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National Characteristics of Emergency Department Visits by Patients with Cancer in the United States

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Abstract

PURPOSE: The Emergency Department (ED) is an important venue for the care of patients with cancer. We sought to describe the national characteristics of ED visits by patients with cancer in the United States.

METHODS: We performed an analysis of 2012–2014 ED visit data from the National Hospital Ambulatory Medical Care Survey (NHAMCS). We included adult (age ≥ 18 years) ED patients, stratified by history of cancer. Using the NHAMCS survey design and weighting variables, we estimated the annual number of adult ED visits by patients with cancer. We compared demographics, clinical characteristics, ED resource utilization, and disposition of cancer vs. non-cancer patients.

RESULTS: There were an estimated 104,836,398 annual ED visits. Patients with cancer accounted for an estimated 3,879,665 (95% CI: 3,416,435 – 4,342,895) annual ED visits. Compared with other ED patients, those with cancer were older (mean 64.8 vs. 45.4 years), more likely to arrive by Emergency Medical Services (28.0 vs. 16.9%), and experienced longer lengths

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AUTHOR CONTRIBUTIONS:

JH, JXM and HEW conceived the study. JH, JXM, JPD and HEW obtained the data set and conducted the analysis. JH and HEW drafted the manuscript, and all authors contributed to its critical review. HEW assumes overall responsibility for the paper.

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CONFLICTS OF INTEREST

The authors do not report any related conflicts of interest.

of ED stay (mean 4.9 vs. 3.8 hours). Over 65% of ED patients with cancer underwent radiologic imaging. Patients with cancer almost twice as likely to undergo CT scanning; four times more likely to present with sepsis; twice as likely to present with thrombosis, and three times more likely to be admitted to the hospital than non-cancer patients.

CONCLUSIONS: Patients with cancer comprise nearly 4 million ED visits annually. The findings highlight the important role of the ED in cancer care and need for addressing acute care conditions in patients with cancer.

Keywords

Cancer; emergency department

INTRODUCTION

Cancer is the second leading cause of death after heart disease in the United States.¹ In 2017, there will be an estimated 1,688,780 new cases of cancer in the United States (US), with an estimated 600,920 deaths due to cancer.¹ It is projected that by year 2020 the national cost of cancer care will be \$173 billion.² In addition, the overall incidence rate of new cancer cases is also expected to increase between 2010 and 2030.³

The Emergency Department (ED) is an important venue for the care of patients with cancer. Patients with cancer often develop conditions requiring emergency care such as fever, infection, dehydration, intractable nausea and vomiting, weakness, dyspnea and systemic reactions to therapeutic agents.⁴⁻⁷ Cancer is also often identified during the ED care of other acute conditions.⁸⁻¹⁰ Despite its importance in cancer care, there are currently few reports of ED utilization by patients with cancer in the United States (US).¹¹ Prior studies have been limited to smaller population samples, single EDs, or EDs outside the US.¹²⁻¹⁴ An improved understanding of the characteristics of patients with cancer presenting to US EDs could enhance the care provided to and outcomes of this important population.

We sought to determine the national characteristics, processes of care, and outcomes of patients with cancer presenting to the ED in the US.

METHODS

Study Design

We used data from the National Hospital Ambulatory Medical Care Survey (NHAMCS).¹⁵ This study was exempted from review requirements by the Institutional Review Board of the University of Alabama at Birmingham due to the de-identified, publicly-available nature of the data set.

Data Source

Managed by the National Center for Health Statistics (NCHS), NHAMCS is a national probability sample of outpatient and ED hospital visits across the US.¹⁵ The survey uses a four-stage probability design to sample geographical areas, hospitals within these areas, emergency service areas within the EDs of these hospitals, and patient visits to these

emergency service areas. NHAMCS examines ED visits to selected facilities for a defined four-week period to identify clinical data from all identified records. The clinical information collected varies by survey year but generally includes patient demographics, vital signs, ED tests and treatments, and ED disposition and outcome. Surveys from 2012 and 2013 included up to three primary diagnoses, and surveys from 2014 included up to five diagnoses.

For this study, we used the 2012–2014 NHAMCS public-use data set, which encompassed a period with uniform reporting of cancer status, medications given in the ED, and selected patient demographics needed for the planned analysis.

Selection of Subjects

We included ED visits by adults over 18 years old. We stratified the analysis by patient cancer status, identified using the NHAMCS variable “cancer status.” NHAMCS defined cancer status as any type of cancer, including carcinoma, sarcoma, leukemia, and lymphoma. The NHAMCS definition excluded a history of cancer in remission or that had been cured.

ED Visit Characteristics

We examined demographic characteristics including patient age, sex, race, and ethnicity. Clinical characteristics included mode of arrival, triage vital signs, length of visit, fever, and mean pain scale. Following prior convention, we defined fever as a temperature of $\geq 100.4^{\circ}\text{F}$ or $\geq 96.8^{\circ}\text{F}$.¹⁶ We identified diagnostic imaging performed in the ED, including computed tomography, magnetic resonance imaging, ultrasound, and X-ray imaging. We classified ED medications using drug class identification codes specified by the NCHS (Lexicon Plus, Cerner Multum, Inc., Kansas City, MO, USA).

For the ED visit diagnoses, data abstractors identified the three (year 2012 and 2013) or five (year 2014) most prominent documented diagnoses for each ED visit. We grouped primary ED diagnoses by major International Classification of Diseases, ninth edition (ICD-9) categories. In addition, because of their relevance to cancer, we identified primary ED diagnoses for respiratory, abdominal/pelvic and digestive symptoms, signs and conditions, as well as thrombosis and sepsis. We identified thrombotic events through the ICD-9 codes 415.0–415.19, 451.0–451.9, 453.2, 453.4–453.42, 453.8–453.89, 453.9 and 996.74. We defined sepsis using the method of Wang, et al., identifying patients with the concurrent presence of a serious infection (triage fever or ICD-9 code for serious infection [Appendix 1]) and organ dysfunction (triage systolic blood pressure ≤ 90 mmHg, ED endotracheal intubation, or ICD-9 diagnosis for organ dysfunction [Appendix 2]).¹⁶ We also identified select NHAMCS reasons for ED visits, focusing on complaints relevant to cancer, including abdominal pain, nausea/vomiting, chest pain, and shortness of breath.

ED disposition categories included discharge home, admission to hospital, transfer to another hospital, and other/unknown (e.g., not reported, died in ED, or left against medical advice). Admission destinations included non-ICU, ICU, and other/unknown.

Data Analysis

We determined the annual number of ED visits for individuals with cancer. We compared demographic, clinical and disposition characteristics between patients with and without cancer. We annualized all frequency estimates. We used the NHAMCS sampling design and weight variables to provide nationally-weighted estimates with 95% confidence intervals (CIs). We performed Rao-Scott corrected chi-square tests of association and adjusted Wald F-tests of equal means to compare categorical and continuous variables, respectively.¹⁷ For all analyses, we used ultimate cluster design variables (“masked” stratum and primary sampling unit identifiers from the NHAMCS data set) with single stage sampling in standard error calculations; prior studies have demonstrated that these estimation methods are conservative. Results based upon less than 30 raw observations or standard error values greater than 30% relative to the estimate are considered unreliable by the NCHS, so we noted table cells not fulfilling this threshold. All analyses were performed using Stata 14.1 (StataCorp LLC, College Station, TX, USA).

RESULTS

In 2012–2014, there were 314,509,185 total adult ED visits in the US, corresponding to approximately 104,836,398 annual ED visits. Patients with cancer comprised approximately 3,879,665 (95% CI: 3,416,435–4,342,895) (3.7%) of these ED visits. ED visits for cancer did not vary by census region; Northeast 17.1%, Midwest 24.0%, South 37.1%, West 21.5%, $p=0.23$.

ED patients with cancer were older than patients without cancer (mean 64.8 vs. 45.4 years). ED patients with cancer were more likely to be white and non-Hispanic. (Table 1) Patients with cancer were more likely to arrive to the ED by EMS (28.0 vs 16.9%; $p<0.001$). Patients with cancer presented with higher triage pulse and respiratory rate and lower systolic blood pressure than patients without cancer. Patients with cancer were more likely to present to the ED with a fever. Pain scales were lower for patients with cancer. Patients with cancer also experienced longer lengths of ED stay (mean 4.9 vs. 3.8 hours).

Over 65% of ED patients with cancer underwent radiologic imaging. Patients with cancer were more likely to undergo head, chest and abdomen CT scans (27.7 vs 17.7%; $p<0.001$) and X-rays (47.8 vs 34.1%; $p<0.001$). (Table 2) The most common medications administered for ED patients with cancer included CNS agents, respiratory agents, nutritional products, and gastrointestinal (GI) agents. (Table 3) ED patients with cancer were more likely to be receive anti-infective agents, cardiovascular agents, CNS agents, coagulation modifiers, GI agents, nutritional products, respiratory agents, and metabolic agents. Among CNS agents, the most common medications were analgesics and antiemetics. Bronchodilators and antihistamines were the most common respiratory agents.

Patients with cancer exhibited a range of primary ED diagnoses. (Table 4) Common oncology-related reasons for ED visit were abdominal pain, nausea and vomiting, chest pain, and shortness of breath. Compared with non-cancer patients, patients with cancer were four times more likely to present with sepsis (2.1% vs 0.5%; $p<0.001$) and twice as likely to present with a thrombotic event (0.8% vs. 0.4%; $p=0.02$). ED patients with cancer were

more than two times more likely to be admitted to the hospital than non-cancer patients (28.8 vs. 10.7%; p -value<0.001). (Table 5) Among admitted patients, rates of intensive care unit admission were similar between patients with and without cancer (14.2 vs 12.6%; p -value=0.41).

DISCUSSION

Cancer is one of the most prominent healthcare conditions in the US. The ED is a recognized arena for cancer diagnosis and care. Our results affirm the enormous national burden of patients with cancer upon US EDs. Patients with cancer comprised almost 4 million ED visits annually, presented with higher acuity than other patients, were large users of ED resources, and experienced longer ED length of stay. Almost 30% of ED patients with cancer were admitted to the hospital.

Prior studies of ED use by patients with cancer have notable limitations. Yucel, et al. and Sadil, et al. characterized ED visits by patients with cancer in Turkey, but these series were relatively limited (n =336 and 408) and may not apply to the US setting.^{12, 13} Vandyk et. al. performed a meta-analysis of ED visits related to cancer treatment or cancer-related symptoms but focused on symptoms reported by patients.¹⁸ Mayer, et al. described 37,760 ED visits by patients with cancer in North Carolina.¹⁴ Our study has notable strengths over these prior studies, using the most currently available data to providing one of the first nationally representative descriptions of ED visits by patients with cancer in the US. We were also able to illuminate processes of ED care and ED outcomes among these individuals.

Rivera et al. estimated US ED visits of cancer diagnosed patients and presented clinical utilization patterns between 2006 and 2012 from the Nationwide Emergency Department Sample.¹⁹ There are important but complementary distinctions between the Rivera study and our current work. Rivera, et al. estimated 2.5 million annual ED visits by cancer patients, while we estimated 3.9 million annual ED visits. Rivera, et al. were able to discern cancer types, finding that breast, prostate and lung cancer were the most commonly diagnosed cancers with ED visits. The most common reasons for ED visits in the Rivera study were pneumonia (4.5%), nonspecific chest pain (3.7%), and urinary tract infection (3.2%), while in our study abdominal pain, nausea and vomiting, chest pain, and shortness of breath were common conditions. While Rivera, et al. observed higher admission rates than in our study (59.7% vs 28.8%), they could not ascertain intensive care unit admission rates, which we found to be similar between cancer and non-cancer patients. Finally, we were able to provide additional key information about cancer patient ED visits not available in the National Emergency Department Sample, including physiologic findings (vital signs), use of radiological tests, and administered medications.

Emergency medicine textbooks highlight important principles in the ED evaluation and care of patients with cancer.²⁰ Our observations largely affirm these beliefs and practices. For example, patients with cancer are thought to be more susceptible to infections and thrombotic event; we found that patients with cancer were almost four times more likely to present with sepsis and almost twice as likely to present with a thrombotic event.^{21–24}

Nausea, vomiting and dehydration are common side-effects of chemotherapy; our results affirm the frequent ED use of intravenous fluids and antiemetics among patients with cancer.²⁵ We observed an approximately 30% hospital admission rate among ED patients with cancer, which is lower than in prior studies.^{14, 18} Mayer et. al. reported a 63.2% admission rate for patients with cancer but included cases based upon cancer-related ICD-9 codes, which may have selected a higher-acuity population.¹⁴

A tempting question is whether there may be opportunities for mitigating ED visits by patients with cancer. The Centers for Medicare and Medicaid Services (CMS) novel Oncology Care Model advocates the delivery of higher quality, more highly coordinated oncology care at the same or lower cost to Medicare.²⁶ In addition, the National Cancer Institute has advocated scientific efforts to better understand the utilization of the ED for cancer care, application of clinical strategies to improve the outcomes of patients utilizing the ED, and efforts to reduce ED use by patients with cancer.²⁷ However, we underscore that while our paper illuminates the national epidemiology of ED use by patients with cancer, our results cannot be used to estimate the number of avoidable ED visits in this population. For example, while cancer-related pain and vomiting are often perceived as symptoms that may be ameliorated in the outpatient setting, the severity of these cases vary widely, with many cases meriting treatment in the emergency setting. Other conditions such as sepsis and thromboembolic disease clearly merit evaluation and treatment in the ED, regardless of perceived severity.

The large presence of patients with cancer in the ED may indicate an opportunity for better integrating the ED into the continuum of cancer care. Emergency physicians are accustomed to rapid patient evaluation and risk stratification, provision of appropriate initial treatment (including critical care), and the identification of the most appropriate care destination. The ED plays a pivotal role in the care of a range of acute conditions such as myocardial infarction, stroke, sepsis and trauma. These principles can potentially apply to the care of patients with cancer. While additional granular data may identify subsets of patients with cancer that could receive emergency care in alternate settings, the opportunity and potential system gains could be limited. Larger advances may result from organized systemic efforts to better integrate the ED into spectrum of cancer care. Examples of integrating strategies include providing education on the contemporary issues in oncologic emergencies, definition of diagnostic and treatment protocols for patients with cancer presenting to the ED, and aligned decision making with oncology teams when determining admission vs. discharge. Furthermore, risk stratification tools used by the ED (for example, the Pneumonia Severity Index, or the Pulmonary Embolism Rule-Out Criteria score) must be updated to account for the presence of cancer, which may alter the predictive of these decision rules.^{28, 29}

LIMITATIONS

The most important limitation of these data is the inability to differentiate the types or stages of cancer exhibited by each patient. The NHAMCS cancer definition was designed to identify individuals undergoing treatment for active cancer, but the reliability of chart abstraction for this measure has not been tested. We did not use hospital or ED diagnoses to identify cancer status. We also could not link to cancer treatment regimens. While we

identified the high use of ED diagnostic and therapeutic resources, we could not evaluate the utility or appropriateness of these measures. We also could not link to long-term outcomes. Prospective studies are needed to answer these and other important questions regarding the ED care of patients with cancer. Nonetheless, our study represents one of the first national perspectives of ED use by cancer patients in the US.

NHAMCS uses a retrospective, probability-sampled design and coding may be inconsistent or incomplete. Abstractors also may not have been consistent in the identification or coding of cancer in the medical record. We were also unable to determine whether ED visits represented re-visits by the same person. Laboratory values were not available. Only triage vital signs were available – repeat physiologic measures were not available. Data on certain processes of ED care such as volume of fluid resuscitation were not available. We did not have data on hospital inpatient course.

CONCLUSIONS

Patients with cancer comprise a significant portion of US Emergency Department visits, with almost 4 million visits estimated each year. These observations underscore the importance of the ED in the care of patients with cancer.

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APPENDIX 1: International Classification of Diseases, ninth edition (ICD-9) codes associated with a serious infection.30–32

Infection Category	ICD-9 Code	ICD-9 Code Description
Parasitic	001	Cholera
	002	Typhoid/paratyphoid fever
	003	Other salmonella infection
	004	Shigellosis
	005	Other food poisoning
	008	Intestinal infections due to Escherichia coli
	008.1	Intestinal infections due to Arizona group of paracolon bacillus
	008.2	Intestinal infections due to Aerobacter aerogenes
	008.3	Intestinal infections due to Proteus (mirabilis morganii)
	008.4	Intestinal infections due to unspecified bacteria
	008.5	Bacterial enteritis, unspecified
	009	Ill-defined intestinal infection
	013	CNS tuberculosis
	018	Miliary tuberculosis
	020	Plague

Infection Category	ICD-9 Code	ICD-9 Code Description
	021	Tularemia
	022	Anthrax
	023	Brucellosis
	024	Glanders
	025	Melioidosis
	026	Rat-bite fever
	027	Other bacterial zoonoses
	032	Diphtheria
	033	Whooping cough
	034	Streptococcal throat/scarlet fever
	035	Erysipelas
	036	Meningococcal infection
	037	Tetanus
	038	Septicemia
	039	Actinomycotic infections
	040	Other bacterial diseases
	041	Bacterial infection in other diseases not specified
	098	Gonococcal infections
	100	Leptospirosis
	101	Vincent's angina
	112	Candidiasis, of mouth
	112.4	Candidiasis, of lung
	112.5	Candidiasis, disseminated
	112.8	Candidiasis, of other specified sites
	114	Coccidioidomycosis
	115	Histoplasmosis
	116	Blastomycotic infection
	117	Other mycoses
	118	Opportunistic mycoses
Nervous	320	Bacterial meningitis
	321	Cryptococcal meningitis
	321.1	Meningitis in other fungal diseases
	324	CNS abscess
	325	Phlebitis of intracranial sinus
	360	Purulent endophthalmitis
	376	Acute inflammation of orbit
	380.14	Malignant otitis externa
	383	Acute mastoiditis
Circulatory	420.99	Acute pericarditis due to other specified organisms
	421	Acute or subacute endocarditis
Respiratory	461	Acute sinusitis
	462	Acute pharyngitis

Infection Category	ICD-9 Code	ICD-9 Code Description
Digestive	463	Acute tonsillitis
	464	Acute laryngitis/tracheitis
	465	Acute upper respiratory infection of multiple sites/not otherwise specified
	475	Peritonsillar abscess
	481	Pneumococcal pneumonia
	482	Other bacterial pneumonia
	485	Bronchopneumonia with organism not otherwise specified
	486	Pneumonia, organism not otherwise specified
	491.21	Acute exacerbation of obstructive chronic bronchitis
	494	Bronchiectasis
	510	Empyema
	513	Abscess of lung and mediastinum
	522.5	Periapical abscess without sinus
	522.7	Periapical abscess with sinus
	526.4	Inflammatory conditions of the jaw
	527.3	Abscess of the salivary glands
	528.3	Cellulitis and abscess of oral soft tissue
	540	Acute appendicitis
	541	Appendicitis not otherwise specified
	542	Other appendicitis
	562.01	Diverticulitis of the small intestine without hemorrhage
	562.03	Diverticulitis of the small intestine with hemorrhage
	562.11	Diverticulitis of colon without hemorrhage
	562.13	Diverticulitis of colon with hemorrhage
	566	Abscess of the anal and rectal regions
	567	Peritonitis
	569.5	Intestinal abscess
	569.61	Infection of colostomy or enterostomy
	569.83	Perforation of intestine
Genitourinary	572	Abscess of liver
	572.1	Portal pyemia
	575	Acute cholecystitis
	590	Kidney infection
	599	Urinary tract infection not otherwise specified
	601	Prostatic inflammation
	604	Orchitis and epididymitis
	614	Female pelvic inflammation disease
	615	Uterine inflammatory disease
	616.3	Abscess of Bartholin's gland
Pregnancy	616.4	Other abscess of vulva
	634	Spontaneous abortion, complicated by genital tract and pelvic infection
	635	Legally induced abortion, complicated by genital tract and pelvic infection

Infection Category	ICD-9 Code	ICD-9 Code Description
Skin	636	Illegally induced abortion, complicated by genital tract and pelvic infection
	637	Unspecified abortion, complicated by genital tract and pelvic infection
	638	Failed attempted abortion, complicated by genital tract and pelvic infection
	639	Complications following abortion and ectopic and molar pregnancies
	646.6	Infections of genitourinary tract in pregnancy
	658.4	Infection of amniotic cavity
	670	Major puerperal infection
	675.1	Abscess of breast
	681	Cellulitis, finger/toe
	682	Other cellulitis or abscess
	683	Acute lymphadenitis
	685	Pilonidal cyst, with abscess
	686	Other local skin infection
Musculoskeletal	711	Pyogenic arthritis
	728.86	Necrotizing fasciitis
	730	Osteomyelitis
Other	790.7	Bacteremia
	958.3	Posttraumatic wound infection, not elsewhere classified
	996.6	Infection or inflammation of device/graft
	998.5	Postoperative infection
	999.3	Infectious complication of medical care not otherwise classified

APPENDIX 2: International Classification of Diseases, ninth edition (ICD-9) codes associated with organ dysfunction.30–32

Organ Dysfunction Category	ICD-9 Code	ICD-9 Code Description
Cardiovascular	458	Orthostatic hypotension
	458.8	Other specified hypotension
	458.9	Hypotension, unspecified
	785.5	Shock without mention of trauma appendix
Hematologic	286.6	Defibrination syndrome
	286.8	Other and unspecified coagulation defects
	287.4	Secondary thrombocytopenia
	287.5	Thrombocytopenia, unspecified
Hepatic	570	Acute and subacute necrosis of liver
	573.4	Hepatic infarction
Neurologic	293	Transient organic psychosis
	348.1	Anoxic brain damage
	348.3	Encephalopathy
Renal	584	Acute renal failure

Organ Dysfunction Category	ICD-9 Code	ICD-9 Code Description
Respiratory	518.8	Respiratory Failure
	786.03	Apnea
	799.1	Respiratory Arrest

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TABLE 1

Characteristics of Emergency Department visits among individuals with cancer, 2012–2014

Condition	Non-Cancer N=100,956,733 % (95% CI)	Cancer N= 3,879,665 % (95% CI)	p-value
Age			<0.001
18–24 years	15.8 (15.2, 16.5)	2.2 (1.1, 4.3)	
25–44	37.0 (36.3, 37.8)	9.6 (8.0, 11.6)	
45–64	28.3 (27.7, 28.8)	34.2 (31.4, 37.1)	
65–74	8.4 (8.0, 8.8)	22.7 (21.1, 25.5)	
>75	10.5 (9.8, 11.2)	31.3 (28.5, 34.3)	
Sex			0.20
Female	57.5 (56.7, 58.3)	55.1 (51.6, 58.5)	
Male	42.5 (41.7, 43.5)	45.0 (41.5, 48, 4)	
Race			<0.001
White	72.6 (69.9, 75.1)	81.8 (78.8, 84.5)	
Black	24.1 (21.7, 26.7)	14.9 (12.2, 17.8)	
Other	3.3 (2.8, 4.0)	3.4 (2.1, 5.3)	
Ethnicity			<0.001
Hispanic	13.5 (12.0, 15.2)	8.6 (6.6, 11.2)	
Non-Hispanic	86.5 (84.8, 88.0)	91.4 (88.8, 93.4)	
Arrival by Emergency Medical Services			<0.001
Yes	16.9 (16.1, 17.9)	28.0 (25.2, 30.9)	
No	79.6 (78.5, 80.7)	69.4 (66.4, 72.1)	
Unknown	3.4 (2.8, 4.2)	2.7 (1.8, 4.1)	
Triage Pulse			0.01
0–40 beats/min	0.21 (0.2, 0.3)	0.1 (0.0, 0.6)	
41–80	37.7 (36.7, 38.8)	38.6 (35.4, 42.0)	
81–120	53.0 (51.8, 54.1)	53.0 (49.9, 56.2)	
>120	3.4 (3.0, 3.8)	4.5 (3.6, 5.7)	
Unknown	5.9 (4.6, 7.6)	3.9 (2.7, 5.5)	
Triage Respiratory Rate			<0.001
0–6 breaths/min	0.0 (0.0, 0.1)	0.1 (0.0, 0.7) *	
7–12	1.1 (0.9, 1.4)	1.2 (0.7, 2.0) *	
13–20	86.9 (85.9, 87.9)	83.1 (80.7, 85.3)	
21–30	7.4 (6.9, 7.9)	12.2 (10.3, 14.5)	
>30	0.9 (0.7, 1.1)	1.3 (0.8, 2.0)	
Unknown	3.6 (3.0, 4.4)	2.1 (1.5, 3.0)	
Triage Systolic Pressure			<0.001
0–100 mmHg	2.8 (2.6, 3.0)	6.2 (5.0, 7.6)	
101–120	20.4 (19.7, 21.1)	19.2 (16.8, 21.8)	
>120	73.3 (72.2, 74.2)	72.2 (69.5, 74.6)	
Unknown	3.6 (2.9, 4.3)	2.5 (1.6, 4.0)	

Condition	Non-Cancer N=100,956,733 % (95% CI)	Cancer N= 3,879,665 % (95% CI)	p-value
Fever (triage temperature 100.4 F or 96.8 F)	4.7 (4.1, 5.3)	7.5 (6.0, 9.4)	<0.001
Pain Scale (mean)	5.3 (5.2, 5.4)	4.4 (4.1, 4.6)	<0.001
Length of ED Visit			<0.001
0–2 hours	32.4 (30.7, 34.1)	18.3 (15.8, 20.9)	
2–4	34.2 (33.2, 35.2)	35.3 (32.8, 37.8)	
4–8	21.0 (19.7, 22.4)	31.2 (28.4, 34.2)	
>8	6.3 (5.6, 7.0)	9.6 (8.0, 11.6)	
Unknown	6.1 (4.6, 8.1)	5.6 (3.7, 8.5)	

* Estimate based on <30 raw observations, considered unreliable by the National Center for Health Statistics

Table 2

Radiologic imaging performed during Emergency Department visits among individuals with cancer, 2012–2014.

Imaging	Non-Cancer N=100,956,733 % (95% CI)	Cancer N= 3,879,665 % (95% CI)	p-value
Any Imaging	49.2 (47.8, 50.6)	65.3 (61.9, 68.6)	<0.001
CT Scan	17.7 (16.8, 18.8)	27.7 (24.7, 30.9)	<0.001
CT Abdomen	6.8 (6.3, 7.3)	9.8 (8.0, 12.0)	<0.001
CT Chest	2.1 (1.9, 2.4)	5.1 (3.8, 6.9)	<0.001
CT Head	8.2 (7.7, 8.8)	12.5 (10.5, 14.9)	<0.001
X-Ray	34.1 (32.9, 35.3)	47.8 (45.0, 50.6)	<0.001
MRI	0.8 (0.7, 1.0)	1.2 (0.7, 2.0)	0.13
Ultrasound	4.4 (4.0, 4.8)	2.6 (2.0, 3.5)	<0.001

CT = computed tomography; MRI = magnetic resonance imaging.

TABLE 3

Medications given in the Emergency Department for individuals with cancer, 2012–2014

Medication	Non-Cancer N=100,956,733 % (95% CI)	Cancer N= 3,879,665 % (95% CI)	p-value
Anti-Infective	12.4 (11.8, 13.0)	18.2 (79.9, 20.8)	<0.001
Cardiovascular Agents	8.5 (8.0, 9.1)	12.8 (10.9, 15.1)	<0.001
CNS Agents	44.0 (42.5, 45.6)	49.0 (45.8, 51.1)	<0.001
Any Analgesic	35.6 (34.3, 36.9)	39.4 (36.5, 42.2)	0.006
Narcotic Analgesics	22.0 (20.8, 23.2)	27.4 (24.6, 30.3)	<0.001
Anticonvulsants	5.2 (4.8, 5.6)	5.8 (4.8, 7.1)	0.27
Antiemetics	20.3 (19.2, 21.5)	25.1 (22.6, 27.7)	<0.001
Anxiolytics/Sedatives	7.8 (7.2, 8.3)	8.1 (6.8, 9.7)	0.67
Coagulation Modifiers	4.7 (4.2, 5.2)	8.2 (6.7, 9.9)	<0.001
Gastrointestinal Agents	7.6 (7.0, 8.2)	10.4 (8.9, 12.1)	<0.001
Hormones	4.2 (3.9, 4.5)	5.6 (4.0, 8.0)	0.10
Nutritional Products	17.7 (16.2, 19.2)	31.7 (28.3, 35.3)	<0.001
Respiratory Agents	22.7 (21.2, 24.2)	35.6 (32.3, 39.1)	<0.001
Bronchodilators	4.1 (3.9, 4.4)	7.9 (6.5, 9.6)	<0.001
Antihistamines	5.1 (4.6, 5.6)	5.1 (3.9, 6.5)	0.91
Topical Agents	3.6 (3.3, 4.1)	3.2 (2.2, 4.6)	0.46
Psychotherapeutic Agents	1.5 (1.3, 1.7)	1.9 (1.3, 2.8)	0.17
Immunological Agents	3.2 (2.9, 3.5)	2.5 (1.7, 3.5)	0.16
Radiologic Agents	1.6 (1.3, 2.0)	2.6 (1.8, 3.8)	0.01
Metabolic Agents	1.8 (1.6, 2.0)	4.4 (3.2, 5.9)	<0.001

CNS = Central nervous system

TABLE 4

Select reasons for visit and primary Emergency Department diagnoses among ED patients with cancer, 2012–2014.

Condition	Non-Cancer N=100,956,733 % (95% CI)	Cancer N= 3,879,665 % (95% CI)	p-value
Primary ED Diagnoses (ICD-9 codes)			<0.001
Symptoms, Signs, Ill-Defined Conditions (780–799.9)	24.3 (23.5, 25.01)	29.74 (27.2, 32.4)	
Injury, Poisoning (800.0–999.9)	19.6 (18.9, 20.3)	13.5 (11.6, 15.6)	
Musculoskeletal Diseases (710.0–739.9)	8.8 (8.3, 9.3)	6.7 (5.3, 8.5)	
Respiratory Diseases (460.0–519.9)	8.0 (7.5, 8.4)	9.1 (7.7, 10.8)	
Genitourinary Diseases (580.0–629.9)	6.1 (5.8, 6.4)	5.1 (4.1, 6.4)	
Digestive Diseases (520.0–579.9)	6.4 (6.1, 6.8)	8.1 (6.8, 9.67)	
Skin Diseases (680.0–709.9)	4.0 (3.7, 4.3)	3.6 (2.6, 5.0)	
Mental Disorders (290.0–319.9)	4.5 (4.1, 4.9)	1.7 (1.2, 2.3)	
Circulatory Diseases (390.0–459.9)	4.1 (3.8, 4.5)	7.0 (5.5, 9.0)	
Sensory Diseases (360.0–389.9)	1.9 (1.7, 2.0)	0.6 (0.4, 1.1) *	
Nervous System Diseases (320.0–359.9)	2.0 (1.8, 2.1)	1.4 (0.9, 2.2) *	
Infectious Diseases (001.0–139.9)	2.0 (1.8, 2.2)	1.6 (1.0, 2.4) *	
Other/Unknown	8.5 (8.0, 9.1)	11.8 (9.7, 14.2)	
Select Oncology-Related Primary ED Diagnoses ** (ICD-9 codes)			
Respiratory Symptoms, Signs or Conditions (786.0–786.9)	6.6 (6.2, 7.0)	8.2 (6.9, 9.8)	0.02
Abdominal/Pelvic Symptoms, Signs or Conditions (789.0–789.9)	6.2 (5.9, 6.5)	5.6 (4.3, 6.9)	0.30
Digestive Symptoms, Signs or Conditions (787.0–787.9)	1.9 (1.8, 2.1)	3.3 (2.5, 4.4)	<0.001
Sepsis (Appendices 1 and 2)	0.5 (0.5, 0.6)	2.1 (1.5, 3.0)	<0.001
Thrombotic events (415.0–415.19, 451.0–451.9, 453.2, 453.4–453.42, 453.8–453.89, 453.9, 996.74)	0.4 (0.3, 0.6)	0.8 (0.5, 1.4) *	0.02
Select Oncology-Related Reasons for ED Visit			
Abdominal pain	11.3 (10.8, 11.8)	12.4 (10.6, 14.5)	0.25
Nausea/Vomiting	8.6 (8.1, 9.1)	10.9 (9.3, 12.8)	0.003
Chest pain	7.9 (7.5, 8.3)	8.4 (7.0, 10.1)	0.45
Shortness of Breath	6.3 (5.8, 6.7)	13.6 (11.2, 16.4)	<0.001

* Estimate based on <30 raw observations, considered unreliable by the National Center for Health Statistics.

** Subsets of primary ED diagnoses.

TABLE 5

Disposition of Emergency Department patients with cancer, 2012–2014.

Disposition	Non-Cancer N=100,956,733	Cancer N= 3,879,665	p-value
Discharged from ED	80.7 (79.3, 82.0)	61.1 (56.8–65.2)	<0.001
Admitted to Hospital	10.7 (9.6, 11.9)	28.8 (24.9, 33.1)	
Transferred	2.6 (2.3, 3.0)	5.3 (4.0, 7.0)	
Other	6.0 (5.5, 6.6)	4.8 (3.7, 6.2)	
Intensive Care Unit Admission (among those admitted to hospital)	14.2 (12.4, 16.2)	12.6 (9.6, 16.4)	0.41