

Emergency department use by patients with cancer receiving chemotherapy in Ontario, Canada:
A population based cohort study

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Abstract:

Introduction: Patients with cancer frequently require emergency medical care during treatment. The objective of this study was to characterize emergency department (ED) visits made by cancer patients receiving chemotherapy and to describe associated outcomes.

Methods: This retrospective cohort study used population-based administrative data from Ontario, Canada. Patients 18 years and older with a cancer diagnosis who received chemotherapy in the 30 days prior to being seen in an ED between 2013 and 2017 were included. ED discharge diagnosis codes were categorized in order to identify the most frequent ED diagnoses. We examined the proportion of patients admitted to hospital, ED length-of-stay, and 30-day mortality. We used logistic regression to identify predictors of hospital admission.

Results: We identified 218,459 ED visits made by 87,555 patients. The median (interquartile range [IQR]) number of ED visits per patient was 2 (1, 3). Hematological, gastrointestinal, breast, and lung cancer were the most common malignancies represented. The most common ED diagnoses were infection/fever (57,036 [26.1%]) and gastrointestinal diagnoses (26,456 [12.1%]). Of all visits, 77,978 (35.7%) resulted in admission to hospital. Median (IQR) ED length of stay was 5.3 (2.3, 6.0) hours. Thirty-day mortality after an ED visit was 9.8%. There was an increased odds of admission among patients who previously received palliative consultation, patients with a bone/soft tissue or hematological malignancies, and those with infection, GI, pulmonary, cardiac, weakness or GU/nephrology diagnoses.

Interpretation: Patients with cancer frequently use the ED during chemotherapy. We found that one in four ED visits were due to infection/fever and approximately 35% of ED visits resulted in hospital admission. These results highlight opportunities to optimize care for certain patients being actively treated for cancer, particularly around infectious complaints.

Words: 280

Introduction:

It is estimated that half of all Canadians will develop cancer during their lifetime,¹ and cancer is the leading cause of death in Canada.² Although advances in treatments such as chemotherapy and radiation have improved survival among many patients with cancer, these treatments are not without significant adverse effects and toxicities.³ Given these issues, it is not surprising that patients undergoing active cancer treatment are frequent users of the emergency department (ED).⁴⁻⁶

A recent study from the United States (U.S.) using the Nationwide Emergency Department Sample estimated that patients with cancer account for approximately 4% of all ED visits in the U.S.⁷ Another U.S. report that examined health insurance claims found that patients with cancer who were undergoing systemic therapy were seen in the ED an average of twice per year.⁶ In Canada, the Cancer Quality Council of Ontario reported that over 40% of patients with colon or breast cancer who receive adjuvant chemotherapy are seen in the ED at least once within four weeks of chemotherapy.⁸ Approximately 20% of these patients are admitted to hospital from the ED visit. Six percent of these patients will be seen in the ED five or more times during active treatment.

Previous studies have shown that fever, gastrointestinal complaints and pain are common reasons patients with cancer are seen in the ED and/or admitted to hospital.⁹⁻¹¹ The objective of this study was to describe on a population-based level why adult patients with cancer receiving chemotherapy are seen in the ED in Ontario, Canada, and to describe the outcomes associated with these ED visits.

Methods:

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3 We conducted a retrospective cohort study of population-based health data from Ontario,
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5 Canada. This study received privacy approval from ICES and ethics approval from the Research
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7 Ethics Board at Sinai Health System.
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10 11 12 *Data Sources* 13

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15 Study patients and related information were obtained from province-wide health
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17 administrative databases held at ICES. See the *Appendix* for a description of the databases used
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19 for this study. These datasets were linked using encoded identifiers and analyzed at ICES.
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21 Ontario has universal health care coverage for medically-necessary care, therefore, these
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23 databases contain the large majority of healthcare utilization in the province.
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28 29 *Study Participants* 30

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32 Adult patients aged 18 years and older with a cancer diagnosis were identified from the
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34 Ontario Cancer Registry if they had a valid Ontario Health Insurance Plan (OHIP) health card
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36 number. We then identified patients who received chemotherapy from the Activity Level
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38 Reporting Database, New Drug Funding Database, and the Ontario Health Insurance Plan
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40 database in the 30 days prior to an ED visit between January 1, 2013 and June 30, 2017. All ED
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42 visits (whether cancer-related or not) within 30 days of chemotherapy were included. We
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44 identified ED visits from the Canadian Institute for Health Information's National Ambulatory
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46 Care Reporting System. See the *Appendix* for further description of codes used to identify
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48 patients receiving chemotherapy.
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52 We excluded visits in an Ontario ED that was not open 24 hours per day or visits to an
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54 urgent care centre (n=5,538), visits that resulted in the patient leaving the ED without being seen
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3 by a healthcare provider or leaving against medical advice (n=1,149), and visits with missing ED
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5 diagnoses (n=19). We also excluded ED visits where the main diagnosis for the ED visit was
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7 listed as radiation or chemotherapy (n=3,569).
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10 11 12 *Outcome Variables*

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15 The primary outcome of interest was the ED diagnosis. We classified the primary ED
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17 diagnoses into general categories based on the *International Classification of Diseases – 10th*
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19 *Edition* (ICD-10) codes. If the primary ED diagnosis was a broad ‘cancer’ diagnosis, the second
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21 and third ED diagnosis and chief complaint were assessed to ascertain the reason for the ED
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23 visit. If we were still unable to determine a main ED diagnosis by this method, the diagnosis was
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25 left as ‘cancer’. We identified over 30 categories of diagnoses. These categories included
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27 infection/fever (i.e., sepsis, pneumonia, urinary tract infections, cellulitis, fever, neutropenia,
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29 etc.); gastrointestinal diagnoses (i.e., varices, ulcers, GI bleed, obstruction, etc.), pain (abdominal
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31 pain, headache, any pain-related diagnosis); hematological diagnoses (i.e., anemias,
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33 thrombocytopenias, etc.); pulmonary diagnoses (i.e., dyspnea, pulmonary hypertension, COPD,
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35 pleural effusion, etc.); thrombosis; etc. See the *Appendix, Table 1* for categorization of ICD-10
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37 codes.
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43 Secondary outcomes included 1) proportion of ED visits resulting in admission to
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45 hospital; 2) median ED length-of-stay, defined as time from ED registration to the time the
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47 patient physically left the ED; 4) 30-day mortality after an ED visit; and 6) factors associated
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49 with hospital admission.
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52 53 54 *Covariates*

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3 To identify factors associated with hospital admission, the following covariates were
4 included in the multivariable model: demographics (age, sex, income quintile), cancer-related
5 variables (cancer type categorized based on ICD-O codes, radiation in the 90 days prior to ED
6 visit), receipt of palliative consultation prior to the ED visit, ED visit characteristics (ambulance
7 arrival, triage acuity [based on the Canadian Triage and Acuity Scale [CTAS]], time of ED visit
8 [day, evening or night], day of ED visit [weekday or weekend], ED diagnosis [ED visits without
9 any of the top 10 diagnoses was used as the reference category], and hospital type [small,
10 community, academic]). See the *Appendix* for further description and definitions of covariates.
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24 *Statistical Analysis*

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26 The total number of ED visits by unique patients during the study period was determined.
27 Descriptive statistics were used to characterize unique patients based on their first ED encounter.
28 Characteristics of all ED visits were then described using frequencies and percentages for
29 categorical data and medians and interquartile ranges (IQR) for non-normally distributed
30 continuous variables. ED visits resulting in admission versus discharge were then described,
31 removing patients who died in the ED. Proportional differences were estimated using chi-square
32 statistics with 95% confidence intervals (CIs).
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42 To examine the adjusted association of the above-listed covariates with admission to
43 hospital, we conducted a multivariable logistic regression model using generalized estimating
44 equations with an exchangeable correlation structure to account for clustering at the patient level
45 due to repeat visits. The correlation coefficient with the outcome was assessed to determine the
46 effect of clustering. The unadjusted and adjusted odds ratios (OR) with 95% CIs were calculated.
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54 All analyses were conducted using SAS 9.3 (SAS, North Carolina).
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Results:

There were 87,555 unique patients who made 218,459 ED visits within 30 days of receiving chemotherapy during the study period. See Figure 1 for a study flow diagram. Table 1 contains the baseline characteristics of the cohort. The median (IQR) age of patients was 66 (56, 74) years and the median (IQR) number of ED visits per patient was 2 (1, 3).

The most common ED diagnosis was infection/fever (57,036 [26.1%] ED visits). In the infectious/fever diagnostic category, the most common diagnoses included fever not yet diagnosed, neutropenia, lower respiratory tract infections, genitourinary infections and skin/soft tissue infections. The next most frequent ED diagnoses were gastrointestinal (26,456 [12.1%]), and pain-related diagnoses (22,135 [10.1%]). See Table 2 and Figure 2 for top 10 ED diagnoses.

Over half of ED visits occurred during daytime hours (8:00-16:59). Over 40% of ED visits had a specialty consultation in the ED (93,098, [42.6%]), and 77,978 (35.7%) ED visits resulted in hospital admission. The overall median (IQR) ED length of stay was 5.3 (3.0, 9.8) hours. For patients discharged from the ED, median (IQR) ED length of stay was 3.9 (2.3, 6.0) hours, compared to 11.3 (6.6, 21.0) hours for admitted patients. Thirty-day mortality after an ED visit was 9.8%.

ED visits by patients with hematological malignancies (47,207 visits) were the most common, followed by gastrointestinal cancers (45,626 visits), breast cancer (38,914 visits) and lung cancer (27,710 visits). Infection/fever was the most common ED diagnosis for all cancers. See Table 3 for the top three ED diagnoses for hematological, gastrointestinal, breast and lung cancers. Patients with bone/soft tissue cancer had the highest (41.1%) proportion of admissions; whereas patients with breast cancer had the lowest (27.4%) admission rate.

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3 Six-hundred and forty-eight (0.3%) patients died in the ED, leaving 217,811 ED visits for
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5 analysis of predictors of admission. Comparison of the characteristics of ED visits resulting in
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7 admission versus discharge for these patients are presented in Table 4. In the adjusted analysis,
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9 ED visits with a diagnosis of infection/fever, GI diagnoses, pulmonary diagnoses, cardiac
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11 diagnoses, weakness, or GU/nephrology diagnoses had an increased odds of hospital admission
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13 compared to those without one of the top 10 main diagnoses (Table 5). Conversely, those with a
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15 final diagnosis of pain or a device problem were significantly less likely to be admitted. ED
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17 visits made by patients over the age of 65, patients who had received radiation, and those who
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19 had received palliative care were more likely to be admitted ED visits at a community or
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21 academic hospital had an increased odds of admission compared to smaller hospital sites.
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24 Compared to patients with gastrointestinal cancer, patients with bone/soft tissue and
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26 hematological malignancies had an increased odds of admission, whereas those with
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28 gynecological, head and neck and breast cancer were less likely to be admitted to hospital.
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35 **Interpretation:**

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38 In this study, there were over 200,000 ED visits made in the province of Ontario by
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40 cancer patients receiving chemotherapy over 4.5 years. Over a third resulted in hospital
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42 admission. By comparison, in the general population the rate of hospital admission in Ontario in
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44 the 2017/2018 fiscal year was 12%.¹² The three-times higher rate of admission for patients with
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46 cancer in our study is consistent with previous literature that has shown that the proportion of ED
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48 visits resulting in hospital admission among patients with cancer is significantly higher than the
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50 general population.¹³ The rate of hospital admission found in our study was lower than studies
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52 from the U.S., which have reported 50% to 90% of ED visits among patients with active cancer
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3 result in hospital admission.^{7,14,15} Two of these U.S. studies examined ED visits that were
4 cancer-related⁷ or treatment-related,¹⁴ whereas we examined all-cause ED visits by cancer
5 patients. The different type of ED visits examined in the studies may account for some of the
6 disparity in the admission rates. This variability may also be related to different healthcare
7 systems between the two countries: higher rates of hospital admission have been shown for other
8 diseases in the U.S. versus comparable countries.¹⁶
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11 We found that one in four (26.1%) ED visits were due to infection or fever, and it
12 remained the most common ED diagnosis across all types of cancers. This finding is in keeping
13 with previous literature, which has shown that infection, fever, and febrile neutropenia are
14 among the most frequent reasons for ED use among cancer patients.^{7,9-11,14,17} We also found that
15 45.7% of ED visits related to infection or fever resulted in hospital admission, and
16 infection/fever had the highest odds of hospital admission, which is consistent with previous
17 studies.^{7,14} There is increasing interest in the area of potentially preventable ED visits among
18 patients with cancer,^{18,19} and the high number of ED visits for infection/fever highlights the need
19 for validated risk stratification tools for cancer patients to determine which febrile patients
20 require an ED visit. Future work should focus on determining which patients with fever can
21 safely avoid an ED visit (e.g., patients with non-systemic infections such as a cellulitis or otitis
22 media) and the best non-ED setting to be safely worked-up and treated.
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45 Gastrointestinal diagnoses and ED visits for pain were also common in the cohort, each
46 accounting for more than 10% of all ED visits. While over 40% of gastrointestinal diagnoses
47 resulted in hospital admission, only 20% of visits for pain resulted in admission to hospital. ED
48 visits with pain-related diagnoses had a lower odds of hospital admission compared to those
49 without any of the top 10 diagnoses. The low number of admissions for ED visits associated with
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3 pain is promising; health care practitioners are able to offer acceptable outpatient management
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5 for pain-related ED visits in order to avoid hospital admission. However, based on the high
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7 number of ED visits related to pain, it is important to understand why cancer patients with pain
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9 require the ED services in the first place. Increased access to palliative care for pain control and
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11 discussions surrounding pain control with the patient's primary care physician or specialist may
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13 reduce ED visits related to pain.
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17 We found that over half of ED visits occurred during daytime hours. During daytime
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19 hours, cancer centres are typically open and may be able to see patients on an urgent basis
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21 through an urgent care clinic. This would allow for continuity of care in a setting where the
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23 patient and their course of illness is known to providers. Furthermore, some patients may be
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25 better treated in an urgent care clinic setting, where they may avoid wait times and potential
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27 exposure to infectious pathogens commonly encountered in the ED. The number of ED visits
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29 during daytime hours highlights an important opportunity for future research to examine the
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31 availability and outcomes associated with urgent care clinic use by cancer patients.
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38 *Limitations*

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40 There are several limitations of this study. We examined a heterogeneous group of
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42 patients with various cancers who were receiving different treatment regimens. Future studies are
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44 needed to determine whether our findings are specific to certain treatment regimens.
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47 Additionally, this study used administrative data and there may be potential misclassification
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49 bias if there were coding errors for the variables used in this study, including the main diagnosis.
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51 However, many studies have previously used these databases and found good agreement
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3 between chart reviews and the databases for mandatory variables²¹ and the main ED diagnosis
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5 for various diseases.²²⁻²⁴
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8 In smaller communities, patients may receive scheduled treatment in the ED; therefore,
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10 the ED visit captured in this study may not have been an unexpected visit or a true emergency
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12 visit. We tried to mitigate this potential bias by excluding patients with the main diagnosis of
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14 chemotherapy or radiation therapy. Finally, we examined *all* ED visits within 30-days of
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16 chemotherapy. It was expected the majority of the included ED visits were related to cancer or
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18 treatment side effects, however, some of the ED visits captured in this study may not be due to
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20 the cancer or treatment itself. It is known that patients with cancer make far more ED visits than
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22 age-matched controls,¹³ therefore, it is expected that the majority of ED visits were related to
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24 cancer or treatment.
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31 **Conclusions:**

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33 Patients with cancer frequently use the ED while undergoing chemotherapy. We found
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35 that one in four ED visits were due to infection/fever and approximately 35% of ED visits
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37 resulted in hospital admission. The results of this study highlight opportunities for future
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39 research, including the identification of high-yield groups and diagnoses to target for future care
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41 interventions.
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Contributors:

All authors contributed to study conception and design, and the acquisition, analysis, or interpretation of data. Keerat Grewal and Clare Atzema drafted the manuscript. All authors contributed to editing and revising the manuscript. Keerat Grewal had full access to all the data in the study and performed the statistical analysis. Clare Atzema supervised the study. All authors gave final approval of the version to be published and agreed to be accountable for all aspects of the work.

Confidential

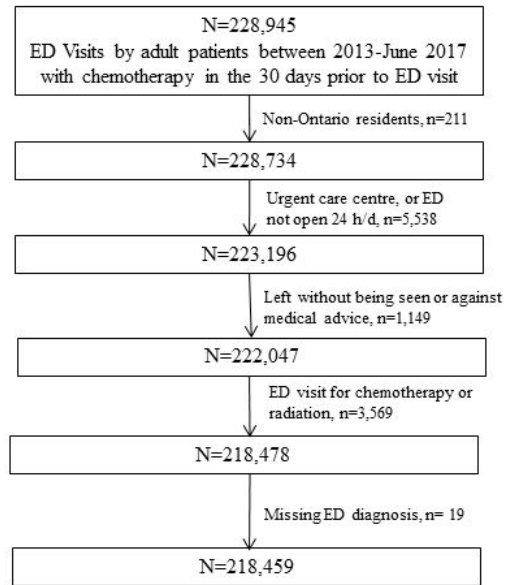
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Figure 1. Study flow diagram



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Figure 2: Top 10 emergency department diagnoses

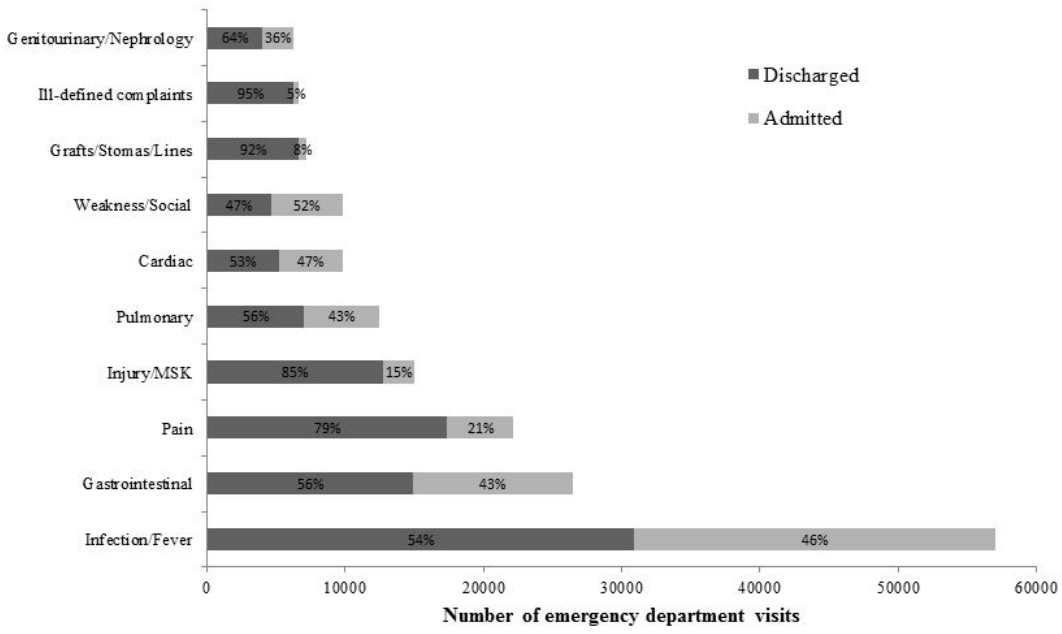


Table 1: Baseline characteristics of unique patients with cancer seen in the emergency department within 30 days of receiving chemotherapy

Characteristic	Total number of unique patients n = 87,555
Median (IQR) age	66 (56, 74)
Median (IQR) number of ED visits within 30 days of chemotherapy	2 (1, 3)
Sex, n (%)	
Female	48,172 (55.0)
Rural, n (%)	13,604 (15.5)
Income quintile, n (%)	
1 (highest)	15,674 (18.0)
2	17,145 (19.7)
3	17,543 (20.1)
4	18,701 (21.4)
5 (lowest)	18,200 (20.9)
Cancer type, n (%)	
Gastrointestinal	17,857 (20.4)
Breast	17,288 (19.8)
Hematological	16,834 (19.2)
Lung	11,732 (13.4)
Gynecological	5,322 (6.1)
Male genital	4,811 (5.5)
Head & neck	3,720 (4.3)
Genitourinary	3,241 (3.7)
Neurological	2,065 (2.4)
Melanoma	1,908 (2.2)
Bone/soft tissue	972 (1.1)
Endocrine	81 (0.1)
Other	1,706 (2.0)

IQR = interquartile range; ED = emergency department.

Table 2: Top 10 diagnoses for emergency department visits by patients with cancer seen within 30 days of receiving chemotherapy, N= 218,459 ED visits

ED diagnosis	Total number of ED visits N= 218,459	Hospital Admission n = 77,978 (35.7%)*	30 day mortality n=21,333 (9.8%)*
Infection/fever	57,036 (26.1)	26,060 (45.7)	3,900 (6.8)
Gastrointestinal	26,456 (12.1)	11,490 (43.4)	2,578 (9.7)
Pain	22,135 (10.1)	4,744 (21.4)	1,664 (7.5)
Injury/MSK†	14,971 (6.9)	2,220 (14.8)	639 (4.3)
Pulmonary	12,492 (5.7)	5,406 (43.3)	2,319 (18.6)
Cardiac	9,870 (4.5)	4,613 (46.7)	923 (9.3)
Weakness, social	9,814 (4.5)	5,131 (52.3)	2,377 (24.2)
Device/graft/stoma related	7,176 (3.3)	588 (31.7)	310 (4.3)
Ill-defined complaints	6,585 (3.0)	355 (5.4)	308 (4.7)
Genitourinary, nephrology	6,280 (2.9)	2,280 (36.3)	644 (10.3)

ED = emergency department; MSK = musculoskeletal

*Note: percentages in these columns reflect the percent of ED visits for that diagnosis resulting in hospital admission or 30-day mortality

†Includes: fractures, dislocations, injuries (e.g., trauma, lacerations), sprains, strains, etc.

Table 3: Top three emergency department diagnoses for the four most common cancers represented in the cohort

Diagnosis	Total number of ED visits	Admission to hospital*
Hematological cancer (n = 47,207 ED visits)		
Infection	15,460 (32.8)	8,101 (52.4)
Injury/MSK	3,940 (8.4)	612 (15.5)
Pain	3,901 (8.3)	735 (18.8)
Gastrointestinal cancer (n = 45,626 ED visits)		
Infection	10,618 (23.3)	4,577 (43.1)
Gastrointestinal	8,822 (19.3)	4,516 (51.2)
Pain	5,130 (11.2)	1,254 (24.4)
Breast cancer (n = 38,914 ED visits)		
Infection	11,158 (28.7)	3,931 (35.2)
Pain	4,564 (11.7)	741 (16.2)
Gastrointestinal	3,680 (9.5)	1,209 (32.9)
Lung cancer (n = 27,710 ED visits)		
Infection	6,551 (23.6)	3,357 (51.2)
Pulmonary	3,298 (11.9)	1,690 (51.2)
Gastrointestinal	2,697 (10.2)	951 (35.3)

ED = emergency department; MSK = musculoskeletal

*Note: percentages in this column reflect the percent of ED visits for that diagnosis resulting in hospital admission or 30-day mortality

Table 4: Characteristics of emergency department visits by patients with cancer within 30 days of chemotherapy by discharge versus admission to hospital (N=217,811 ED visits)

Variable	Total ED Visits n = 217,811	Discharged n = 139,833	Admitted n = 77,978	p-value	Difference (95% CI)
Demographics					
Age ≥65	116,871 (53.7)	72,501 (51.8)	44,370 (56.9)	<0.0001	5.1 (4.6-5.5)
Female Sex	117,894 (54.1)	78,071 (55.8)	39,823 (51.1)	<0.0001	4.8 (4.3-5.2)
Income quintile				0.44	
1 (highest)	40,935 (18.9)	26,343 (18.8)	14,592 (18.7)		0.1 (-0.2-0.5)
2	42,519 (19.5)	27,209 (19.5)	15,310 (19.6)		0.2 (-0.2-0.5)
3	43,469 (20.0)	27,883 (19.9)	15,586 (20.0)		0.1 (-0.3-0.4)
4	46,048 (21.1)	29,543 (21.1)	16,505 (21.2)		0 (-0.3-0.4)
5 (lowest)	44,019 (20.2)	28,303 (20.2)	15,716 (20.2)		0.1 (-0.3-0.4)
Missing	821 (0.4)	552 (0.4)	269 (0.3)		
Cancer Characteristics					
Palliative Care	110,061 (50.5)	64,368 (46.0)	45,693 (58.6)	<0.0001	12.6 (12.1-13.0)
Radiation 90 days prior to ED visit	31,041 (14.3)	18,375 (13.1)	12,666 (16.2)	<0.0001	3.1 (2.8-3.4)
Cancer type				<0.0001	
Hematological	47,086 (21.6)	29,254 (20.9)	17,832 (22.9)		2.0 (1.6-2.3)
Gastrointestinal	45,467 (20.9)	28,841 (20.6)	16,626 (21.3)		0.7 (0.3- 1.0)
Breast	38,867 (17.9)	28,210 (20.2)	10,657 (13.7)		6.5 (6.2-6.8)
Lung	27,558 (12.7)	16,202 (11.6)	11,356 (14.6)		3.0 (2.7-3.3)
Gynecological	13,806 (6.3)	8,961 (6.4)	4,845 (6.2)		0.2 (0-0.4)
Male genital	12,347 (5.7)	7,948 (5.7)	4,399 (5.6)		0 (-0.2-0.2)
Genitourinary	8,352 (3.8)	5,279 (3.8)	3,037 (3.9)		0.1 (0-0.3)
Head and neck	8,110 (3.7)	5,275 (3.8)	2,835 (3.6)		0.1 (0-0.3)
Neurological	4,826 (2.2)	2,866 (2.0)	1,960 (2.5)		0.5 (0.3-0.6)
Melanoma	4,496 (2.1)	2,821 (2.0)	1,675 (2.2)		0.1 (0.0-0.3)
Bone/soft tissue	2,636 (1.2)	1,550 (1.1)	1,086 (1.4)		0.3 (0.2-0.4)
Endocrine	216 (0.1)	133 (0.1)	83 (0.1)		0 (0-0)
Other	4,003 (1.8)	2,474 (1.8)	1,529 (2.0)		0.2 (0.1-0.3)
Missing	41 (0.02)	19 (0.0)	22 (0.0)		0.3
ED Visit Characteristics					
Ambulance arrival	54,077 (24.8)	21,649 (15.5)	32,428 (41.6)	<0.0001	26.1 (25.7-26.5)
CTAS Triage Acuity				<0.0001	
1-2 (highest acuity)	91,345 (41.9)	45,260 (32.4)	46,085 (59.1)		26.7 (26.3-27.2)
3	97,688 (44.9)	67,776 (48.5)	29,912 (38.4)		10.1 (9.7-10.5)
4-5 (lowest acuity)	28,341 (13.0)	26,444 (18.9)	1,897 (2.4)		16.5 (16.3-16.7)
Missing	437 (0.2)	353 (0.3)	84 (0.1)		
Shift				<0.0001	
Day (8:00-16:59)	124,709 (57.3)	82,721 (59.2)	41,988 (53.9)		5.3 (4.9-5.8)
Evening (17:00-	67,176 (30.8)	41,273 (29.5)	25,903 (33.2)		

23:59)					
Night (0:00-7:59)	25,926 (11.9)	15,839 (11.3)	10,087 (12.9)		1.6 (1.3-1.9)
Weekend	60,248 (27.7)	39,540 (28.3)	20,708 (26.6)	<0.0001	1.7 (1.3-2.1)
Hospital type				<0.0001	
Small	18,145 (8.3)	14,825 (10.6)	3,320 (4.3)		6.3 (6.1-6.6)
Community	136,384 (62.6)	90,163 (64.5)	46,221 (59.3)		5.2 (4.8-5.6)
Academic	63,240 (29.0)	34,829 (24.9)	28,411 (36.4)		11.5 (11.1-11.9)
Missing	42 (0.0)	16 (0.0)	26 (0.0)		
ED diagnosis				<0.0001	
None of top 10	45,233 (20.8)	30,142 (21.6)	15,091 (19.4)		2.2 (1.9-2.6)
Infection/fever	56,994 (26.2)	30,934 (22.1)	26,060 (33.4)		11.3 (10.9-11.7)
Gastrointestinal	26,432 (12.1)	14,942 (10.7)	11,490 (14.7)		4.0 (3.8-4.4)
Pain	22,123 (10.2)	17,379 (12.4)	4,744 (6.1)		6.3 (6.1-6.6)
Injury/MSK	14,964 (6.9)	12,744 (9.1)	2,220 (2.9)		6.3 (6.1-6.5)
Pulmonary	12,429 (5.7)	7,023 (5.0)	5,406 (6.9)		1.9 (1.7-2.1)
Cardiac	9,818 (4.5)	5,205 (3.7)	4,613 (5.9)		2.2 (2.0-2.4)
Weakness, social	9,783 (4.5)	4,652 (3.3)	5,131 (6.6)		3.3 (3.1-3.5)
Device/graft-related	7,175 (3.3)	6,587 (4.7)	588 (0.8)		4.0 (3.8-4.1)
Ill-defined	6,582 (3.0)	6,227 (4.5)	355 (0.5)		4.0 (3.9-4.1)
Genitourinary/ nephrology	6,278 (2.9)	3,998 (2.9)	2,280 (2.9)		0.1 (-0.1-0.2)

ED = emergency department; CTAS = Canadian Triage and Acuity Scale; MSK = musculoskeletal

Table 5: Unadjusted and adjusted odds of admission to hospital after ED visit (N = 217,811 ED visits) with generalized estimating equation accounting for patient-level clustering

Variable	Unadjusted OR	95 % CI	Adjusted OR	95% CI
Age				
< 65 years	REF		REF	
≥ 65 years	1.27	1.25-2.30	1.14	1.11-1.16
Sex				
Male	REF		REF	
Female	0.80	0.78-0.82	0.96	0.93-0.98
Income quintile				
1 (highest)	REF		REF	
2	1.03	1.00-1.07	1.01	0.98-1.05
3	1.04	1.01-1.07	0.99	0.96-1.03
4	1.02	0.99-1.05	0.99	0.95-1.02
5 (lowest)	1.01	0.98-1.04	0.95	0.92-0.99
Palliative Care	1.73	1.69-1.76	1.48	1.44-1.51
Radiation 90 days prior to ED visit	1.25	1.22-1.29	1.09	1.06-1.12
Cancer type				
Gastrointestinal	REF		REF	
Hematological	1.05	1.02-1.09	1.13	1.09-1.17
Breast	0.62	0.60-0.64	0.77	0.74-0.80
Lung	1.23	1.19-1.27	1.00	0.96-1.04
Gynecological	0.91	0.87-0.95	0.92	0.88-0.97
Male genital	0.96	0.91-1.01	0.95	0.90-1.00
Genitourinary	1.01	0.96-1.07	0.98	0.92-1.04
Head and neck	0.91	0.86-0.96	0.89	0.84-0.95
Neurological	1.15	1.08-1.23	0.94	0.87-1.02
Melanoma	1.0	0.93-1.07	0.96	0.88-1.03
Bone/soft tissue	1.22	1.11-1.33	1.13	1.02-1.24
Endocrine	0.97	0.72-1.30	0.90	0.67-1.22
Other	1.05	0.98-1.13	1.02	0.94-1.11
Ambulance arrival	3.74	3.66-3.82	3.50	3.42-3.59
CTAS Triage acuity				
3	REF		REF	
1-2 (highest acuity)	2.27	2.23-2.31	2.09	2.05-2.14
4-5 (lowest acuity)	0.19	0.18-0.20	0.29	0.28-0.31
Shift				
Day (8:00-16:59)	REF		REF	
Evening (17:00 – 23:59)	1.20	1.17-1.22	0.99	0.96-1.01
Night (0:00 – 7:59)	1.22	1.19-1.25	0.94	0.92-0.97

Weekend	0.91	0.90-0.93	0.90	0.88-0.92
Hospital type				
Small	REF		REF	
Community	2.10	2.01-2.20	1.12	1.06-1.17
Academic	3.36	3.21-3.52	1.80	1.71-1.89
ED Diagnosis				
None of top 10 diagnoses	REF		REF	
Infection	1.67	1.63-1.71	1.72	1.67-1.77
Gastrointestinal	1.49	1.44-1.54	1.56	1.50-1.61
Pain	0.56	0.54-0.58	0.48	0.46-0.50
Injury/MSK	0.36	0.35-0.38	0.39	0.37-0.41
Pulmonary	1.50	1.44-1.57	1.28	1.23-1.34
Cardiac	1.74	1.66-1.82	1.17	1.11-1.23
Weakness, social	2.10	2.01-2.19	1.52	1.45-1.60
Device/graft related	0.19	0.18-0.21	0.31	0.28-0.34
Ill-defined	0.16	0.15-0.18	0.32	0.29-0.35
Genitourinary/ Nephrology	1.15	1.08-1.22	1.22	1.14-1.29

ED = emergency department; OR = odds ratio; CI = confidence interval; CTAS = Canadian Triage and Acuity Scale; MSK = musculoskeletal; REF = reference category

Appendix

Methods. Additional information regarding data sources and covariates

Table 1: Categorization of ICD-10 codes

Table 2: ICD-O Codes to classify cancer type

Table 3: Palliative care codes and databases

Methods:

Data Sources

Patients with cancer were identified from the Ontario Cancer Registry (OCR). The OCR contains information on all diagnosed cases of cancer in Ontario (except basal and squamous cell skin cancers). Using methods previously described, data regarding chemotherapy were obtained from the Cancer Activity Level Reporting database (ALR), the New Drug Funding database, and claims for the supervision of chemotherapy in the Ontario Health Insurance Plan database (OHIP).^{1,2} Data regarding radiation were obtained from the ALR database.²

ED visits were identified from the Canadian Institutes of Health Information National Ambulatory Care Reporting System (CIHI-NACRS). NACRS is an administrative database that contains anonymized, abstracted data on all ED patient visits in the province of Ontario; it contains over 300 data points on every ED visit. Reporting to NACRS is mandatory in Ontario. Data in NACRS are reviewed and errors and/or missing data are identified, and returned to the submitting hospital as necessary for resubmission; therefore, missing data for mandatory variables in NACRS is very low.³

CIHI's Discharge Abstract Database (DAD) contains information on all acute care hospitalizations in the province. The Ontario Health Insurance Plan (OHIP) database contains all physician billings for medically-necessary care. The Registered Persons Database contains validated mortality information for all Ontario residents, including out-of-hospital deaths.⁴

Diagnoses

The primary ED diagnoses were categorized into general categories based on the *International Classification of Diseases – 10th Edition* (ICD-10) codes. See Table 1 for categorization of ICD-10 codes.

Covariates

Cancer type was categorized into broad categories based on ICD-O codes. See Table 2 for codes to classify cancer type. Receipt of palliative consultation was determined by an approach previously used at ICES which uses several databases to ascertain inpatient or outpatient palliative care treatment or consults. Patients were considered to have received palliative consultation if they had a palliative care code, end of life code, or hospice care code in any one of eight databases in the two years prior to the ED visit. See Table 3 for the databases and codes used to identify patients who received palliative consultation.

The triage score of patients was based on the Canadian Triage and Acuity Scale (CTAS). EDs across Canada use the CTAS score to triage patients based on medical acuity. A triage nurse assigns a CTAS score to each patient on arrival to the ED. The score ranges from the 1 (resuscitation) to 5 (non-urgent), and has been validated and found to be reliable.⁵

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Table 1: Categorization of ICD-10 codes

Category	ICD-10 codes
Arrest	I460, I461, I469, R092, R961, R98, R99
Breast	N645, N648, N649, S200, S201, S2100, S2101
Cancer	C00, D0007, D001, D01, D011, D015, D022, D035, D036, D039, D059, D0590, D0591, D0599, D060, D075, D091, D099, Z031, Z080, Z081, Z082, Z087, Z088, Z089, Z090, Z091, Z092, Z113, Z114, D131, D151, D163, D166, D169, D172, D175, D179, D1808, D1809, D181, D234, D24, D252, D259, D27, D287, D291, D320, D329, D332, D352, D367, D3708, D371, D372, D373, D374, D375, D376, D377, D379, D380, D381, D383, D385, D391, D392, D397, D400, D401, D410, D414, D430, D431, D432, D434, D439, D443, D479, D480, D481, D482, D484, D485, D486, D487, D489, N608, N609, N62, N63, N644
Cardiac	E877, I100, I101, I11, I13, I059, I200, I201, I2080, I2088, I209, I210, I211, I212, I213, I214, I219, I229, I236, I2388, I240, I248, I249, I2510, I2519, I253, I255, I259, I308, I309, I311, I313, I319, I330, I340, I350, I351, I358, I420, I421, I427, I428, I429, I440, I441, I442, I443, I447, I451, I453, I455, I459, I470, I471, I472, I479, I4800, I4801, I4802, I483, I484, I4890, I4891, I4900, I491, I492, I493, I494, I495, I498, I499, I500, I501, I509, I510, I514, I515, I516, I517, I518, I519, J81, R000, R001, R002, R008, R030, R098, R55, R570, R931, R9430, R9431, R9438, Z031, Z035, Z136
Chemotherapy/ radiation	Z292, Z510, Z511, Z512
Dental	K028, K029, K036, K040, K045, K047, K049, K050, K051, K052, K053, K056, K068, K069, K072, K0761, K0762, K0763, K0764, K0768, K0769, K079, K0887, K0888, K102, K103, K108, K109
Dermatological	B081, B082, L109, L139, L208, L209, L219, L22, L231, L233, L235, L237, L238, L239, L245, L248, L249, L250, L251, L253, L255, L258, L259, L26, L270, L271, L278, L279, L280, L282, L293, L298, L299, L301, L302, L304, L308, L309, L401, L405, L408, L409, L42, L500, L501, L508, L509, L511, L512, L519, L52, L530, L538, L539, L551, L552, L558, L559, L561, L568, L569, L570, L579, L580, L589, L590, L598, L599, L600, L601, L602, L608, L609, L700, L708, L709, L718, L719, L720, L721, L728, L729, L731, L732, L738, L739, L740, L80, L814, L819, L82, L84, L853, L858, L859, L88, L89, L890, L891, L892, L893, L898, L899, L900, L905, L906, L918, L922, L929, L930, L931, L949, L959, L97, L982, L984, L988, L989, R21, R220, R221, R222, R223, R224, R227, R229, R230, R232, R233, R234, R238, R619
Drug side effects/ toxicity	G211, G210, G240, G251, G620, G720, I952, T360, T361, T368, T369, T370, T371, T375, T378, T379, T380, T381, T383, T387, T388, T389, T390, T391, T393, T398, T402, T403, T404, T406, T412, T420, T421, T422, T423, T424, T426, T427, T428, T430, T432, T433, T435, T436, T443, T447, T448, T450, T451, T452, T455, T457, T458, T460, T461, T462, T464, T465, T472, T481, T484, T490, T493, T494, T495, T507, T508, T509, T528, T529, T549, T55, T568, T58, T594, T597, T598, T612, T628, T629, T634, T658, T659, T66, T7800, T7802, T7803, T7808, T781, T782, T783, T784, T788, T789, T805, T881, T885, T886, T887, Z036
Electrolytes	E340, E611, E612, E790, E806, E8310, E8319, E833, E834, E835, E838, E870, E871, E872, E873, E875, E876, E878, E880, E883
Endocrine	E038, E039, E040, E041, E049, E059, E0788, E100, E1010, E1023, E1028, E1040, E1052, E1063, E1064, E1068, E1070, E1071, E109, E110, E1110, E1111, E1123, E1128, E1130, E1136, E1140, E1141, E1142, E1150, E1151, E1152, E1160, E1163, E1164, E1168, E1170, E1171, E1178, E119, E1310, E1328, E1363, E1364, E1368, E139, E140, E1410, E1411, E1412, E1423, E1428, E1440, E1441, E1442, E1450, E1451, E1452, E1460, E1461, E1463, E1464, E1468, E1470, E1471, E1478, E14780, E160, E161, E162, E210, E213, E222, E232, E236, E242, E249, E271, E272, E273, E274, E890, E891, R730, R73812, R739, R946, Z131
ENT	H605, H608, H609, H612, H619, H652, H680, H681, H690, H699, H729, H730, H740, H742, H748, H749, H810, H811, H812, H813, H818, H819, H830, H838, H839, H905, H918, H919, H920, H922, H931, H932, H938, H939, H958, T16, T700, J302, J304, J310, J320, J321, J323, J328, J329, J338, J342, J3488, J350, J351, J370, J3801, J3802, J3809, J381, J383, J384, J385, J386, J387, J955, K112, K114, K115, K116, K117, K118, K119, K130, K132, K137, K140, K141, K143, K146, K148, K149, R040, R041, R042, R066, R070, R490, R491, R498, T170, T171, T172, T173, T174, T180
Environmental	R680, T335, T354, T670, T675, T678, T68, T699, T732, T751, T753, T754, T7588, T702, Z578, Z585
Gastrointestinal	I850, I864, K3180, K5520, K625, K920, K921, K922, K2211, K2214, K226, K251, K254, K255, K256, K260, K261, K264, K265, K271, K274, K275, K285, K290, K20, K210, K219, K220, K2213, K2219, K222, K223, K224, K225, K228, K229, K259, K269, K279, K289, K291, K292, K295, K296, K297, K298, K30, K3188, K500, K508, K509, K510, K512, K513, K514, K518, K519, K550, K551, K558, K559, K561, K580, K589, K590, K591, K593, K594, K598, K599, K600, K602, K621, K623, K624, K626, K627, K628, K629, K634, K6388, K639, K640, K6411, K6420, K6421, K6430, K644, K645, K648, K649, K660, K668, K669, K900, K904, K909, K911, K912, K918, K919, K9280, K9288, K929, R110, R111, R112, R113, R12, R130, R132, R138, R14, R15, R160, R161, R162, R17, R18, R190, R194, R1950, R1958, R198, R933, R935, T181, T182, T185, T189, K402, K409, K412, K419, K429, K432, K435, K439, K449,

	K458, K469, K311, K315, K400, K403, K413, K420, K430, K433, K436, K450, K460, K560, K562, K563, K564, K565, K566, K567, K913, K316, K603, K604, K632, T8182, T8183, K352, K353, K358, K36, K37, K388, K570, K571, K572, K573, K574, K575, K578, K579, K8000, K8001, K8010, K8011, K8020, K8021, K8030, K8031, K8040, K8041, K8050, K8051, K8081, K810, K811, K818, K819, K820, K822, K828, K829, K831, K832, K835, K838, K839, K851, K852, K853, K858, K859, K861, K862, K863, K868, K869, K631, K650, K658, K659, K661, R100, A099, B085, K520, K521, K523, K528, K529, A690, A691, B084, K120, K121, K123, K700, K701, K703, K711, K716, K720, K729, K746, K751, K752, K754, K759, K760, K762, K763, K767, K768, K769, K8300, K8301, R740, R932, R945, D735, D738
Genitourinary/ nephrology	I861, N005, N009, N039, N049, N059, N10, N110, N111, N118, N119, N12, N130, N131, N132, N133, N134, N135, N136, N138, N139, N140, N141, N151, N159, N170, N178, N179, N182, N183, N185, N189, N19, N200, N201, N202, N209, N210, N211, N219, N23, N258, N259, N280, N281, N2888, N289, N301, N304, N308, N309, N312, N319, N320, N321, N322, N324, N328, N329, N342, N359, N360, N368, N369, N391, N3939, N394, N398, N399, N40, N410, N418, N419, N4288, N432, N433, N4408, N470, N471, N481, N4828, N483, N485, N488, N489, N492, N498, N499, N5010, N5018, N508, N509, N990, N998, N999, R300, R309, R310, R311, R318, R32, R33, R34, R350, R358, R36, R390, R3910, R3911, R3913, R3914, R3918, R392, R398, R80, R81, R827, R829, R860, R944, Z492,
Graft/stoma/ devices	K9140, K9142, K9143, K9145, K9160, K9162, J9500, J9502, J9503, J9508, N9950, N9952, T8188, T819, T820, T821, T822, T823, T824, T825, T828, T829, T83, T830, T831, T834, T848, T849, T850, T852, T854, T855, T856, T858, T859, T86000, T86001, T86100, T86200, T86400, T86401, T8767, T838, T839, T8400, T8403, T84030, T84031, T84033, T84038, T8404, T84043, T8408, T8410, T8413, T8414, T8420, T8423, T8424, T8428, T844, Z430, Z431, Z432, Z433, Z434, Z435, Z436, Z438, Z439, Z450, Z4500, Z4501, Z4502, Z4508, Z451, Z452, Z458, Z459, Z460, Z462, Z464, Z465, Z466, Z467, Z468, Z469, Z470
Gynecological	N750, N760, N762, N765, N766, N7680, N811, N812, N813, N814, N816, N820, N823, N824, N825, N829, N830, N832, N834, N838, N839, N840, N842, N843, N858, N859, N898, N899, N904, N905, N907, N908, N915, N920, N921, N926, N930, N938, N939, N941, N946, N948, N949, N950, N952, N981, T192, O019, O020, O039, O044, O16003, O16004, O20003, O20903, O21103, O23403, O72204, O75103, O86404, O90204, O91204, O99603, P768
Hematological	D45, D465, D467, D469, D471, D472, D473, D474, D67, D683, D684, D685, D686, D688, D689, D698, D699, D721, D748, D751, D7581, D7588, D759, D801, D841, D848, D899, R701, R71, T803, T806, T808, T809, Z130, D500, D508, D509, D510, D513, D518, D519, D521, D529, D538, D539, D570, D571, D582, D589, D590, D591, D592, D594, D598, D599, D609, D610, D611, D612, D613, D618, D619, D62, D641, D642, D643, D648, D649, Z513, D691, D692, D6930, D6938, D694, D695, D696, D708, D720, D728, D729, R72
Ill-defined	D860, D868, D869, E854, E858, E859, E840, E841, Q063, Q181, Q204, Q2738, Q278, Q282, Q288, Q311, Q419, Q438, Q443, Q644, Q743, Q998, R628, R629, T888, T889, Z000, Z015, Z016, Z017, Z018, Z019, Z027, Z0288, Z029, Z038, Z039, Z048, Z097, Z098, Z099, Z115, Z128, Z121, Z138, Z139, Z201, Z203, Z204, Z208, Z235, Z242, Z251, Z271, Z278, Z291, Z298, Z299, Z300, Z304, Z480, Z488, Z489, Z710, Z509, Z514, Z5188, Z519, Z530, Z532, Z538, Z558, Z642, Z7688, Z769, Z760, Z718, Z719, Z712
Infection/fever	A01, A029, A040, A044, A045, A046, A047, A048, A049, A059, A061, A071, A073, A078, A083, A084, A085, A09, A1690, A199, A319, A327, A370, A379, A38, A394, A400, A401, A403, A408, A409, A410, A411, A412, A414, A4150, A4151, A4152, A4158, A4180, A4188, A419, A42, A420, A46 A480, A488, A490, A491, A498, A499, A521, A527, A568, A590, A599, A600, A60, A630, A64, A692, A812, A879, A99, B00, B001, B002, B003, B005, B009, B019, B022, B023, B027, B028, B029, B07, B088, B09, B169, B179, B181, B182, B24, B258, B259, B269, B278, B279, B303, B341, B348, B349, B350, B351, B352, B353, B354, B356, B358, B359, B360, B369, B370, B372, B373, B374, B377, B3780, B3788, B379, B407, B409, B429, B448, B465, B488, B49, B580, B589, B59, B820, B852, B86, B874, B878, B879, B99, D700, G009, G030, G038, G039, G048, G049, G060, G06, G062, G360, G373, H600, H601, H602, H603, H650, H651, H659, H660, H664, H669, H700, H709, I38, J00, J010, J011, J012, J018, J019, J020, J028, J029, J030, J039, J040, J041, J050, J051, J060, J068, J069, J09, J100, J101, J110, J111, J118, J121, J122, J128, J129, J13, J14, J150, J151, J152, J154, J157, J159, J168, J180, J181, J188, J189, J205, J2088, J22, J340, J36, J390, J851, J852, K113, K122, K610, K611, K612, K613, K630, K8302, K8308, K9141, K9144, K9161, L010, L020, L021, L022, L023, L024, L028, L029, L0300, L0301, L0310, L0311, L032, L0330, L0331, L0332, L0333, L0334, L0335, L0336, L0339, L038, L039, L040, L041, L042, L050, L059, L080, L088, L089, M0001, M0006, M0091, M0092, M0093, M0094, M0095, M0096, M0097, M0098, M0099, M4622, M4625, M4628, M4644, M4646, M4647, M4649, M6005, M6006, M6008, M7105, M7111, M7112, M7116, M7260, M7263, M7265, M7266, M7267, M7268, M7269, M8617, M8618, M8665, M8688, M8690, M8694, M8695, M8696, M8697, M8698, M8699, M8792, M8795, N300, N390, N412, N413, N4500, N450, N4590, N459, N4592, N4820, N4821, N493, N700, N701, N730, N739, N751, N764, N9951, R02, R502, R508, R509, R572, T793, T802, T814, T826, T827, T82701, T82700, T82709, T8279, T835, T836, T8450, T8453, T8454, T8463, T8468, T847, T857, T8748, T880, Z113, Z114
Inflammatory/ immune	M6088, M6096, M6098, M6099, N61, N719, Q822, R590, R591, R599, R700, R768, R769

Injury/MSK	M064, M068, M069, M1000, M1002, M1006, M1007, M1017, M1021, M1027, M1037, M1090, M1091, M1092, M1093, M1094, M1096, M1097, M1098, M1099, M1123, M1126, M1127, M1193, M1254, M130, M1313, M1314, M1316, M1317, M1319, M1380, M1384, M1387, M1390, M1391, M1392, M1393, M1394, M1395, M1396, M1397, M1398, M1399, M159, M160, M161, M169, M170, M171, M173, M174, M175, M179, M189, M190, M198, M199, M200, M201, M206, M213, M216, M224, M2321, M238, M239, M2401, M2427, M2441, M2445, M2458, M2491, M2501, M2502, M2505, M2506, M2507, M2540, M2541, M2542, M2543, M2544, M2545, M2546, M2547, M2548, M2565, M2566, M2568, M2569, M2583, M2585, M2594, M2595, M2596, M4029, M4196, M4302, M4316, M4318, M436, M45, M4602, M461, M4714, M4719, M4782, M4786, M4787, M4796, M4797, M4800, M4802, M4804, M4806, M4807, M4809, M4844, M4846, M4849, M4854, M4855, M4856, M4859, M4882, M4892, M4894, M4899, M500, M501, M502, M503, M508, M511, M512, M513, M518, M519, M5326, M5329, M533, M5382, M5396, M5410, M5412, M5413, 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Neurological	F03, F050, F051, F058, F059, F063, F067, F068, F069, F072, F078, G08, G119, G20, G243, G248, G249, G252, G253, G258, G259, G3088, G309, G35, G4000, G4010, G4011, G4020, G4030, G4031, G4040, G4050, G4060, G4061, G4080, G4090, G4091, G410, G419, G450, G453, G454, G458, G459, G500, G510, G518, G519, G528, G529, G540 G541, G542, G543, G549, G560, G562, G563, G569, G570, G571, G573, G579, G588, G589, G608, G610, G618, G628, G629, G64, G700, G709, G728, G729, G809, G8190, G8191, G8199, G82093, G82223, G82293, G82490, G831, G8322, G838, G839, G900, G902, G903, G909, G92, G932, G934, G9380, G9388, G939, G958, G959, G961, G968, G969, G970, G971, G978, G979, G98, H490, H492, H512, H814, I630, I632, I633, I634, I635, I636, I638, I639, I64, I651, I652, I658, I659, I660, I662, I668, I669, I671, I676, I677, I678, I679, R200, R202, R203, R208, R251, R252, R253, R258, R260, R262, R263, R2682, R2688, R270, R278, R290, R298, R400, R401, R4029, R410, R413, R4180, R4188, R438, R470, R471, R478, , R54, R5601, R5602, R5609, R5680, R5688, R940, Z033
Neurosurgical	G834, G910, G911, G912, G918, G919, G935, G936, G952, G9600, G9602, G9608, G9609, I600, I601, I602, I603, I604, I608, I609, I610, I611, I612, I613, I614, I615, I616, I618, I619, I620, I621, I629, R900, R930, S061, S0625, S064, S065, S066, S0685, S0686, S069, S090, S1412, S3438
Nutrition/ metabolic	E41, E46, E500, E538, E616, E631, E639, E65, E662, E669, E671, E713, E722, E725, E739, E778, E789, E889, R633, R636, R638, R64, R630, Z713, E807
Pain, headache	G430, G431, G433, G438, G439, G440, G441, G442, G443, G444, G448, G501, M2550, M2551, M2552, M2553, M2554, M2555, M2556, M2557, M2558, M2559, M545, M546, M7960, M7961, R071, R072, R073, R074, R1010, R1011, R1012, R1019, R102, R1030, R1031, R1032, R1039, R104, R51, R520, R521, R522, R529, Z5180,
Psychiatric/drugs/ alcohol	F09, F20, F200, F202, F208, F209, F220, F239, F252, F258, F259, F29, F300, F302, F309, F310, F311, F312, F313, F314, F318, F319, F321, F322, F323, F328, F329, F331, F332, F339, F341, F39, F402, F410, F411, F412, F418, F419, F429, F430, F432, F438, F439, F445, F448, F449, F453, F458, F459, F480, F489, F509, F602, F603, F608, F609, F69, F801, F845, F919, F929, F985, F99, R440, R441, R442, R443, R448, R450, R451, R452, R453, R454, R455, R456, R457, R458, R461, R462, R4688, Z004, Z711, Z728, Z730, Z733, Z738, Z739, Z765, Z659, F100, F101, F102, F103, F104, F109, F110, F111, F112, F113, F114, F120, F121, F130, F133, F135, F141, F145, F151, F189, F190, F191, F192, F193, R784, R788, R789, T407, T510, Z502, Z721
Pulmonary	I270, I272, I279, I288, I289, J209, J219, J392, J398, J399, J40, J42, J438, J439, J440, J441, J448, J449, J4500, J4501, J4510, J4590, J4591, J47, J61, J6799, J680, J683, J688, J690, J698, J700, J702, J704, J708, J80, J82, J841, J848, J849, J850, J860, J869, J90, J930, J931, J938, J939, J942, J948, J9580, J9581, J959, J9600, J9601 J9609, J9610, J9611, J9619, J9690, J9691, J9699, J980, J9810, J9818, J982, J984, J985, J988, J989, , R048, R05, R060, R061, R062, R064, R068, R090, R091, R845, R91, R942, T179, T71, Z111
Optomological	B309, H000, H001, H01, H010, H011, H019, H020, H024, H026, H028, H029, H041, H043, H045, H049, H050, H051, H052, H058, H059, H100, H101, H102, H103, H104, H105, H108, H109, H110, H111, H113, H114, H150, H151, H158, H159, H160, H162, H163, H168, H169, H182, H188, H189, H200, H209, H210, H262, H269, H309, H330, H332, H333, H335, H341, H342, H348, H354, H356, H358, H359, H400, H402, H405, H408, H409, H430, H431, H433, H438, H440, H441, H46, H470, H471, H501, H509, H519, H531, H532, H534, H538, H539, H540, H544, H549, H571, H578, H579, H5988, H599, S001, S002, S0110, S050, S051, S055, S058, S059, T150, T151, T158, T159
Sleep	F510, G470, G472, G4730, G4738, G474, G478, G479
Thrombosis	I260, I269, I513, I740, I741, I742, I743, I744, I745, I748, I749, I800, I801, I802, I803, I808, I809, I81, I820, I822, I823, I828, I829, T800
Vascular	I710, I711, I712, I713, I714, I718, I719, I720, I724, I728, I770, I771, I772, I701, I7020, I7021, I708, I709, I730, I738, I739, I776, I779, I788, I830, I831, I832, I838, I839, I868, I871, I872, I878, I879, I880, I888, I889, I890, I891, I898, I972, I978, I979, I99, M310, M311, M313, M314, M315, M316, M329, M331, M349, M352, M353, M358, R600, R601, R609
Volume depletion	E860, E868, I950, I951, I958, I959, R571, R578, R579, R58, R031
Weakness, social issues	R296, R42, R464, R53, R631, R634, R682, R688, Z540, Z541, Z542, Z544, Z548, Z549, Z593, Z598, Z608, Z609, Z630, Z632, Z637, Z638, Z740, Z741, Z742, Z748, Z749, Z751, Z755, Z758, Z515

Table 2: ICD-O Codes to classify cancer type

Cancer type	ICD-O Code(s)
Head and neck	C00.* – C08.*, C09.* – C15.*, C30.* – C32.*, C37.*, C73.*
Gastrointestinal	C16.*, C17.*, C18.0 – C18.9, C19.9, C20.9, C21.*, C22.*-C26.*,
Lung	C33.*, C34.*
Breast	C50.*
Gynecological	C51.*- C58.*
Male genital	C60.*- C63.*
Genitourinary	C64.* - C68.*
Neurological	C47.*, C70.*-C72.*
Melanoma (“skin”)	C44.*
Hematological	C42.*, C77.*
Endocrine	C74.*, C75.*
Bone, soft tissue	C40.*, C41.*, C49.*
Other	
• Heart, mediastinum, pleura	• C38.*
• Other respiratory/intrathoracic organs	• C39.*
• Retroperitoneum and peritoneum	• C48.*
• Eye	• C69.*
• Other ill defined	• C76.*
• Unknown primary	• C80.*

Table 3: Palliative care codes and databases

Database	Codes
CCC (complex continuing care)	P1AO (hospice care) = 1 J5C (end stage disease, < 6 mos to live) = 1
CCRS-LTC (long term care)	P1AO (hospice care) = 1 J5C (end stage disease, < 6 mos to live) = 1
DAD (hospitalizations)	DX10CODE1 (main diagnosis) = Z515 (palliative care) INSERV (intervention provider service) = 00121 (palliative med) PRVSERV (provider service) = 00121 (palliative med)
HCD-OACCAC (homecare)	SERVICE_RPC (service recipient)= 54 (complex end of life), 95 (end of life, home) RESID_TYPE = 2000 (hospice, palliative care unit) SRC_ADMISSION (service goals) = 95 (end of life, home) SRC_DISCH (service goals) = 95 (end of life, home)
OHIP (physician billings)	Feecode = A900 (COMPLEX HOUSE CALL ASSESSMENT), A901 (GENERAL/FAMILY PRACTICE-HOUSECALL ASSESSMENT), A945 (GEN./FAM.PRACT.SPECIAL PALLIATIVE CARE CONSULTATION), B960-B964 (TRAVEL PREMIUM - SPECIAL VISIT TO PATIENT'S HOME), B966 (TRAVEL PREMIUM - PALLIATIVE CARE HOME VISIT), B986-B988 (GERIATRIC HOME VISIT SPECIAL VISIT PREMIUM), B990 (SPEC VIS TO PT'S HOME, WK/DAYTIME), B992 (SPEC VIS-PT'S HOME/NON-ELECT -SAC OFF HRS. WK/DAYTIME), B993 (EMERGENCY CALL WITH SACRIFICE OF OFFICE HOURS), B994 (SPEC VIS TO PT'S HOME/NON-ELECT., EVE) , B996 (SPECIAL VISIT-HOME-NIGHTS(12MN-7AM) 1ST PT.), B997 (SPEC VIS TO PT'S HOME OR EQUI), B998 (SPEC VIS PALLIATIVE CARE HOME, DAYS, EVE), C882 (TERMINAL CARE IN HOSP.G.P/F.P), C945 (SPECIAL PALLIATIVE CARE CONSULT HOSP IN PATIENT), C982 (PALLIATIVE CARE), G511 (TELEPHONE MANAGEMENT OF PALLIATIVE CARE AT HOME), G512 (PALLIATIVE CARE CASE MANAGEMENT FEE THE SERVICE RENDERED), K023 (PALLIAT CARE SUPPORT INDIVID CARE 1/2 HR OR MAJOR PART), K700 (PALLIATIVE CARE OUT-PATIENT CASE CONFERENCE), W872 (TERMINAL CARE N.H G.P/FAMILY PRACTICE), W882 (TERMINAL CARE IN CHR.HOSP.G.P), W972 (PALLIATIVE CARE), W982 (PALLIATIVE CARE)
NACRS (ED visits)	PRVSERV (provider service) = 00121 (palliative med) CONSULTSERV (consulting service) = 00121 (palliative med)
RAI-CA (Resident Assessment Instrument – Contact Assessment)	B2C (referral to initial or continue palliative services) = 1 B4(expected residential status during services) = 12 (hospice/palliative care unit) E7 (client group) = 2 (end of life)
RAI-HC (Resident Assessment Instrument – Home Care source)	CC3F (goals of care – palliative care) = 1 K8E (prognosis of < 6 mos to live) = 1 P2S (hospice care) = 1, 2