ORIGINAL RESEARCH

Patient-Reported Symptom Complexity and Acute Care Utilization Among Patients With Cancer: A Population-Based Study Using a Novel Symptom Complexity Algorithm and Observational Data

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ABSTRACT

Background: Patients with cancer in Canada are often effectively managed in ambulatory settings; however, patients with unmanaged or complex symptoms may turn to the emergency department (ED) for additional support. These unplanned visits can be costly to the healthcare system and distressing for patients. This study used a novel patient-reported outcomes (PROs)–derived symptom complexity algorithm to understand characteristics of patients who use acute care, which may help clinicians identify patients who would benefit from additional support. **Patients and Methods:** This retrospective observational cohort study used population-based linked administrative healthcare data. All patients with cancer in Alberta, Canada, who completed at least one PRO symptom-reporting questionnaire between October 1, 2019, and April 1, 2020, were included. The algorithm used ratings of 9 symptoms to assign a complexity score of low, medium, or high. Multivariable binary logistic regressions were used to evaluate factors associated with a higher likelihood of having an ED visit or hospital admission (HA) within 7 days of completing a PRO questionnaire. **Results:** Of the 29,133 patients in the cohort, 738 had an ED visit and 452 had an HA within 7 days of completing the PRO questionnaire. Patients with high symptom complexity had significantly higher odds of having an ED visit (OR, 3.10; 95% CI, 2.59–3.70) or HA (OR, 4.20; 95% CI, 3.36–5.26) compared with low complexity patients, controlling for demographic covariates. **Conclusions:** Given that patients with higher symptom complexity scores were more likely to use acute care, clinicians should monitor these more complex patients closely, because they may benefit from additional support or symptom management in ambulatory settings. A symptom complexity algorithm can help clinicians easily identify patients who may require additional support. Using an algorithm to guide care can enhance patient experiences, while reducing use of acute care services and the accompanying cost and burden.

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Background

In Canada, many patients with cancer are managed effectively in outpatient settings by care teams within provincial or regional cancer programs. Despite efforts to provide comprehensive cancer care, patients may have unmet needs or experience unexpected health issues outside of their scheduled clinic appointments. When this occurs, patients may turn to acute healthcare services, such as emergency departments (EDs) with possible inpatient admission.[1] These distressing impromptu visits may disrupt the continuum of care, causing delays in scheduled cancer treatments.[2,3]

Crowding, long waits, and unpredictable environments can make unplanned acute care visits an unpleasant experience for patients with cancer.[4] Although ED visits are appropriate for certain health concerns, many can be prevented with coordinated care and adequate symptom management in ambulatory settings.[5] Based on clinician interpretation of medical records or assessment of their own medical encounters, it is estimated that 19% to 23% of ED visits and hospital admissions (HAs) are potentially avoidable for patients with cancer.[6–10] To decrease impromptu acute care visits, cancer teams need to recognize, assess, and treat patients' symptoms before they escalate to unmanageable levels.[2,11]

Identifying similarities among patients who use acute care services can help us understand which patients may benefit from additional and/or earlier clinician support. Patients' symptoms and their associated severity directly impact the care they require, and patients with multiple and/or severe symptoms may need more support or use additional services. A study conducted in Ontario, Canada, used patient-reported outcomes (PROs) data to examine symptoms associated with ED visits and found that pain, nausea, and shortness of breath were significantly associated.[12] Additionally, as symptom severity increased, the odds of visiting the ED increased further.[12] PROs are routinely collected throughout Alberta's provincial cancer program, Cancer Care Alberta (CCA), creating the opportunity to investigate factors that influence health service utilization in a different provincial context. A unique feature of PROs in Alberta is that the information is used with a novel, validated symptom complexity algorithm that considers the combination, severity, and number of symptoms and concerns reported and assigns a score of low, moderate, or high complexity.[13] This unique algorithm allows for a quick understanding of a patient's overall condition, easily identifying complex patients who will require additional investigation.

The purpose of this study was to use CCA's symptom complexity algorithm to examine the relationship between symptom complexity levels and patients' use of EDs and HAs in Alberta. We hypothesized that patients with higher symptom complexity would be more likely to have an ED visit or HA within 7 days of their PRO questionnaire date, independent of sociodemographic factors.

Patients and Methods

Study Context

Since 2012, CCA has routinely collected PROs to enhance symptom management by increasing clinician awareness of patient concerns. PROs are collected using a paper questionnaire that includes 2 standardized tools: the Edmonton Symptom Assessment System–Revised (ESAS-r)[14] and the Canadian Problem Checklist (CPC).[15] These measures align with national reporting requirements and provide a comprehensive overview of common symptoms and concerns that patients with cancer experience.[16] The questionnaire is intended for completion by all adult patients who attend an appointment, although there are instances when staff may not offer the questionnaire or a patient may decline to complete it. The provincial completion rate across all 17 cancer centers is approximately 75%.[17] The process of administering the questionnaire is integrated into standard clinic workflows as a routine aspect of care, with patients completing the questionnaire in the waiting room prior to clinic appointments.

Case Ascertainment and Study Design

The study cohort comprised patients with cancer who filled out at least one PRO questionnaire between October 1, 2019, and April 1, 2020, across all 17 ambulatory cancer centers in Alberta. Patients with any cancer diagnosis who were at least 18 years of age and had received care within CCA were included. The study used deterministically linked administrative healthcare data and received ethics approval from the Health Research Ethics Board of Alberta–Cancer Committee (HREBA-CC).

Data Sources and Covariates

The data used in this study were collected from the Alberta Cancer Registry and CCA's electronic medical record for demographic and PROs information, and the Discharge Abstract Database (DAD)[18] and National Ambulatory Care Reporting System (NACRS)[19] for acute care visit information. Data linkage between all datasets was achieved through a unique provincial healthcare number assigned to patients as part of the cancer registry process. If a patient had multiple cancer diagnoses, the most recent diagnosis was used to enable the cohort to be divided into tumor groups. If a patient had completed multiple questionnaires within the time period, only the first was included.

Sociodemographic and Disease-Specific Variables

Data were extracted to obtain the age, sex, rurality, location of ambulatory cancer care, group type, Charlson comorbidity index (CCI) score,[20] and treatment information for each patient. Rurality was assigned based on a patient's most recent residence location using a 7-level provincial rurality index.[21] The 7 levels were collapsed into 3 for analysis: metro, urban, and rural. Location of care refers to the type of cancer center a patient visited to complete the PRO questionnaire. The 17 centers in Alberta fall into 3 categories: tertiary, which are located in large cities and are the largest and most comprehensive centers in the province; regional, which are located in smaller cities and provide similar services to tertiary centers but on a smaller scale; and community, which are located in small cities or towns and provide systemic treatment once a patient has first received a consult and treatment plan at a tertiary or regional center.[22] CCI score was calculated according to diagnoses coded in the DAD in the 12 months before patients' first questionnaire in the study period. A modified version of the CCI is used throughout CCA that excludes cancer and associated metastasis as factors, because all patients included have a cancer diagnosis.[23,24] A patient was classified as being "on treatment" if they had radiation therapy within 14 days prior to the completion of the PRO questionnaire, or chemotherapy within 21 days prior.[12]

PRO Questionnaire Data

Patient-reported symptoms and concerns were extracted from the PRO questionnaires. The ESAS-r assesses the severity of 9 symptoms: pain, tiredness, drowsiness, nausea, lack of appetite, shortness of breath, depression, anxiety, and well-being.[14] Patients rate each symptom on a severity scale from 0 to 10, with 10 indicating the highest severity. The CPC is a self-report checklist of concerns commonly experienced by patients with cancer.[15] Throughout CCA, a modified version of the checklist is used that includes 54 items.[25]

Symptom Complexity

Our validated algorithm uses ESAS-r symptoms and CPC concerns to calculate a complexity score. Upon examining the PRO data, we found that approximately 50% of the sample had left the CPC portion of the questionnaire blank. To manage this large amount of missing data, we calculated the symptom complexity scores for all patients using the original validated algorithm as well as a modified algorithm using ESAS-r scores only and evaluated the differences between scores to determine the impact of excluding CPC data. Figure 1 shows the components of each algorithm.

We first calculated the accuracy index using sensitivity, specificity, and overall accuracy and found a very small difference (overall accuracy >97.0%). We then ran Goodman and Kruskal gamma (γ) to determine the association between the 2 scores and the correlation was very strong ($\gamma = 0.993$; $P<.01$). Gamma ranges from −1 to 1, with 1 indicating a perfect positive match.[26,27] Considering the negligible difference and near-perfect matching between the 2 symptom complexity scores, we chose to report the scores using ESAS-r only, to minimize any potential bias caused by the high percentage of missing values in the CPC data.

Acute Care Utilization Outcomes

ED visits and HAs were included as the 2 acute care utilization outcome measures. Data were extracted from the NACRS for ED visits and the DAD for HAs. ED visits or HAs within 7 days of a completed PRO questionnaire were included. The 7-day interval was determined using similar literature,[12] which suggests this is long enough for the provider to have responded to the symptoms, and short enough that the symptoms could reasonably be attributed to the visit.[12] We excluded records in which multiple questionnaires were completed before an ED visit or an HA within 7 days (∼0.1% of the sample).

Statistical Analyses

Descriptive statistics were applied to evaluate the frequencies, mean, and standard deviation for participants' symptom complexity scores and characteristics, as appropriate. These variables were further cross-tabulated by the acute care utilization outcomes (both were binary: "yes" or "no"). Bivariate and multivariable logistic regression analyses were performed to evaluate factors associated with the outcomes. Crude and adjusted odds ratios were calculated with 95% confidence intervals to assess the influence of all independent variables on both outcomes. Model fit was assessed using the Hosmer-Lemeshow goodness of fit test. Data were exported into SPSS Statistics, version 25 (IBM Corp) for analysis, and statistical significance was set a priori at $P<.05$.

Results

Sample Characteristics

The study cohort comprised 29,133 unique patients with cancer. Figure 2 provides details on how the final sample was determined.

Mean age of the cohort was 63.0 years (Table 1). Additionally, the cohort was 54.8% female, 67.1% resided in a metro area, and 85.9% received care from 1 of the 2 tertiary cancer centers in the province. Hematology was the most common tumor group (21.0%), followed by breast

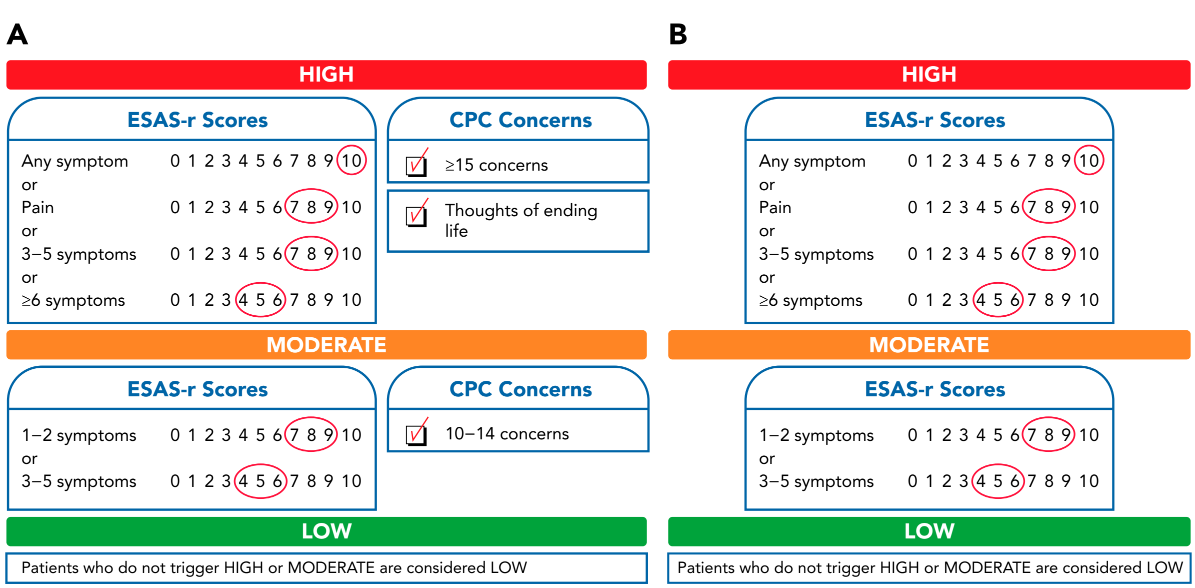

Figure 1. **(A)** Validated Cancer Care Alberta symptom complexity algorithm and **(B)** modified symptom complexity algorithm.
Abbreviations: CPC, Canadian Problem Checklist; ESAS-r, Edmonton Symptom Assessment System–Revised.

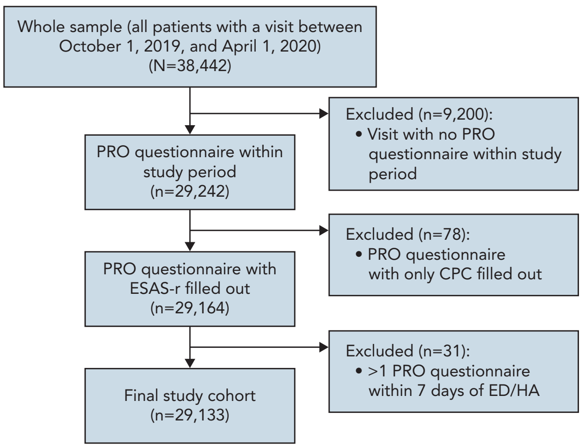

Figure 2. Flow diagram illustrating sample determination.
Abbreviations: CPC, Canadian Problem Checklist; ED, emergency department; ESAS-r, Edmonton Symptom Assessment System–Revised; HA, hospital admission; PRO, patient-reported outcome.

(20.1%). A minority of the cohort (13.7%) had a CCI score ≥1. Of the total sample, 16.5% received chemotherapy within 21 days prior to completing the PRO questionnaire, and 3.3% received radiation therapy within 14 days prior. Symptom complexity scores, calculated using the algorithm with ESAS-r data only, were distributed as high (13.7%), moderate (19.1%), and low (67.2%).

Acute Care Utilization

ED Visits

A total of 738 (2.5%) patients had an ED visit within 7 days of completing their PRO questionnaire. Bivariate analysis showed that higher symptom complexity scores were more likely to be associated with ED visits, as were older age, rural or urban residence, location of care (all sites), tumor group (gastrointestinal, gynecologic, hematologic, and lung), CCI score ≥1, and receiving chemotherapy within 21 days prior to the completion of the PRO questionnaire (Table 2). In the multivariable logistic regression model, after adjusting for all covariates, higher symptom complexity scores were associated with a greater likelihood of ED visits. Specifically, when compared with low complexity scores, patients with moderate complexity were 1.83 times (95% CI, 1.51–2.20) more likely to use the ED and patients with high complexity were 3.10 times (95% CI, 2.59–3.70) more likely. Other variables associated with ED visits were rural residence, location of care (RCCs and CCCs), tumor group (gastrointestinal, gynecologic, hematologic, lung, and other), CCI score ≥1, and chemotherapy within 21 days prior to the completion of the PRO questionnaire.

Hospital Admissions

A total of 452 (1.6%) patients were admitted to the hospital within 7 days of their questionnaire. Bivariate analysis showed that higher symptom complexity scores were more likely to be associated with HAs, as were older age, rural residence, location of care (TCC 2 and CCCs), tumor group (all), CCI score ≥1, and receiving radiation within 14 days prior to questionnaire completion (Table 2). In the multivariable logistic regression model, after adjusting for covariates, higher symptom complexity scores were associated with a greater likelihood of being admitted to a hospital within 7 days of completing a questionnaire. When compared with patients with low complexity scores, those with moderate complexity were 1.92 times (95% CI, 1.49–2.47) more likely to be admitted to a hospital, and those with high complexity were 4.20 times (95% CI, 3.36–5.26) more likely. Other variables associated with HA were rural residence, tumor group (all), CCI score ≥1, and radiation within 14 days of questionnaire completion.

Discussion

This study demonstrated that higher symptom complexity is associated with increased likelihood of using acute healthcare services. The findings are similar to several retrospective reviews addressing common cancer symptoms and their association with utilizing the healthcare system.[28–31] To our knowledge, this is the first study that uses a comprehensive symptom complexity measure to examine utilization of acute care services, rather than assessing individual symptoms.

Although PROs have demonstrable use in patient care, there continue to be barriers to interpreting and utilizing PRO data in clinical settings.[32] In the process of integrating PROs into routine practice in CCA, many clinicians identified a perceived lack of time to address the number of symptoms and/or concerns indicated on a routine screening assessment.[13] This highlights the importance of tools such as CCA's symptom complexity algorithm, which quickly condenses a large amount of PROs information into a simple visual flag for clinicians, enabling quick identification of, and response to, patients who may require additional symptom management or time in the clinic. Basch et al[33] reported on a randomized controlled trial that showed that patients who routinely reported PROs electronically, with real-time symptom triage and follow-up telephone assessments for patients with high symptom burden, were less frequently admitted to the ED (34% vs 41%) or hospitalized (45% vs 49%) than those who received standard in-person care. The symptom complexity algorithm used in this study could be strategically used to influence the creation of innovative models of care with symptom surveillance between and prior to clinical encounters and as part of triage practices to identify which patients require more proactive symptom management in ambulatory settings.[17] Validating an ESAS-r–only algorithm, like the one used in this study, should be considered in the future, because this measure is commonly used in

Table 1. Patient Characteristics and Symptom Complexity Scores

		ED		HA	
Characteristic	Entire Cohort n (%)	No n (%)	Yes n (%)	No n (%)	Yes n (%)
Total, n	29,133	28,395	738	28,681	452
Symptom complexity score					
Low	19,583 (67.2)	19,254 (67.8)	329 (44.6)	19,405 (67.7)	178 (39.4)
Moderate	5,554 (19.1)	5,373 (18.9)	181 (24.5)	5,450 (19.0)	104 (23.0)
High	3,996 (13.7)	3,768 (13.3)	228 (30.9)	3,826 (13.3)	170 (37.6)
Age, mean [SD], y	63.0 [14.1]	63.0 [14.1]	65.1 [13.9]	63.0 [14.1]	64.4 [13.9]
Sex					
Female	15,963 (54.8)	15,563 (54.8)	400 (54.2)	15,726 (54.8)	237 (52.4)
Male	13,170 (45.2)	12,832 (45.2)	338 (45.8)	12,955 (45.2)	215 (47.6)
Rurality index					
Metro	19,551 (67.1)	19,166 (67.5)	385 (52.2)	19,301 (67.3)	250 (55.3)
Urban	3,266 (11.2)	3,178 (11.2)	88 (11.9)	3,215 (11.2)	51 (11.3)
Rural	5,743 (19.7)	5,485 (19.3)	258 (35.0)	5,609 (19.6)	134 (29.6)
Missing	573 (2.0)	566 (2.0)	7 (0.9)	556 (1.9)	17 (3.8)
Location of care					
TCC 1	14,439 (49.6)	14,159 (49.9)	280 (37.9)	14,247 (49.7)	192 (42.5)
TCC 2	10,569 (36.3)	10,285 (36.2)	284 (38.5)	10,378 (36.2)	191 (42.3)
RCCs	3,816 (13.1)	3,663 (12.9)	153 (20.7)	3,754 (13.1)	62 (13.7)
CCCs	309 (1.1)	289 (1.0)	21 (2.8)	302 (1.1)	7 (1.5)
Tumor group					
Breast	5,850 (20.1)	5,753 (20.3)	97 (13.1)	5,826 (20.3)	24 (5.3)
Gastrointestinal	3,566 (12.3)	3,417 (12.0)	149 (20.2)	3,474 (12.1)	92 (20.4)
Genitourinary	4,176 (14.3)	4,091 (14.4)	85 (11.5)	4,126 (14.4)	50 (11.1)
Gynecologic	2,370 (8.1)	2,312 (8.1)	58 (7.9)	2,316 (8.1)	54 (11.9)
Hematologic	6,120 (21.0)	5,959 (21.0)	161 (21.8)	6,020 (21.0)	100 (22.1)
Lung	2,242 (7.7)	2,158 (7.6)	84 (11.4)	2,199 (7.7)	43 (9.5)
Other combined[a]	4,809 (16.5)	4,705 (16.6)	104 (14.1)	4,720 (16.5)	89 (19.7)
CCI score					
0	25,149 (86.3)	24,622 (86.7)	527 (71.4)	24,831 (86.6)	318 (70.4)
≥1	3,984 (13.7)	3,773 (13.3)	211 (28.6)	3,850 (13.4)	134 (29.6)
Chemotherapy within 21 days					
No	24,318 (83.5)	23,767 (83.7)	551 (74.7)	23,949 (83.5)	369 (81.6)
Yes	4,815 (16.5)	4,628 (16.3)	187 (25.3)	4,732 (16.5)	83 (18.4)
Radiation within 14 days					
No	28,161 (96.7)	27,449 (96.7)	712 (96.5)	27,732 (96.7)	429 (94.9)
Yes	972 (3.3)	946 (3.3)	26 (3.5)	949 (3.3)	23 (5.1)

Abbreviations: CCC, community cancer center; CCI, Charlson comorbidity index; ED, emergency department; HA, hospital admission; RCC, regional cancer center; TCC, tertiary cancer center.
[a]Includes central nervous system, endocrine, head and neck, melanoma, nonmelanoma skin, sarcoma, and other.

other cancer programs throughout the country whereas the CPC is not, making a dedicated ESAS-r algorithm applicable to multiple jurisdictions.

Reducing avoidable acute care visits is a key strategy for delivering ambulatory oncology care sustainably at a lower cost. Costs in oncology care represent a growing burden for

Table 2. Bivariate and Multivariable Logistic Regressions for Acute Care Utilizations

Characteristic	ED Bivariate OR (95% CI)	ED Multivariable OR (95% CI)	HA7 Bivariate OR (95% CI)	HA7 Multivariable OR (95% CI)
Symptom complexity score				
Low	Ref	Ref	Ref	Ref
Moderate	**1.97 (1.64–2.37)**	**1.83 (1.51–2.20)**	**2.08 (1.63–2.66)**	**1.92 (1.49–2.47)**
High	**3.54 (2.98–4.21)**	**3.10 (2.59–3.70)**	**4.84 (3.92–5.99)**	**4.20 (3.36–5.26)**
Age, continuous	**1.01 (1.01–1.02)**	1.00 (1.00–1.01)	**1.01 (1.00–1.01)**	1.00 (1.00–1.01)
Sex				
Female	Ref	Ref	Ref	Ref
Male	1.03 (0.89–1.19)	1.11 (0.93–1.32)	1.10 (0.91–1.33)	1.08 (0.87–1.35)
Rurality index				
Metro	Ref	Ref	Ref	Ref
Urban	**1.38 (1.09–1.74)**	1.00 (0.74–1.35)	1.23 (0.90–1.66)	1.28 (0.88–1.86)
Rural	**2.34 (1.99–2.75)**	**1.90 (1.58–2.29)**	**1.84 (1.49–2.28)**	**1.79 (1.42–2.25)**
Location of care				
TCC 1	Ref	Ref	Ref	Ref
TCC 2	**1.40 (1.18–1.65)**	1.18 (1.00–1.40)	**1.37 (1.12–1.67)**	1.08 (0.87–1.33)
RCCs	**2.11 (1.73–2.58)**	**1.51 (1.16–1.97)**	1.23 (0.92–1.64)	0.87 (0.60–1.26)
CCCs	**3.69 (2.33–5.83)**	**1.90 (1.16–3.11)**	**1.72 (0.80–3.69)**	1.16 (0.52–2.57)
Tumor group				
Breast	Ref	Ref	Ref	Ref
Gastrointestinal	**2.59 (2.00–3.35)**	**2.24 (1.69–2.98)**	**6.43 (4.09–10.1)**	**5.60 (3.46–9.06)**
Genitourinary	1.23 (0.92–1.65)	1.35 (0.96–1.89)	**2.94 (1.81–4.79)**	**3.12 (1.82–5.36)**
Gynecologic	**1.49 (1.07–2.07)**	**1.60 (1.14–2.24)**	**5.66 (3.49–9.18)**	**5.35 (3.24–8.83)**
Hematologic	**1.60 (1.24–2.07)**	**1.49 (1.13–1.97)**	**4.03 (2.58–6.31)**	**3.71 (2.30–5.97)**
Lung	**2.31 (1.72–3.11)**	**1.58 (1.16–2.17)**	**4.75 (2.87–7.84)**	**3.17 (1.87–5.35)**
Other combined[a]	1.31 (0.99–1.73)	**1.50 (1.11–2.03)**	**4.58 (2.91–7.20)**	**4.54 (2.81–7.33)**
CCI score				
0	Ref	Ref	Ref	Ref
≥1	**2.61 (2.22–3.08)**	**1.82 (1.53–2.16)**	**2.72 (2.22–3.34)**	**1.87 (1.50–2.33)**
Chemotherapy within 21 days				
No	Ref	Ref	Ref	Ref
Yes	**1.74 (1.47–2.06)**	**1.60 (1.34–1.92)**	1.14 (0.90–1.45)	1.16 (0.90–1.50)
Radiation within 14 days				
No	Ref	Ref	Ref	Ref
Yes	1.06 (0.71–1.58)	1.05 (0.70–1.58)	**1.57 (1.03–2.40)**	**1.55 (0.99–2.42)**

Bold represents a statistically significant difference.
Abbreviations: CCC, community cancer center; CCI, Charlson comorbidity index; ED, emergency department; HA, hospital admissions; RCC, regional cancer center; TCC, tertiary cancer center.
[a]Includes central nervous system, endocrine, head and neck, melanoma, nonmelanoma skin, sarcoma, and other.

the healthcare system, and acute hospital care is one of the single largest drivers.[34] A study comparing the costs of outpatient, inpatient, and ED healthcare utilization found that inpatient hospitalizations cost up to 5 times more than ambulatory or outpatient care, which was associated with the greatest potential for cost savings.[35] Strategies to reduce patient suffering while also reducing acute care utilization are of interest to the public, healthcare providers, and administrators alike for quality improvement and resource optimization.[36] Our approach aligns with the first common strategy for reducing unplanned acute care utilization, by identifying patients at high risk due to their symptom complexity.[37] A recent study reported that 64% of patients with cancer admitted to a hospital stated that the symptoms leading to their admission had developed over several days.[38] By utilizing the symptom complexity algorithm, the escalation of common symptoms could be identified earlier and managed in the ambulatory setting, potentially eliminating the need for many acute care visits.[39]

Although this study focused on symptom complexity, we also found significant associations between several sociodemographic characteristics and acute care utilization. Patients living in rural areas were more likely to visit EDs and have HAs. Relatedly, patients who visited a regional or community cancer center were more likely to have an ED visit; these smaller centers may have less capacity to manage all patient concerns in the clinic compared with the larger tertiary centers. Rural patients may have fewer options regarding care available when they need it, given that healthcare access varies across Alberta. Rural patients may rely on the ED to manage symptoms that a metro or urban patient could have managed through their local ambulatory oncology clinic or walk-in clinic.[40] Rural residents may also have less access to supportive care resources typically available in the larger metro cancer centers.[40–42] Improving access to care in rural areas remains a problematic issue; however, recent advances in CCA's virtual care strategy presents an important opportunity to help rural patients access and use cancer care services more easily.[43]

Additionally, patients with higher CCI scores were more likely to have an ED visit or HA. Treatment also played a role, with patients who recently had chemotherapy more likely to have an ED visit, and patients who recently had radiation therapy more likely to have an HA. These results are not surprising, given that comorbidities[44,45] and active treatment[46,47] are often linked to symptom burden and severity. Compared with patients with breast cancer (the reference group), patients from all other tumor groups were significantly more likely to have an HA or ED visit (with the exception of patients with genitourinary cancers, for the latter outcome). Patients with gastrointestinal cancers had the highest odds of both ED visits and HAs, which may suggest that the symptoms commonly experienced by these patients, such as nausea, are more likely to require additional and/or urgent care.[12]

We acknowledge the limitations of this study. The data provided limited details on the use of EDs and HAs and we were unable to determine the exact reason for each visit. We could not calculate the percentage of visits that were cancer-related; some patients may have visited acute care for unrelated urgent health issues. We were also unable to differentiate the status of each patient's cancer diagnosis as curative or palliative, which may impact their use of acute care. Finally, because the symptom complexity scores in this study were derived from PRO data, patients who did not complete a PRO questionnaire within the study timeframe were excluded. We could not examine their symptoms and did not explore their health service utilization patterns or sociodemographic characteristics. The symptoms, characteristics, and acute care utilization of these patients may differ somewhat from the included patients, as similar studies have demonstrated.[48–51]

Conclusions

Patients with cancer who have higher symptom complexity are more likely to use EDs and have HAs than lower complexity patients. Although not all instances of acute care utilization can, or should, be prevented, there are instances in which additional clinician support could help reduce the need for unplanned visits. The findings of this study demonstrate the value of PROs and how novel initiatives, such as CCA's symptom complexity algorithm, can make PROs more helpful to clinicians. Using PROs in this way, by identifying patients in need of more comprehensive care and symptom management, can aid in improving patient experiences, and can contribute to mitigation of the economic impact of seeking care in the acute healthcare system.

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