	% Male	Cancer Studied	Oncologic Emergency Studied	Intervention Used in the ED/Hospital
Hsu et al., 2021 [47]	Other: Taiwan	Retrospective Observational Cohort Study	Adults with cancer who received palliative care during the final 6 months of their life	762	70.4 (13.0)	44 (49.4%)	All	Anemia, altered mental status, catheter-related events, dyspnea, falls, fever, N/V or other GI symptoms, pain, and tumor bleeding/complications	n/a
Kao et al., 2018 [48]	Other: Taiwan	Case–Control Study	Advanced cancer patients receiving palliative home care services	65	72.6 (12.1)	35 (54.8)	All	Pain, infection or fever, nausea or vomiting, constipation, dyspnea, change of consciousness, and gastrointestinal bleeding	Morphine
Kerhuel et al., 2015 [49]	Other: France	Retrospective Observational Cohort Study	All patients admitted to the ICU within the 3 months following HDT/ASCT during the study period	27	54 (38–60)	14 (52%)	Lymphoma	Infection, shock, acute respiratory failure, neurologic disorder, bleeding	Vasopressors, invasive mechanical ventilation, non-invasive mechanical ventilation, renal replacement therapy

Table 2 (continued)

Author, year	Country	Methods	Population	Sample Size	Age, years (Mean, SD, or Median)	% Male	Cancer Studied	Oncologic Emergency Studied	Intervention Used in the ED/Hospital
Kim et al., 2014 [50]	Other: Korea	Retrospective Observational Cohort Study	Patients with pathologically confirmed lung cancer who were admitted to the medical ICU at Seoul National Uni-versity Bundang Hospital between 2003 and 2011	95	65.6 (10.3)	78 (82%)	Lung, stage IIIB and IV	Obstructive pneumonia, respiratory failure due to lung involvement of cancer, cardiac tamponade, tumor bleeding, neurologic events, metabolic events, radiation pneumonitis, chemo-induced lung toxicity, infection with neutropenia, infection without neutropenia, other complications due to treatment, neutropenic septic shock, comorbidity related events	Vasoactive agents, hemodialysis, CPR, mechanical ventilation
Klamroth et al., 2022 [51]	Other: Germany	Prospective Observational Cohort Study	Patients diagnosed with cancer-associated venous thrombosis with newly diagnosed symptomatic or asymptomatic VTE, pulmonary embolism (PE), or deep vein thromboses (DVT) and age ≥ 18 years	382	Median is 67 years for patients with CAT	189 (49.5%, patients with CAT)	All	Cancer-associated venous thrombosis (CAT)	Anticoagulant therapy with low-molecular weight heparin, direct oral anticoagulants, Vit K antagonists, unfractionated heparin

Table 2 (continued)

Author, year	Country	Methods	Population	Sample Size	Age, years (Mean, SD, or Median)	% Male	Cancer Studied	Oncologic Emergency Studied	Intervention Used in the ED/Hospital
Lagman et al., 2007 [52]	United States	Prospective Observational Cohort Study	Patients who were admitted to The Harry R. Horvitz Acute Inpatient Palliative Medicine Unit with an episode needing acute inpatient treatment for symptom control or management of complications	96	62 (31–92)	48 (50%)	All	Acute inpatient treatment of symptom control and cancer-related complications (i.e., neutropenic fever, radiation-induced pneumonitis, intractable emesis), terminal care, antineoplastic therapy-induced complications, comorbid condition related symptoms	Invasive diagnostic (i.e., endoscopy) and therapeutic procedures, medications (i.e., opioids, laxatives, acid suppressants, corticosteroids, antiemetics), hydration, transfusions, radiation or chemo or a combination, discharged home with hospice care, lab tests, radiologic investigations
Mercadante et al., 2010 [53]	Other: Italy	Prospective Observational Cohort Study	Patients consecutively admitted to a Pain Relief and Palliative Care unit in a period of 6 months from January 2008 to June 2008, who were receiving opioids in doses of oral morphine equivalents equal to or more than 60 mg daily or who were prescribed opioids for breakthrough pain (BTP) of different nature	66	66.7 (12.2)	42 (63.6%)	All	Pain	Opioids intravenous, oral, transdermal
Mercadante et al., 2017 [54]	Other: Italy	Prospective Observational Cohort Study	Advanced cancer patients who were admitted to an APSCU	235	66.7 (11.9, first admission); 62.7 (11.9, readmission)	134 (57%, first admission); 48 (60.8% readmissions)	All	Uncontrolled pain, opioid-induced toxicity, chemotherapy-induced toxicity, symptom control, and end-of-life care	Opioid therapy

Table 2 (continued)

Author, year	Country	Methods	Population	Sample Size	Age, years (Mean, SD, or Median)	% Male	Cancer Studied	Oncologic Emergency Studied	Intervention Used in the ED/Hospital
Miranda et al., 2016 [55]	Other: Brazil	Cross-Sectional Study	Patients with cancer treated at oncological service and attended an ED for oncologic monitored from September 2011 to December. 2011, with length of stay > 2 h, aged 18 years or older	191	Not reported	68 (35.6)	All	Infection, pain, GI symptoms, respiratory symptoms,	n/a
Moghnieh et al., 2015 [56]	Other: Lebanon	Retrospective Observational Cohort Study	Adult cancer patients with fever and neutropenia, including those undergoing Hematopoietic Stem Cell Transplantation (HSCT), with positive blood cultures were selected	70	Not reported	36 (48%)	All	Febrile neutropenia	n/a

Table 2 (continued)

Author, year	Country	Methods	Population	Sample Size	Age, years (Mean, SD, or Median)	% Male	Cancer Studied	Oncologic Emergency Studied	Intervention Used in the ED/Hospital
Numico et al., 2015 [57]	Other: Italy	Retrospective Observational Cohort Study	Patients admitted to the General Valle d'Aosta Hospital inpatient oncology ward between August 1, 2011 and December 31 2012	454	69.2 (26–92)	258 (56.9%)	All	Breathlessness, pain, fever, intestinal obstruction, other digestive symptoms (nausea and vomiting, jaundice, diarrhea, dysphagia, etc.), neurological symptoms (mainly related to brain metastases or meningeal carcinomatosis), general symptoms (such as fatigue and cachexia) and cardiovascular symptoms (such as those related to deep vein thrombosis, pericardial effusion, heart failure)	Imaging, antitumor interventions, antibiotics, opiates, diagnostic or therapeutic invasive procedures (thoracentesis for pleural effusion or biliary drainage for obstruction), chemotherapy or radiotherapy, transferred to hospice, or in-hospital death
Patel et al., 2017 [58]	United States	Retrospective Observational Cohort Study	Opioid-tolerant cancer patients > 18 years old who presented to two urban tertiary-care EDs between January 1, 2012 and November 30, 2014 and received opioids for the management of acute pain	216	Mean (range): 58 (29–89)	92 (42.40%)	All	Pain	Opioids

Table 2 (continued)

Author, year	Country	Methods	Population	Sample Size	Age, years (Mean, SD, or Median)	% Male	Cancer Studied	Oncologic Emergency Studied	Intervention Used in the ED/Hospital
Peyrony et al., 2021 [59]	Other: France	Cross Sectional Study	Patients of 18 years or older with solid or hematologic malignancy	1081	72 (62–82)	611 (56.52%)	All	Dyspnea, neurological disorder, and fatigue	Ultrasound, blood tests, ECG, venous access, oxygen therapy, mechanical ventilation, existing tracheostomy use, fluid challenge, catecholamines, analgesia, morphine, CPR, sedation, antibiotics,
Poutsiaka et al., 2007 [60]	United States	Prospective Observational Cohort Study	All patients receiving daptomycin resided on the Bone Marrow Transplant Units of the two participating institutions (Tufts-New England Medical Center, Boston Massachusetts and the University of Iowa Hospital, Iowa City, Iowa) from 2000 to 2002	9	Mean (range): 52.9 (25–70)	7/9 (77.8%)	All hematological malignancies	Treating VRE BSI in febrile neutropenic patients	Daptomycin
Raghavendra et al., 2014 [61]	United States	Retrospective Observational Cohort Study	Patients with neutropenic fever with fever > 38.8 degrees Celsius	215	Median is 69 years	Not reported	All	Neutropenic fever	Antibiotics and infectious disease consult service use
Rolston et al., 2010 [62]	United States	Prospective Observational Cohort Study	Patients with neutropenic fever	21	44 (24–84)	4 (19%)	All solid tumors	Neutropenic fever	Physical exam, lab tests, oral moxifloxacin

Table 2 (continued)

Author, year	Country	Methods	Population	Sample Size	Age, years (Mean, SD, or Median)	% Male	Cancer Studied	Oncologic Emergency Studied	Intervention Used in the ED/Hospital
Ruiz-Artacho et al., 2018 [63]	Other: USA, Argentina, Austria, Belgium, Brazil, China, Colombia, Czechia, Ecuador, Egypt, France, Germany, Greece, Honduras, Iran, Ireland, Israel, Italy, Japan, Latvia, Morocco, North Macedonia, Portugal, Spain, Switzerland, UK, Vietnam,	Prospective Observational Cohort Study	Patients with biopsy-proven active cancer in the lung presenting with acute symptomatic, objectively confirmed VTE	1725	65 (12.0, both pulmonary embolism and deep VT groups)	873 (72%, Pulmonary embolism); 377 (73%, Deep VT)	Lung	Recurrent DVT, or PE and major bleeding	Anticoagulant therapy, repeat compression ultrasonography, helical CT pulmonary, ventilation–perfusion lung scintigraphy, angio-graphy, or pulmonary angiography
Sandgren et al., 2010 [64]	Other: Sweden	Cross Sectional Study	Palliative cancer patients	520	70 (62, 71, 79 quartiles, 2002 DATA); 74 (67, 76, 83, 2007)	107 (55.7%, 2002); 182 (55.5%, 2007)	All	Pain, deterioration, nausea, infection	n/a
Skiba et al., 2020 [65]	Australia	Retrospective Observational Cohort Study	Adult cancer patients with a recorded diagnosis of neutropenic fever who were hospitalized at a tertiary care hospital between January 2017 and December 2017	88	64 (12.25)	31 (35.2)	All solid tumors	Neutropenic fever	Antibiotics

Table 2 (continued)

Author, year	Country	Methods	Population	Sample Size	Age, years (Mean, SD, or Median)	% Male	Cancer Studied	Oncologic Emergency Studied	Intervention Used in the ED/Hospital
Soares, Martins, and Uchoa, 2003 [66]	Other: Brazil	Prospective Observational Cohort Study	Patients with severe cancer pain admitted to our palliative care center's emergency room between April 2001 and June 2002 and aged between 18 and 80, on concurrent morphine therapy for at least 2 weeks, and had severe pain at initial assessment	18	51 (34–74)	10 (55.5%)	All solid tumors	Severe pain	IV fentanyl
Sutradhar, Barbera, and Seow, 2017 [67]	Canada	Retrospective Observational Cohort Study	Each decedent had to be at least 18 years of age at cancer diagnosis and had to have received homecare nursing (with standard or palliative intent) prior to their date of death	54,743	Not reported	26,913 (47.9%)	All	Dyspnea, malaise and fatigue, acute abdominal or pelvic pain, fever with chills, pain in throat, projectile vomiting, nausea, disorientation, rheumatism or other soft-tissue disorders, panniculitis affecting regions of next and back multiple sites in spine	n/a

Table 2 (continued)

Author, year	Country	Methods	Population	Sample Size	Age, years (Mean, SD, or Median)	% Male	Cancer Studied	Oncologic Emergency Studied	Intervention Used in the ED/Hospital
Teimouri et al., 2022 [68]	Canada	Retrospective Observational Cohort Study	Adult medical oncology patients (≥ 18 years of age) with an NSH-CZ postal code who had received at least one dose of nivolumab, ipilimumab, or the nivolumab plus ipilimumab combination for cancer treatment at the Victoria General Hospital	129	64 (11.0)	84 (65.1%)	All	Diarrhea/colitis, hepatitis, pneumonitis, nephrotoxicity, and cardiotoxicity	Steroids
Verhoef et al., 2020 [69]	Other: Netherlands	Retrospective Observational Cohort Study	Adult patients who visited the ED between May 2011 and June 2014, included those who were in the palliative phase of cancer at the moment of the ED visit and died within 3 months thereafter	420	63 (22–92)	229 (54.5%)	All	Dyspnea, pain, and ascites	Imaging and blood tests, EOL goals of care discussions, hospitalizations

Table 2 (continued)

Author, year	Country	Methods	Population	Sample Size	Age, years (Mean, SD, or Median)	% Male	Cancer Studied	Oncologic Emergency Studied	Intervention Used in the ED/Hospital
Verhoef et al., 2020 [70]	Other: Netherlands	Retrospective Observational Cohort Study	All adult patients with HM who died within 3 months after their last ED visit were included. They were compared to patients. with ST having advanced cancer, which was defined as not having any curative options or receiving anticancer treatment not aimed at curation	498	63 (22–94, all); 61 (27–94, HM); 61 (22–92, ST)	282 (56.6%, all); 53/78 (67.9%, HM); 229/420 (54.5%, ST)	All	Dyspnea, pain, fever, nausea or vomiting, neurologic deterioration, weakness or loss of strength, bleeding, obstipation or diarrhea, fatigue, difficulty swallowing or passage problems, seizure, edema, ascites	Diagnostic imaging, laboratory tests, hospitalization
Waddle et al., 2015 [71]	United States	Retrospective Observational Cohort Study	Cancer patients who initiated external beam RT at the University of North Carolina at Chapel Hill from January 1, 2010, through December 31, 2010	1116	Not reported	534 (47.85%)	All	GI symptoms, neurologic symptoms, respiratory symptoms, pain, fever or infection	n/a
Won et al., 2014 [72]	Other: Korea	Retrospective Observational Cohort Study	Patients aged 20 years and older, who stayed in the CED for more than 24 h and experienced pain with self-reported numeric rating scale (NRS) scores of 4 or greater at the time of admission or during the CED stay	455	53.9 (11.9, before CPCP); 56.2 (11.4, after CPCP)	81 (50%, before CPCP); 159 (55%, after CPCP)	All	Pain	Regular, time-release analgesics and immediate-release analgesics

Table 2 (continued)

Author, year	Country	Methods	Population	Sample Size	Age, years (Mean, SD, or Median)	% Male	Cancer Studied	Oncologic Emergency Studied	Intervention Used in the ED/Hospital
Woon et al., 2021 [73]	Canada	Retrospective Observational Cohort Study	All men aged 66 and older who received abiraterone or enzalutamide as first-line (chemotherapy-naïve) treatment for mCRPC between January 1, 2012, and December 31, 2017 in Ontario, Canada	3405	78.9 (7.2 overall)	3405 (100%)	Prostate	UTI, treatment-related toxicity	n/a
Xia and Wang, 2016 [74]	Other: China	Retrospective Observational Cohort Study	Patients aged ≥ 18 years; medical patients with a definite diagnosis of solid cancer according to pathological results obtained by surgical or micro-invasive biopsy; tumor metastasis assessed by radiography or exfoliative cytology; life expectancy evaluated by an oncologist as > 3 months; > 3 days in the ICU; and nonpregnant women	141	63 (54–74)	87 (61.7%)	All solid tumors	Respiratory failure, severe sepsis or septic shock, acute renal failure, acute heart failure	Vasopressors, mechanical ventilation, renal replacement therapy

Table 2 (continued)

Author, year	Country	Methods	Population	Sample Size	Age, years (Mean, SD, or Median)	% Male	Cancer Studied	Oncologic Emergency Studied	Intervention Used in the ED/Hospital
Yaman et al., 2022 [75]	Other: Turkey	Prospective Observational Cohort Study	Patients 18 years or older, having hematological cancer, having laboratory TLS or clinical TLS, and receiving a single dose (7.5 mg) rasburicase	82	64 (19–85)	43 (52.4%)	All hematological malignancies	Tumor lysis syndrome (TLS)	Rasburicase administration
Yildirim and Tanriverdi, 2014 [76]	Other: Turkey	Retrospective Observational Cohort Study	Patients > 18 yrs of age with cancer treated or followed at the Department of Medical Oncology of our institution between August 2011 and September 2013	107	51 (11.0, group 1); 52 (13.0, group 2)	41 (64%, group 1); 21 (49%, group 2)	All	Dyspnea, pain, deterioration in general health status, fever, hemorrhage, icterus, abdominal distention/ascites, neurological symptoms	Pain treatment (fentanyl vs. tramadol vs. morphine), discharged, died in the ED, hospitalized
Yilmaz et al., 2017 [77]	Other: Turkey	Randomized Clinical Trial	Adults 18 to 65 years of age presenting to the ED with lung cancer and dyspnea; presentation to the ED with the complaint of shortness of breath and, such as dyspnea on exertion, wheezing, and accessory muscle use; not requiring assisted ventilation, peak expiratory flow rate (PEFR) of < 250	91	Mean (95%CI): 54.7 (51.8–57.7)	46 (50.5%)	Lung	Dyspnea	Salbutamol and magnesium sulfate

Abbreviations: *ED* Emergency Department, *MLBO* Malignant large-bowel obstruction, *KAMC-HC* King Abdullah Medical City Health Clusters, *CAR* Chimeric Antigen Receptor, *ICU* Intensive Care Unit, *IV* Intravenous, *INF* Intranasal Fentanyl, *IVH* Intravenous Hydromorphone, *HSCT* Hematopoietic Stem Cell Transplant, *ICI* Immune Checkpoint Inhibitors, *ICD-9* International Classification of Diseases V9th Rev., *GI* Gastrointestinal, *CRC* Colorectal Cancer, *VTE* Venous Thromboembolism, *HDT* High-dose Therapy, *ASCT* Autologous Stem Cell Transplant, *PE* Pulmonary Embolism, *DVT* Deep Vein Thromboses, *CAT* Cancer-associated Venous Thrombosis, *BTP* Breakthrough Pain, *APSCU* Acute Palliative-Supportive Care Unit, *ECG* Electrocardiogram, *CPR* Cardiopulmonary Resuscitation, *VRE* Vancomycin-Resistant Enterococcus, *BSI* Blood Stream Infection, *EOL* End of Life, *HM* Hematemesis and Melena, *CED* Coverage with Evidence Development, *NRS* Numeric Rating Scale, *UTI* Urinary Tract Infection, *TLS* Tumor lysis Syndrome

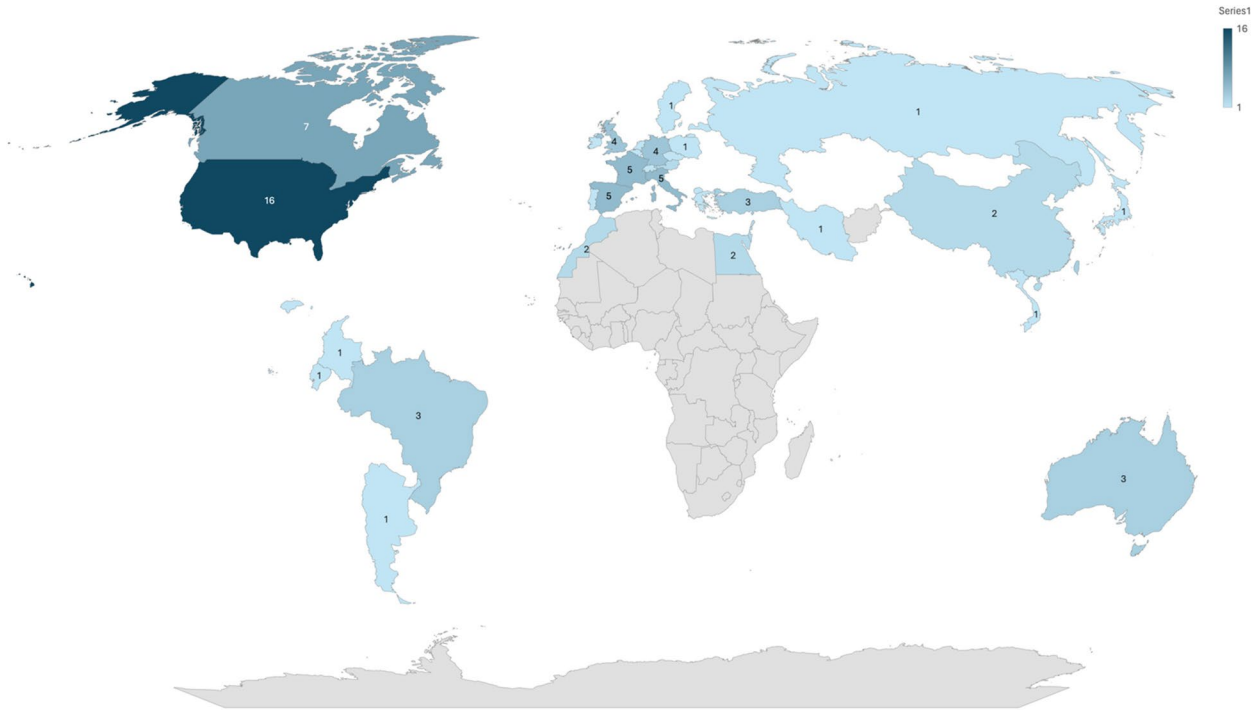

Fig. 3 Location of Studies Included (Note: total number is greater than the sample size due to multi-country studies being listed individually)

and acute renal failure, which necessitated the use of vasopressors, mechanical ventilation, and renal replacement therapy.

Lagman et al. [52] discussed the acute inpatient management of treatment-related complications, including neutropenic fever and radiation-induced pneumonitis, highlighting the use of various medications, invasive procedures, and supportive care measures to stabilize patients. Additionally, Abelson et al. [29] described interventions for malignant large-bowel obstruction secondary to colorectal cancer treatments, including palliative stenting or stoma creation.

Discussion

We conducted a systematic review of oncological emergencies and related interventions from 49 studies [29–77]. We examined the types and management of oncologic emergency-related ED visits and hospitalizations globally using data from multiple published sources. We observed that reports on oncological emergencies [4] varied widely, addressing infections with antibiotics and supportive care, pain with a range of analgesics, dyspnea with ventilatory support and other respiratory interventions, and GI symptoms with palliative procedures and steroid therapy. These interventions mitigate symptoms, improve quality of life, and reduce the impact on hospitalizations and ED visits worldwide.

Our findings are consistent with previous reports and similarly suggest that patients with cancer are at high risk for unplanned hospital use [78]. We expect ED use for oncologic emergencies to increase substantially in the next decade [79]. With over 63% of our identified articles reporting their total study population at an age over ≥ 60 years, we believe healthcare systems should prepare for an increase in patients requiring focused geriatric and supportive cancer care and management strategies in the ED. In accordance with this, we report that most interventions included lifesaving and often invasive procedures such as intubation, mechanical ventilation, and/or surgical procedures [29, 31, 34, 37, 38, 43, 46, 49, 50, 52, 57, 59, 63, 74]. Other prevalent interventions included steroids and/or antibiotics for infection [31, 34, 38–40, 42, 46, 57, 60–63, 65, 77]. and opioids for when patients presented with severe pain [32, 48, 52–54, 58, 59, 66, 72, 76]. With an expected increase in ED use by cancer patients, increased training for emergency department physicians may benefit the flow of oncological patients in the ED. Specifically, we recommend developing physician competency measures which ensures treating physicians are well equipped to provide symptom management and treatment related toxicity care. Although a majority of oncological emergencies presented in this review required an ED visit, further research is required to identify if we

can minimize ED use by increasing access to management of emergencies in outpatient facilities.

Pain management remains a central concern in oncologic emergencies, with providers relying heavily on opioids, requiring patients and providers to mutually consider both the palliative benefits and associated risks of dependence and side effects. The use of various opioid formulations and adjunctive therapies such as acetaminophen and corticosteroids points to an ongoing need for optimizing pain control while minimizing adverse effects. Similarly, GI symptoms, including bowel obstruction, were frequently managed with palliative interventions such as stenting or specific chemotherapy regimens. The importance of specialized care, including palliative care consultations, reflected the complex nature of managing gastrointestinal complications during cancer treatment. The resources and time required in the ED to address these GI complications are limited; thus, challenges with exacerbations of complications are a primary concern.

The American Society of Clinical Oncology (ASCO) and National Cancer Institute (NCI) guidelines recommend early integration of palliative care as standard care alongside cancer care for patients with cancer. However, in many cases, palliative care is deferred until the EOL, with referrals often occurring in the last month of life (often in an inpatient setting) or not at all. Only one study [41] mentioned palliative care consultation in the ED and another study [70] reported EOL goals of care discussion. We found that pain is one of the most common reasons patients with cancer visit the ED; hence, providing palliative interventions to meet all their needs, including social and spiritual care, might be beneficial. Most importantly, studies focusing on patients admitted to acute inpatient palliative care units also reported administering invasive diagnostic and treatment procedures [52]. Most of the interventions reported as life-prolonging aggressive care suggest that there is a significant gap globally regarding the integration of palliative care in acute care settings.

This review indicates that while a broad array of treatments is available for managing oncologic emergencies, there is a lack of standardized protocols and guidelines, particularly for new cancer therapies such as immune checkpoint inhibitors. This variability in practice highlights the need for further research to develop evidence-based guidelines that can inform clinical decision-making and improve patient outcomes. A comprehensive, and integrative, approach will be crucial in improving the quality of care and outcomes for cancer patients facing emergencies.

Strengths and limitations

Our study identified diverse interventions used in the ED and other acute care settings for cancer-related concerns. We demonstrated a paramount need for palliative, hospice, and advanced care planning among this population. We have noted the need to strengthen endeavors that promote the integration of palliative care into standard emergency care for patients, especially those with cancer.

We restricted article inclusion to English language reviews and those reviews published in academic journals. Regarding the articles included, most studies did not report cancer type and treatment type, and we are unaware of the time required for intervention from these studies. Thus, we are unable to extrapolate the probability of emergent care according to the cancer type and complication. Most studies were conducted in a single site, which may limit the generalizability of findings due to variations in local healthcare practices, resources, and patient demographics. The heterogeneity in patient populations, with a significant proportion of studies not specifying cancer type, stage, or treatment, suggests a need for more granular data better to understand the specific needs of different patient subgroups.

Conclusions

Patients with cancer rely on the hospital for evaluation and management of disease and treatment-related concerns throughout their illnesses. However, studies reporting on oncologic emergencies are limited. These studies primarily focus on infection, pain, dyspnea, and GI symptoms with treatments including an array of interventions (e.g., opioids, invasive procedures). Most studies included older patients, suggesting that tailored interventions and management strategies are necessary to address the complex care needs (including social and palliative) of older patients with cancer. Further research may clarify the optimal management strategies to improve the outcomes for this vulnerable patient population.

Abbreviations

APSCU	Acute Palliative-Supportive Care Unit
ASCO	American Society of Clinical Oncology
ASCT	Autologous Stem Cell Transplant
BSI	Blood Stream Infection
BTP	Breakthrough Pain
CAR	Chimeric Antigen Receptor
CAT	Cancer-associated Venous Thrombosis
CED	Coverage with Evidence Development
CPR	Cardiopulmonary Resuscitation
CRC	Colorectal Cancer
DVT	Deep Vein Thromboses
ECG	Electrocardiogram
ED	Emergency department
EM	Emergency Medicine
EOL	End of Life
HM	Hematemesis and Melena
HDT	High-dose Therapy
HSCT	Hematopoietic Stem Cell Transplant
ICD-9	International Classification of Diseases V9th Rev
ICI	Immune Checkpoint Inhibitors
ICU	Intensive Care Unit
INF	Intranasal Fentanyl

irAEs	Immune-related Adverse Events
IV	Intravenous
IVH	Intravenous Hydromorphone
GI	Gastrointestinal
KAMC	HC – King Abdullah Medical Health Clusters
NCI	National Cancer Institute
NEDI	National Emergency Department Inventories
NRS	Numeric Rating Scale
PE	Pulmonary Embolism
PRESS	Peer Review of Electronic Search Strategies
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
RCT	Randomized Controlled Trial
TLS	Tumor lysis Syndrome
UTI	Urinary Tract Infection
VRE	Vancomycin-Resistant Enterococcus
VTE	Venous Thromboembolism

Acknowledgements
The Comprehensive Oncologic Emergencies Research Network (CONCERN) supported this study with scientific review and suggestions on the study design and conduct.

Authors' contributions
All authors made substantial contribution to the study including but not limited to the conception, design, data collection and interpretation and review and editing. SY, KA, JK, JJB, ASH, NW, BEGR, MFH, SWH, MKW, CJC, and CRG: took lead in the conception and design, original draft, data interpretation, review and editing.

Funding
T32CA102618 (Yilmaz), American Cancer Society CSDG-20–023-01-CPHPS (Hong).

Data availability
The dataset used and/or analyzed during the current study is available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate
Not applicable.

Consent for publication
Not applicable.

Competing interests
Bonnie E. Gould Rothberg: Stock Ownership: Butterfly Networks Inc., Quantum Si, Hyperfine Research, AI Therapeutics, Detect Labs, identifeye Health, Protein Evolution Inc.) and direct family members: #A) Stock Ownership: Butterfly Networks Inc., Quantum Si, Hyperfine Research, AI Therapeutics, Detect Labs, identifeye Health, Protein Evolution Inc., 454 Corporation, Electric Futures, (Abbvie Inc, Amgen inc, Biocryst Pharmaceuticals, Gilead Sciences, Inc, Regeneron Pharmaceuticals Inc, Roche Holdings, Pacific Biosciences of California Inc (sold 07/2023)), Telesis Bio Inc #B) Employment: Butterfly Networks Inc, 4Catalyzer #C) Significant Leadership: Butterfly Networks Inc, Quantum Si, Hyperfine Research, AI Therapeutics, identifyee Health, Detect Labs, Protein Evolution Inc. #D) Patents, Royalties, and Other Intellectual Property: Thermo Fisher, Butterfly Networks, Quantum Si, Hyperfine Research, AI Therapeutics, Tesseract, Detect Labs. Christopher William Baugh: paid speaker for Roche Diagnostics, Octapharma, and CE Symmetry, an investigator for Abbott Laboratories, an advisory board participant for Roche Diagnostics, Salix Pharmaceuticals, Pfizer Inc., and AstraZeneca, a consultant for Abbott, Pfizer, Roche, and an advisor to Lucia Health Guidelines. Sai-Ching Yeung: an advisory board participant Salix Pharmaceuticals. The remaining authors declare that they have no competing interests.
Christopher William Baugh: paid speaker for Roche Diagnostics, Octapharma, and CE Symmetry, an investigator for Abbott Laboratories, an advisory board participant for Roche Diagnostics, Salix Pharmaceuticals, Pfizer Inc., and AstraZeneca, a consultant for Abbott, Pfizer, Roche, and an advisor to Lucia Health Guidelines.
Sai-Ching Yeung: an advisory board participant Salix Pharmaceuticals.
The remaining authors declare that they have no competing interests.

Author details
[1]Division of Palliative Care, Department of Medicine, University of Rochester Medical Center, 265 Crittenden Blvd., Rochester, NY 14642, USA. [2]McMaster University, Hamilton, ON, Canada. [3]The Ohio State University College of Medicine, Columbus, OH, USA. [4]Department of Emergency Medicine, The Ohio State University Wexner Medical Center, Columbus, OH, USA. [5]Department of Internal Medicine, University of Texas Southwestern Medical Center, DallasTexas, USA. [6]Department of Emergency Medicine, University of Rochester, Rochester, USA. [7]Sylvester Comprehensive Cancer Center, University of Miami Miller School of Medicine, Miami, FL, USA. [8]Prisma Health Cancer Institute, Greenville, SC, USA. [9]Department of Emergency Medicine, Rutgers Robert Wood Johnson Medical School, New Jersey, USA. [10]Department of Emergency Medicine, The University of Texas MD Anderson Cancer Center, Houston, TX, USA. [11]Department of Emergency Medicine, University of California San Diego, San Diego, CA, USA. [12]Hutchinson Institute for Cancer Outcomes Research, Fred Hutchinson Cancer Research Center, Seattle, WA, USA. [13]Department of Medicine, University of Washington School of Medicine, Seattle, WA, USA. [14]Emergency Care Service, Department of Medicine, Memorial Sloan Kettering Cancer Center, New York, NY, USA. [15]Department of Emergency Medicine, William Beaumont Hospital, Troy, MI, USA. [16]Department of Emergency Medicine, Brigham and Women's Hospital, Boston, MA, USA. [17]Department of Emergency Medicine, University of Washington, Seattle, WA, USA. [18]Department of Emergency Medicine, Yale School of Medicine, New Haven, CT, USA. [19]Pediatrics and Emergency Medicine, University of South Florida Morsani College of Medicine, Tampa, FL, USA. [20]Department of Emergency Medicine, University of Cincinnati, Cincinnati, OH, USA. [21]Department of Emergency Medicine, Medical College of Wisconsin, Milwaukee, WI, USA. [22]Department of Emergency Medicine, Intermountain Health Park City Hospital, Park City, UT, USA. [23]Department of Emergency Medicine, University of Utah, Salt Lake City, UT, USA. [24]Department of Medical Oncology, Kaiser Permanente Northern California, San Francisco, CA, USA.

Received: 16 October 2024 Accepted: 7 February 2025
Published online: 05 March 2025

References

1. Al Nuhait M, Bajnaid E, Al Otaibi A, Al Shammari A, Al AY. Real-world safety experience with immune checkpoint inhibitors in Saudi Arabia. Sci Prog. 2021;104(1):36850421997302. https://doi.org/10.1177/0036850421997302.
2. Isikber C, Gulen M, Satar S, Avci A, Acehan S, Isikber GG, Yesiloglu O. Evaluation of the frequency of patients with cancer presenting to an emergency department. Rev Assoc Med Bras (1992). 2020;66(10):1402–8. https://doi.org/10.1590/1806-9282.66.10.1402.
3. Panattoni L, Fedorenko C, Greenwood-Hickman MA, et al. Characterizing Potentially Preventable Cancer- and Chronic Disease-Related Emergency Department Use in the Year After Treatment Initiation: A Regional Study. J Oncol Pract. 2018;14(3):e176–85. https://doi.org/10.1200/jop.2017.028191.
4. Gould Rothberg B, Quest T, Yeung SC, et al. Oncologic emergencies and urgencies: A comprehensive review. CA: Cancer J Clin. 2022;72(6):570–93. https://doi.org/10.3322/caac.21727.
5. Sadik M, Ozlem K, Huseyin M, AliAyberk B, Ahmet S, Ozgur O. Attributes of cancer patients admitted to the emergency department in one year. World J Emerg Med. 2014;5(2):85–90. https://doi.org/10.5847/wjem.j.issn.1920-8642.2014.02.001.
6. Alishahi Tabriz A, Turner K, Hong YR, Gheytasvand S, Powers BD, Elston Lafata J. Trends and Characteristics of Potentially Preventable Emergency Department Visits Among Patients With Cancer in the US. JAMA Netw Open. 2023;6(1):e2250423. https://doi.org/10.1001/jamanetworkopen.2022.50423.
7. Rivera DR, Gallicchio L, Brown J, Liu B, Kyriacou DN, Shelburne N. Trends in Adult Cancer-Related Emergency Department Utilization: An Analysis of

Data From the Nationwide Emergency Department Sample. JAMA Oncol. 2017;3(10):e172450. https://doi.org/10.1001/jamaoncol.2017.2450.
8. 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. 2019;57(3):354–61. https://doi.org/10.1016/j.jemermed.2019.05.023.
9. Lash RS, Hong AS, Bell JF, Reed SC, Pettit N. Recognizing the emergency department's role in oncologic care: a review of the literature on unplanned acute care. Emerg Cancer Care. 2022;1(1):6. https://doi.org/10.1186/s44201-022-00007-4.
10. Chen H, Walabyeki J, Johnson M, Boland E, Seymour J, Macleod U. An integrated understanding of the complex drivers of emergency presentations and admissions in cancer patients: Qualitative modelling of secondary-care health professionals' experiences and views. PLoS ONE. 2019;14(5): e0216430. https://doi.org/10.1371/journal.pone.0216430.
11. Dumnui N, Nagaviroj K, Anothaisintawee T. A study of the factors associated with emergency department visits in advanced cancer patients receiving palliative care. BMC Palliative Care. 2022;21(1):197. https://doi.org/10.1186/s12904-022-01098-w.
12. Gallaway MS, Idaikkadar N, Tai E, et al. Emergency department visits among people with cancer: Frequency, symptoms, and characteristics. J Am Coll Emerg Physicians Open. 2021;2(3). https://doi.org/10.1002/emp2.12438.
13. Rico JF, Caterino JM, Stephens JA, et al. Variables associated with admission rates among cancer patients presenting to emergency departments: a CONCERN group study. Emerg Cancer Care. 2023;2(1):7. https://doi.org/10.1186/s44201-023-00022-z.
14. Mayer DK, Travers D, Wyss A, Leak A, Waller A. Why do patients with cancer visit emergency departments? Results of a 2008 population study in North Carolina. J Clin Oncol. 2011;29(19):2683–8. https://doi.org/10.1200/jco.2010.34.2816.
15. Vandyk AD, Harrison MB, Macartney G, Ross-White A, Stacey D. Emergency department visits for symptoms experienced by oncology patients: a systematic review. Support Care Cancer. 2012;20(8):1589–99. https://doi.org/10.1007/s00520-012-1459-y.
16. Schuur JD, Venkatesh AK. The growing role of emergency departments in hospital admissions. N Engl J Med. 2012;367(5):391–3. https://doi.org/10.1056/NEJMp1204431.
17. Fleshner L, Lagree A, Shiner A, et al. Drivers of Emergency Department Use Among Oncology Patients in the Era of Novel Cancer Therapeutics: A Systematic Review. Oncologist. 2023;28(12):1020–33. https://doi.org/10.1093/oncolo/oyad161.
18. McCaig L, Xu, J., & Niska, R. Estimates of Emergency Department Capacity: United States, 2007. Centers for Disease Control and Prevention. 2015. https://www.cdc.gov/nchs/data/hestat/ed_capacity/ed_capacity.htm.
19. Steptoe AP, Corel B, Sullivan AF, Camargo CA. Characterizing emergency departments to improve understanding of emergency care systems. Int J Emerg Med. 2011;4(1):42. https://doi.org/10.1186/1865-1380-4-42.
20. Wen LS, Xu J, Steptoe AP, Sullivan AF, Walline JH, Yu X, Camargo CA Jr. Emergency department characteristics and capabilities in Beijing. China J Emerg Med. 2013;44(6):1174-1179.e4. https://doi.org/10.1016/j.jemermed.2012.07.083.
21. Maldonado A, Patiño AM, Kearney AS, et al. Emergency Department Characteristics and Capabilities in Quito, Ecuador. Ann Glob Health. 2021;87(1):37. https://doi.org/10.5334/aogh.3129.
22. Jaklic B, Wen L, Sullivan A, Camargo C. A Profile of Emergency Departments in Slovenia. ISRN Emergency Medicine; 2012. https://doi.org/10.5402/2012/461274.
23. Naouri D, El Khoury C, Vincent-Cassy C, Vuagnat A, Schmidt J, Yordanov Y. The French Emergency National Survey: A description of emergency departments and patients in France. PLoS ONE. 2018;13(6): e0198474. https://doi.org/10.1371/journal.pone.0198474.
24. Wen LS, Oshiomogho JI, Eluwa GI, Steptoe AP, Sullivan AF, Camargo CA Jr. Characteristics and capabilities of emergency departments in Abuja. Nigeria Emerg Med J. 2012;29(10):798–801. https://doi.org/10.1136/emermed-2011-200695.
25. van der Meer DM, Weiland TJ, Philip J, et al. Presentation patterns and outcomes of patients with cancer accessing care in emergency departments in Victoria Australia. Support Care Cancer. 2016;24(3):1251–60. https://doi.org/10.1007/s00520-015-2921-4.
26. Hsu J, Donnelly JP, Moore JX, Meneses K, Williams G, Wang HE. National characteristics of Emergency Department visits by patients with cancer in the United States. Am J Emerg Med. 2018;36(11):2038–43. https://doi.org/10.1016/j.ajem.2018.03.025.
27. Min HS, Chang HJ, Sung HK. Emergency Department Utilization of Adult Cancer Patient in Korea: A Nationwide Population-Based Study, 2017–2019. Cancer Res Treat. 2022;54(3):680–9. https://doi.org/10.4143/crt.2021.699.
28. Page MJ, McKenzie JE, Bossuyt PM, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. Bmj. 2021;372:n71. https://doi.org/10.1136/bmj.n71.
29. Abelson JS, Yeo HL, Mao J, Milsom JW, Sedrakyan A. Long-term Postprocedural Outcomes of Palliative Emergency Stenting vs Stoma in Malignant Large-Bowel Obstruction. JAMA Surg. 2017;152(5):429–35. https://doi.org/10.1001/jamasurg.2016.5043.
30. Alsirafy SA, Raheem AA, Al-Zahrani AS, Mohammed AA, Sherisher MA, El-Kashif AT, Ghanem HM. Emergency Department Visits at the End of Life of Patients With Terminal Cancer: Pattern, Causes, and Avoidability. Am J Hosp Palliat Care. 2016;33(7):658–62. https://doi.org/10.1177/1049909115581819.
31. Azoulay É, Castro P, Maamar A, et al. Outcomes in patients treated with chimeric antigen receptor T-cell therapy who were admitted to intensive care (CARTTAS): an international, multicentre, observational cohort study. Lancet Haematol. 2021;8(5):e355–64. https://doi.org/10.1016/s2352-3026(21)00060-0.
32. Banala SR, Khattab OK, Page VD, Warneke CL, Todd KH, Yeung SJ. Intranasal fentanyl spray versus intravenous opioids for the treatment of severe pain in patients with cancer in the emergency department setting: A randomized controlled trial. PLoS ONE. 2020;15(7): e0235461. https://doi.org/10.1371/journal.pone.0235461.
33. Bosscher MR, Bastiaannet E, van Leeuwen BL, Hoekstra HJ. Factors Associated with Short-Term Mortality After Surgical Oncologic Emergencies. Ann Surg Oncol. 2016;23(6):1803–14. https://doi.org/10.1245/s10434-015-4939-8.
34. Bou Chebl R, Safa R, Sabra M, et al. Sepsis in patients with haematological versus solid cancer: a retrospective cohort study. BMJ Open. 2021;11(2):e038349. https://doi.org/10.1136/bmjopen-2020-038349.
35. Bow EJ, Rotstein C, Noskin GA, et al. A randomized, open-label, multicenter comparative study of the efficacy and safety of piperacillin-tazobactam and cefepime for the empirical treatment of febrile neutropenic episodes in patients with hematologic malignancies. Clin Infect Dis. 2006;43(4):447–59. https://doi.org/10.1086/505393.
36. Castillo RM, Sandefur BJ, Finch AS, Richter MD, Thanarajasingam U. Clinical Presentations and Outcomes of Patients Receiving Immune Checkpoint Inhibitors Presenting to the Emergency Department. Mayo Clin Proc Innov Qual Outcomes. 2021;5(6):1029–35. https://doi.org/10.1016/j.mayocpiqo.2021.09.007.
37. Cauley CE, Panizales MT, Reznor G, et al. Outcomes after emergency abdominal surgery in patients with advanced cancer: Opportunities to reduce complications and improve palliative care. J Trauma Acute Care Surg. 2015;79(3):399–406. https://doi.org/10.1097/ta.0000000000000764.
38. Chou KT, Chen CS, Su KC, et al. Hospital outcomes for patients with stage III and IV lung cancer admitted to the intensive care unit for sepsis-related acute respiratory failure. J Palliat Med. 2012;15(11):1234–9. https://doi.org/10.1089/jpm.2012.0084.
39. Cooksley T, Gupta A, Al-Sayed T, Lorigan P. Emergency presentations in patients treated with immune checkpoint inhibitors. Eur J Cancer. 2020;130:193–7. https://doi.org/10.1016/j.ejca.2020.02.025.
40. Coyne CJ, Reyes-Gibby CC, Durham DD, et al. Cancer pain management in the emergency department: a multicenter prospective observational trial of the Comprehensive Oncologic Emergencies Research Network (CONCERN). Support Care Cancer. 2021;29(8):4543–53. https://doi.org/10.1007/s00520-021-05987-3.
41. Delgado-Guay MO, Kim YJ, Shin SH, Chisholm G, Williams J, Allo J, Bruera E. Avoidable and unavoidable visits to the emergency department among patients with advanced cancer receiving outpatient palliative care. J Pain Symptom Manage. 2015;49(3):497–504. https://doi.org/10.1016/j.jpainsymman.2014.07.007.
42. De Silva N, Jackson J, Steer C. Infections, resistance patterns and antibiotic use in patients at a regional cancer centre. Intern Med J. 2018;48(3):323–9. https://doi.org/10.1111/imj.13646.

43. Frago R, Kreisler E, Biondo S, Salazar R, Dominguez J, Escalante E. Outcomes in the management of obstructive unresectable stage IV colorectal cancer. Eur J Surg Oncol. 2010;36(12):1187–94. https://doi.org/10.1016/j.ejso.2010.09.005.
44. Giustozzi M, Connors JM, Ruperez Blanco AB, et al. Clinical characteristics and outcomes of incidental venous thromboembolism in cancer patients: Insights from the Caravaggio study. J Thromb Haemost. 2021;19(11):2751–9. https://doi.org/10.1111/jth.15461.
45. Grewal K, Krzyzanowska MK, McLeod S, Borgundvaag B, Atzema CL. Outcomes after emergency department use in patients with cancer receiving chemotherapy in Ontario, Canada: a population-based cohort study. CMAJ Open. 2020;8(3):E496-e505. https://doi.org/10.9778/cmajo.20190198.
46. Gudiol C, Royo-Cebrecos C, Laporte J, et al. Clinical features, aetiology and outcome of bacteraemic pneumonia in neutropenic cancer patients. Respirology. 2016;21(8):1411–8. https://doi.org/10.1111/resp.12848.
47. Hsu HS, Wu TH, Lin CY, Lin CC, Chen TP, Lin WY. Enhanced home palliative care could reduce emergency department visits due to non-organic dyspnea among cancer patients: a retrospective cohort study. BMC Palliat Care. 2021;20(1):42. https://doi.org/10.1186/s12904-021-00713-6.
48. Kao YH, Liu YT, Koo M, Chiang JK. Factors associated with emergency services use in Taiwanese advanced cancer patients receiving palliative home care services during out-of-hours periods: a retrospective medical record study. BMC Palliat Care. 2018;17(1):46. https://doi.org/10.1186/s12904-018-0302-8.
49. Kerhuel L, Amorim S, Azoulay E, Thiéblemont C, Canet E. Clinical features of life-threatening complications following autologous stem cell transplantation in patients with lymphoma. Leuk Lymphoma. 2015;56(11):3090–5. https://doi.org/10.3109/10428194.2015.1034700.
50. Kim YJ, Kim MJ, Cho YJ, et al. Who should be admitted to the intensive care unit? The outcome of intensive care unit admission in stage IIIB-IV lung cancer patients. Med Oncol. 2014;31(3):847. https://doi.org/10.1007/s12032-014-0847-1.
51. Klamroth R, Sinn M, Pollich C, et al. Anticoagulation Practice in Patients with Cancer-Associated Thrombosis: Insights from GeCAT, a German Prospective Registry Study. Oncol Res Treat. 2022;45(4):178–85. https://doi.org/10.1159/000521698.
52. Lagman R, Rivera N, Walsh D, LeGrand S, Davis MP. Acute inpatient palliative medicine in a cancer center: clinical problems and medical interventions–a prospective study. Am J Hosp Palliat Care. 2007;24(1):20–8. https://doi.org/10.1177/1049909106295292.
53. Mercadante S, Villari P, Ferrera P, Mangione S, Casuccio A. The use of opioids for breakthrough pain in acute palliative care unit by using doses proportional to opioid basal regimen. Clin J Pain. 2010;26(4):306–9. https://doi.org/10.1097/AJP.0b013e3181c4458a.
54. Mercadante S, Adile C, Ferrera P, Casuccio A. Characteristics of advanced cancer patients who were readmitted to an acute palliative/supportive care unit. Support Care Cancer. 2017;25(6):1947–52. https://doi.org/10.1007/s00520-017-3604-0.
55. Miranda B, Vidal SA, Mello MJ, et al. Cancer patients, emergencies service and provision of palliative care. Rev Assoc Med Bras (1992). 2016;62(3):207–11. https://doi.org/10.1590/1806-9282.62.03.207.
56. Moghnieh R, Estaitieh N, Mugharbil A, et al. Third generation cephalosporin resistant Enterobacteriaceae and multidrug resistant gram-negative bacteria causing bacteremia in febrile neutropenia adult cancer patients in Lebanon, broad spectrum antibiotics use as a major risk factor, and correlation with poor prognosis. Front Cell Infect Microbiol. 2015;5:11. https://doi.org/10.3389/fcimb.2015.00011.
57. Numico G, Cristofano A, Mozzicafreddo A, et al. Hospital admission of cancer patients: avoidable practice or necessary care? PLoS ONE. 2015;10(3): e0120827. https://doi.org/10.1371/journal.pone.0120827.
58. Patel PM, Goodman LF, Knepel SA, et al. Evaluation of Emergency Department Management of Opioid-Tolerant Cancer Patients With Acute Pain. J Pain Symptom Manage. 2017;54(4):501–7. https://doi.org/10.1016/j.jpainsymman.2017.07.013.
59. Peyrony O, Fontaine JP, Trabattoni E, et al. Cancer Patients' Prehospital Emergency Care: Post Hoc Analysis from the French Prospective Multicenter Study EPICANCER. J Clin Med. 2021;10(5)https://doi.org/10.3390/jcm10051145.
60. Poutsiaka DD, Skiffington S, Miller KB, Hadley S, Snydman DR. Daptomycin in the treatment of vancomycin-resistant Enterococcus faecium bacteremia in neutropenic patients. J Infect. 2007;54(6):567–71. https://doi.org/10.1016/j.jinf.2006.11.007.
61. Raghavendra M, Hoeg RT, Bottner WA, Agger WA. Management of neutropenic fever during a transition from traditional hematology/oncology service to hospitalist care. WMJ. 2014;113(2):53–8.
62. Rolston KV, Frisbee-Hume SE, Patel S, Manzullo EF, Benjamin RS. Oral moxifloxacin for outpatient treatment of low-risk, febrile neutropenic patients. Support Care Cancer. 2010;18(1):89–94. https://doi.org/10.1007/s00520-009-0634-2.
63. Ruiz-Artacho P, Trujillo-Santos J, López-Jiménez L, et al. Clinical Characteristics and Outcomes of Patients with Lung Cancer and Venous Thromboembolism. TH Open. 2018;2(2):e210–7. https://doi.org/10.1055/s-0038-1656542.
64. Sandgren A, Fridlund B, Nyberg P, Strang P, Petersson K, Thulesius H. Symptoms, care needs and diagnosis in palliative cancer patients in acute care hospitals: a 5-year follow-up survey. Acta Oncol. 2010;49(4):460–6. https://doi.org/10.3109/02841860903463991.
65. Skiba R, Sikotra N, Ball T, Arellano A, Gabbay E, Clay TD. Management of neutropenic fever in a private hospital oncology unit. Intern Med J. 2020;50(8):959–64. https://doi.org/10.1111/imj.14464.
66. Soares LG, Martins M, Uchoa R. Intravenous fentanyl for cancer pain: a "fast titration" protocol for the emergency room. J Pain Symptom Manage. 2003;26(3):876–81. https://doi.org/10.1016/s0885-3924(03)00314-2.
67. Sutradhar R, Barbera L, Seow HY. Palliative homecare is associated with reduced high- and low-acuity emergency department visits at the end of life: A population-based cohort study of cancer decedents. Palliat Med. 2017;31(5):448–55. https://doi.org/10.1177/0269216316663508.
68. Teimouri A, Minard LV, Scott SN, Daniels A, Snow S. Real-World Adherence to Toxicity Management Guidelines for Immune-Related Adverse Events. Curr Oncol. 2022;29(5):3104–17. https://doi.org/10.3390/curroncol29050252.
69. Verhoef MJ, de Nijs E, Horeweg N, et al. Palliative care needs of advanced cancer patients in the emergency department at the end of life: an observational cohort study. Support Care Cancer. 2020;28(3):1097–107. https://doi.org/10.1007/s00520-019-04906-x.
70. Verhoef MJ, de Nijs EJM, Ootjers CS, et al. End-of-Life Trajectories of Patients With Hematological Malignancies and Patients With Advanced Solid Tumors Visiting the Emergency Department: The Need for a Proactive Integrated Care Approach. Am J Hosp Palliat Care. 2020;37(9):692–700. https://doi.org/10.1177/1049909119896533.
71. Waddle MR, Chen RC, Arastu NH, et al. Unanticipated hospital admissions during or soon after radiation therapy: Incidence and predictive factors. Pract Radiat Oncol. 2015;5(3):e245–53. https://doi.org/10.1016/j.prro.2014.08.004.
72. Won YH, Choi YJ, Ahn S, et al. Improving the quality of cancer pain management in an academic medical center emergency department. Clin J Oncol Nurs. 2014;18(6):626–9. https://doi.org/10.1188/14.Cjon.626-629.
73. Woon DTS, Finelli A, Cheung DC, et al. A Population-based Study Comparing Outcomes for Patients With Metastatic Castrate Resistant Prostate Cancer Treated by Urologists or Medical Oncologists With First Line Abiraterone Acetate or Enzalutamide. Urology. 2021;153:147–55. https://doi.org/10.1016/j.urology.2020.11.080.
74. Xia R, Wang D. Intensive care unit prognostic factors in critically ill patients with advanced solid tumors: a 3-year retrospective study. BMC Cancer. 2016;16:188. https://doi.org/10.1186/s12885-016-2242-0.
75. Yaman S, Başcı S, Turan G, et al. Single-Dose Rasburicase Might Be Adequate To Overcome Tumor Lysis Syndrome In Hematological Malignancies. Clin Lymphoma Myeloma Leuk. 2022;22(2):e71–6. https://doi.org/10.1016/j.clml.2021.08.009.
76. Yildirim B, Tanriverdi O. Evaluation of cancer patients admitted to the emergency department within one month before death in Turkey: what are the problems needing attention? Asian Pac J Cancer Prev. 2014;15(1):349–53. https://doi.org/10.7314/apjcp.2014.15.1.349.
77. Yilmaz SYE, Yuksel M, et al. Nonopioid therapy for cancer related dyspnea palliation in the ED: A randomized double blind clinical trial. Acta Medica Mediterranea. 2017;6:1099–106.

78. Shen J, Xing Q, Xu Q, Qian J. Cancer patients in the emergency department or intensive care unit: a 20-year bibliometric analysis of research progress and prospects. Emerg Cancer Care. 2023;2(1):5.
79. Liebregts T, Lueck C, Mohring A, Rißе J, Tzalavras A. Cancer patients in the emergency department. Med Klin Intensivmed Notfmed. 2024;119(1):3–9. https://doi.org/10.1007/s00063-023-01055-2. Krebspatienten in der Notaufnahme.

Publisher's Note