BMJ Open

Retrospective study of cancer patients' predictive factors of care in a large, Hungarian tertiary care centre

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To cite: Koch M, Szabó É, Varga C, *et al*. Retrospective study of cancer patients' predictive factors of care in a large, Hungarian tertiary care centre. *BMJ Open* 2023;**13**:e070320. doi:10.1136/bmjopen-2022-070320

► Prepublication history and additional supplemental material for this paper are available online. To view these files, please visit the journal online (http://dx.doi.org/10.1136/bmjopen-2022-070320).

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Received 18 November 2022
Accepted 27 March 2023

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ABSTRACT

Objectives To identify predictive factors of multiple emergency department (ED) visits, hospitalisation and potentially preventable ED visits made by patients with cancer in a Hungarian tertiary care centre.

Design Observational, retrospective study.

Setting A large, public tertiary hospital, in Somogy County, Hungary, with a level 3 emergency and trauma centre and a dedicated cancer centre.

Participants Patients above 18 years with a cancer diagnosis (International Classification of Diseases, 10th Revision codes of C0000–C9670) who visited the ED in 2018, who had received their diagnosis of cancer within 5 years of their first ED visit in 2018 or received their diagnosis of cancer latest within the study year. Cases diagnosed with cancer at the ED (new cancer diagnosis-related ED visits) were also included, constituting 7.9% of visits.

Primary outcome measures Demographic and clinical characteristics were collected and the predictors of multiple (≥2) ED visits within the study year, admission to inpatient care following the ED visit (hospitalisation), potentially preventable ED visits and death within 36 months were determined.

Results 2383 ED visits made by 1512 patients with cancer were registered. Predictive factors of multiple (≥2) ED visits were residing in a nursing home (OR 3.09, 95% CI 1.88 to 5.07) and prior hospice care (OR 1.87, 95% CI 1.05 to 3.31). Predictive factors for hospitalisation following an ED visit included a new cancer diagnosis-related visit (OR 1.86, 95% CI 1.30 to 2.66) and complaint of dyspnoea (OR 1.61, 95% CI 1.22 to 2.12).

Conclusions Being a resident of a nursing home and receiving prior hospice care significantly increased the odds of multiple ED visits, while new cancer-related ED visits independently increased the odds of hospitalisation of patients with cancer. This is the first study to report these associations from a Central-Eastern European country. Our study may shed light on the specific challenges of EDs in general and particularly faced by countries in the region.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ This is a comparatively large, comprehensive study on patients with cancer visiting the emergency department (ED), where data regarding a wide range of parameters were collected.
⇒ The analysis of multiple aspects of ED visits made by patients with cancer is unique.
⇒ This is a retrospective study from a single centre; therefore, further studies are needed to confirm our results.

BACKGROUND

Cancer is the second-leading cause of mortality in developed countries, and the number of cancer cases and death is projected to increase in the future,[1] thus placing a huge strain on the healthcare system. A large percentage of patients with cancer present to emergency departments (ED) due to a variety of medical conditions ranging from life-threatening conditions such as sepsis and unspecific symptoms such as pain or nausea.[2]

Since patients with cancer have been shown to use the ED more frequently than patients without cancer, it has been proposed that many cases related to symptom management could possibly be prevented with proactive measures or managed in an outpatient setting. Breast, prostate and lung cancer were associated with more frequent ED visits according to a study in the USA, while in an Australian investigation, patients with genitourinary cancers were found to use the ED most often.[3] A recent report found that the presence of metastatic disease and/or comorbidities, such as chronic pulmonary disease, poorly controlled diabetes or renal disease were the risk factors mostly affecting the number of multiple ED visits.[4] EDs providing care to a wide spectrum of patients are often overcrowded, with 10%–40% of ED visits thought to be potentially preventable.[5]

Recent estimations have suggested that two-thirds of the ED visits made by patients with cancer result in hospitalisation, which is a fourfold higher ED hospitalisation rate than in the general population.[6] Older patients with cancer are also significantly more likely

to be admitted to an inpatient unit, than be discharged following an ED visit.[3]

Identifying the characteristics, reasons and factors leading to ED use and multiple ED visits of patients with cancer are crucial for developing and ultimately implementing cost-effective preventive measures to optimise patient care and decrease the increasing cancer burden on the healthcare system. Although several large analyses have been carried out investigating the frequency and causes of patients with cancer visiting the ED in Western countries, to our knowledge, data from Eastern and Central Europe are lacking. In a previous report, as part of a large research project, we analysed the main reasons of ED visits made by patients with cancer.[7]

Objectives

The aim of our present study was to identify predictive factors of multiple ED visits, hospitalisation, death and potentially preventable ED visits made by patients with cancer at an ED in a tertiary care centre. We also analysed the relationship between frequency of ED visits and the 3-year survival of patients with cancer.

METHODS

Setting

The study was carried out at a large, public tertiary hospital, the Somogy County Kaposi Mór Teaching Hospital, in Kaposvár, Hungary, with a level 3 emergency and trauma Centre (ED) and a dedicated cancer centre (including an inpatient unit, a day oncology unit and a radiotherapy unit), which is responsible for the treatment of patients with cancer in Somogy county but also accepts some patients from neighbouring counties. All patients, including patients with cancer and non-cancer, with acute symptoms, are required to present themselves at the ED first as part of the single-gate system. Patients with injuries are also required to visit the emergency and trauma centre. The patients are then triaged according to the Hungarian Emergency Triage System (MSTR)[8]—the required triage system used in Hungary, and which was adapted from the Canadian Triage and Acuity Scale[9]—admitted and subsequently examined and treated. Then, based on their medical status, patients may either be discharged, or admitted to the ED's Short Stay Unit—for a period of maximum 24 hours—or hospitalised (admitted to one of the hospital's inpatient units.) The annual patient turnover of the ED is approximately 35 000 patients and 80% of the patients are over 18 years of age.

Study design

This was an observational, retrospective, study of patients with a cancer diagnosis—that is with an International Classification of Diseases, 10th Revision (ICD-10) code of C0000–C9670—who visited the ED in 2018. All patients with a cancer diagnosis above 18 years who visited the ED between 1 January 2018 and 31 December 2018 were included and who had received their diagnosis of cancer within 5 years of their first ED visit in 2018 or received their diagnosis of cancer latest within the study year.

If a patient presented to the ED without a cancer diagnosis, but with symptoms indicative of cancer and which cancer was subsequently histologically confirmed (but within the study year), the patient was categorised as a 'new cancer diagnosis-related ED visit'. This subgroup of patients constituted 7.9% of all ED visits made by patients with cancer, thus resulting in altogether 189 ED visits (online supplemental file 2).[7]

We screened the hospital's electronic database for all patients who met the inclusion criteria. In the study year of 2018, there were altogether 27 010 visits made by patients 18 years and older at the ED, from which 2383 cases were made by patients who had received an ICD-10 cancer diagnosis latest in the year 2018, thus constituting 8.8% of all adult ED visits.

We carried out automated data collection with a special software, specifically developed for the purposes of the study, which included the collection of demographic data (patient's age at first ED visit, place of residence), date and time of the ED visit, number of ED visits per patient, visit day and visit hour category, type of cancer, type and number of comorbidities, time and date of prior oncological care, triage categorisation, chief complaints, diagnosis given following ED admission, disposition (admitted to inpatient care, discharged), place of inpatient care following ED presentation and, where relevant, time of death of the patient. Types of cancer, diagnoses of comorbidities, chief complaints and diagnoses given following ED admission were classified according to ICD-10. Patients were followed up for 36 months following their last ED visit and—where applicable—the death of the patients was recorded.

The definitions and criteria for the categorisation of data used in the study are attached as online supplemental file 1, as described previously.[7]

The primary outcome measures for this study were the predictors of multiple (≥2) ED visits within the study year, admission to inpatient care following the ED visit (hospitalisation), potentially preventable ED visits (defined as cases with a non-urgent triage category (triage level 5) plus not hospitalised plus who did not die within 30 days of the ED visit) and death within 36 months after ED presentation.

Online supplemental file 2 shows the demographic and clinical characteristics of patients with cancer (n=1512) visiting the ED in 2018.[7] Since a patient could present more than once at the ED within the study year, online supplemental file 3 shows the demographic and clinical characteristics of cancer cases (n=2383) visiting the ED in 2018, as described previously.[7]

The STROBE (STrengthening the Reporting of OBservational studies in Epidemiology) guidelines were used when designing and describing this study.[10] The checklist is attached as online supplemental file 4. The original research protocol is attached as online supplemental file 5.

Patients and public involvement statement

Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Data analysis

The data analysis framework was developed to address the research questions set for the study. Both descriptive and exploratory approaches were used. Two data sets were created: one contained the data of the 1512 patients with cancer who had attended the ED during the study period. The other data set included the total number of ED visits (2383 cases) made by the patients with cancer in the study period. The use of two data sets was necessary because a patient may have visited the ED more than once during the study period. Moreover, some of the characteristics were related to the patient (number of visits, data related to death), while others were related to the ED visit. Frequency tables were used to describe the number of ED visits made by patients with cancer, the demographic and clinical characteristics of ED cases and the number and time of death. A Kaplan-Meier survival analysis, using a log-rank test ($p \leq 0.05$), was conducted to examine the overall survival time of the patients. The mixed effects logistic regression was chosen (due to the possibility of the same patient's repeated visit) and used to determine the predictive factors for hospitalisation, potentially preventable ED visits and multiple (≥2) ED visits made by patients with cancer. The binary logistic regression was used to determine predictive factors for death within 36 months of patients with cancer visiting the ED. The dependent variables were the variables listed in tables 1–2 (the demographic and clinical characteristics of patients/cases). The models were checked for multicollinearity problems (tolerance <0.10 and VIF <3.0), and no multicollinearity issues were found. Statistical analyses were performed using the statistical software Jamovi V.2.2.5.

Table 1 Predictive factors for multiple (≥2) ED visits by patients with cancer

Predictors	OR	95% CI	Significance (p value)
Risk factors			
Number of comorbidities ≥2	1.40	1.16 to 1.69	<0.001
Chief complaint is dyspnoea	1.75	1.30 to 2.34	<0.001
Prior hospice care	1.87	1.05 to 3.31	0.032
Residence type: nursing home	3.09	1.88 to 5.07	<0.001
Protective factors			
New cancer diagnosis-related ED visit	0.39	0.28 to 0.56	<0.001
Prior hormone therapy	0.52	0.35 to 0.77	0.001
Prior surgery	0.59	0.45 to 0.77	<0.001
Diagnosis is injury	0.59	0.44 to 0.80	0.001
Breast cancer	0.69	0.49 to 0.98	0.037
Prior chemotherapy	0.71	0.54 to 0.94	0.015

ED, emergency department.

Table 2 Predictive factors for hospitalisation of patients with cancer

Predictors	OR	95% CI	Significance (p value)
Risk factors			
Diagnosis is gastrointestinal illness	1.35	1.01 to 1.79	0.040
Prior BSC/palliative care	1.53	1.01 to 2.33	0.045
Chief complaint is dyspnea	1.61	1.22 to 2.12	0.001
New cancer diagnosis-related ED visit	1.86	1.30 to 2.66	0.001
Protective factors			
Diagnosis is pain	0.28	0.19 to 0.40	<0.001
Diagnosis is injury	0.57	0.41 to 0.80	0.001
Chief complaint is extremity pain	0.61	0.44 to 0.84	0.003
Prior hormone therapy	0.62	0.42 to 0.93	0.022
Chief complaint is pain (except extremity and abdominal pain)	0.64	0.47 to 0.88	0.006

BSC, Best Supportive Care; ED, emergency department.

RESULTS

Predictive factors for multiple (≥2) ED visits made by patients with cancer

When we investigated which factors influenced multiple (2 or more) ED visits made by patients with cancer, we found that residence in a nursing home more than tripled the odds (OR: 3.09) of multiple ED visits. Prior hospice care and a chief complaint of dyspnoea increased the odds by 87% and 75%, respectively, while 2 or more comorbidities increased the odds somewhat less, but still significantly (OR: 1.40) for multiple ED visits. Prior surgical or hormone treatment, prior chemotherapy, a diagnosis of injury, having breast cancer were factors which significantly decreased the odds of multiple ED visits (OR: 0.59, 0.52, 0.71, 0.59 and 0.69, respectively) (table 1).

We also investigated the association between multiple visits and the 3-year survival of patients with cancer visiting the ED. There was no significant difference between the survival of patients with cancer visiting the ED once or multiple times (data not shown).

Predictive factors for hospitalisation of patients with cancer

Predictive factors for inpatient admission following an ED visit included a diagnosis of gastrointestinal illness (OR: 1.35), prior BSC/palliative treatment (OR: 1.53) and chief complaint of dyspnoea (OR: 1.61), which all

Table 3 Predictive factors for death of patients with cancer visiting the ED

	OR	95% CI
Risk factors		
Frequency of ED visits ≥2	1.80	1.36 to 2.35
Cancer of respiratory tract	2.13	1.44 to 3.17
Admission to inpatient care	2.23	1.68 to 2.94
BSC/palliative care	2.28	1.13 to 4.60
Residence type: nursing home	2.45	1.26 to 4.75
Hospice	2.68	1.11 to 6.46
New cancer diagnosis-related ED visit	3.28	2.09 to 5.14
Protective factors		
Prior hormone therapy	0.45	0.29 to 0.72
Prior surgery	0.56	0.41 to 0.75
Avoidable ED visits	0.59	0.40 to 0.87
Age is <65 years	0.64	0.49 to 0.84

ED, emergency department.

significantly increased the odds of subsequent hospitalisation. Patients with a new cancer-related visit also had 86% higher odds of being hospitalised following their ED visit (table 2).

Factors which predicted that there would be no hospital admission following the ED visit, were prior hormone treatment, diagnoses of injury or pain and chief complaints of pain in the extremities or elsewhere, except for abdominal pain (table 2).

Predictive factors for death within 36 months of patients with cancer visiting the ED

Prior hospice care (OR: 2.68), residence in a nursing home (OR: 2.45), prior BSC/palliative care (OR: 2.28), being hospitalised (OR: 2.23) and cancer of the respiratory tract (OR: 2.13) significantly increased the odds of death within 36 months after an ED visit. A new cancer-related ED visit more than tripled (OR: 3.28) the odds of death within 36 months (table 3).

Younger age (being less than 65), having a potentially preventable ED visit, as well as prior hormone or surgical therapy significantly decreased the odds of death within 36 months (table 3).

Predictive factors for potentially preventable ED visits of patients with cancer

We investigated whether predictive factors for potentially preventable ED visits could be identified, by analysing the association between demographic and clinical characteristics of patients meeting the criteria for being potentially preventable ED visits. A total of 445 ED visits out of 2383 met the criteria for potentially preventable ED visits, which constituted 18.67% of all ED visits (table 4).

A complaint of dyspnoea, prior BSC/palliative care and a subsequent diagnosis of a cardiovascular illness or gastrointestinal disease significantly decreased the odds of the ED visit being potentially preventable, with ORs of 0.38, 0.43 0.61 and 0.55, respectively (table 4).

Table 4 Predictive factors for potentially preventable ED visits of patients with cancer

Predictors	OR	95% CI	Significance (p value)
Factors increasing the odds of preventability			
Diagnosis is injury	1.46	1.04 to 2.04	0.028
Diagnosis is pain	1.47	1.03 to 2.10	0.035
Chief complaint is pain (except extremity, abdominal pain)	1.67	1.20 to 2.32	0.002
Chief complaint is extremity pain	1.73	1.24 to 2.40	0.001
Factors decreasing the odds of preventability			
Chief complaint is dyspnoea	0.38	0.22 to 0.64	<0.001
BSC/palliative treatment	0.43	0.19 to 0.96	0.040
Diagnosis is gastrointestinal illness	0.55	0.34 to 0.87	0.012
Diagnosis is cardiovascular illness	0.61	0.38 to 0.99	0.044
Off-clinic hours/holidays	0.80	0.64 to 1.00	0.046

ED, emergency department.

Pain in the extremities (OR: 1.73) and elsewhere, excepting abdominal pain (OR 1.67) as chief complaints, or diagnosis codes of pain (OR: 1.47) and injury (OR: 1.46) significantly increased the odds of the ED visit being potentially preventable (table 4).

DISCUSSION

To our knowledge, this is the first study to describe predictive factors of multiple ED visits, hospitalisation, potentially preventable visits and death of patients with cancer visiting a large tertiary care emergency centre, in one comprehensive investigation. Many of the independent predictive factors identified in our study have previously been reported in other studies—which support the validity of our findings—however, we were able to identify new independent factors of multiple ED visits, such as residency in a nursing home and risk factors of hospitalisation and poor overall survival, such as a 'new cancer-related ED visit', as well. The additional value of our study is that our data were collected from a Central-Eastern European site, where similar studies have not previously been reported.

Investigations from the USA and Australia have reported that a significant proportion of patients (between 44% and 63%) with cancer had multiple ED visits[11 12] In line with these results, we found that 57% of patients with cancer visiting the ED had 2 or more visits within the study year. We also identified that at least

two or more comorbidities, some form of prior hospice care, symptom of dyspnoea and living in a nursing home were significant risk factors for multiple ED visits. Our findings correspond with previous studies that have also described that a greater number of comorbidities,[6 12 13] more severe symptoms (such as dyspnoea)[14] and less than 1 year of survival after diagnosis[13 15] were all associated with higher rates of ED utilisation. The higher ED utilisation frequency and potentially preventable ED transfers by nursing home residents has only recently been investigated,[16] but data on the frequency of ED utilisation by patients with cancer living in nursing homes is scarce. Our analysis showed that living in a nursing home more than tripled the odds and thus was a strong risk factor for repeated ED utilisation. It has been suggested that the ED use of patients with cancer is most probably the result of the complex interaction of a number of factors, including both disease-related and health system-related factors.[6] Thus, although it is possible that frequent ED use among nursing home residents is a result of their overall poorer state of health, it also appears probable that the scarcity of nursing homes and lack of human resources to adequately provide care for the elderly may also be important contributing factors to the heightened burden of the EDs in Hungary. Although to a lesser extent, residency in a nursing home also increased the odds of death (OR: 2.45) within 3 years of ED presentation among patients with cancer in our study. This may naturally be the result of a higher number of comorbidities among these patients, however, it may also be due to the previously mentioned reasons of lack of optimal care. A large epidemiological Australian analysis indicated that a significant proportion of deaths were both premature and preventable in nursing homes and that no reduction in the prevalence of deaths due to external causes had been observed in the decade preceding the study.[17] Thus, our findings appear to emphasise the importance of improved care for nursing home residents and the integration of preventive methods—against falls, contraction of infections, malnutrition, dehydration, etc—among nursing home residents. The predictive factors of pain and injury as diagnosis and chief complaint of pain in the extremities for potentially preventable ED visits in our study may be explained partially by falls and injuries, which could also be potentially prevented. Furthermore, patients with minor injuries also present to the ED, which often do not even require imaging techniques (eg, X-ray, CT scan, etc) to treat, indicating that—possibly with the introduction of an outpatients phone triage system—these patients could potentially be treated at the primary healthcare level without having to burden the ED. Although studies vary regarding the proportion of ED visits being preventable, two previous reports have estimated it between 19% and 23%[18 19] which is similar to our findings of 18.67%.

The hypothesis regarding lack of specialised care may be extended to the interpretation of our subsequent findings; patients with cancer who were already receiving hospice care had almost twice the odds of having multiple ED visits than patients not in hospice care, indicating that these patients' needs (such as symptom management) were not being adequately met. Although most other studies have focused on ED visits made by patients with advanced cancer—and not hospice care per se—it has been reported that the use of palliative care services was still comparatively low among patients with cancer, and patients with advanced stage cancer regularly visited the ED due to worsening symptoms, since it was perceived to be the quickest way to obtain hospital admission.[20] A Dutch study reported that 65% of lung and patients with colon cancer with metastases used in-hospital medical care—including ED visits and inpatient care—yet specialised palliative care was initiated too late.[21] Furthermore, hospitalisation rates of patients with advanced cancer were found to be 76%[22] vs 58% among all oncology patients,[23] indicating that the highest inpatient admission rates were among patients with advanced stage cancer. These reports correspond with our findings that receiving 'only' BSC was a significant predictor of hospitalisation following the ED visit. A presenting main symptom of dyspnoea and a diagnosis of gastrointestinal illness were also important risk factors for hospital admission according to our study. In line with our results, it has previously been reported that dyspnoea and gastrointestinal symptoms, such as nausea, were frequent presenting symptoms of patients with cancer when visiting the ED.[24] Dyspnoea was an independent risk factor for hospitalisation and multiple ED visits, and the cancer types often associated with dyspnoea, that is, respiratory cancer, was an independent risk factor for death, in our study. Managing dyspnoea is often challenging, as it is highly distressing for both patient and caregivers, it can rarely be managed at home by the patient, and it may also indicate life-threatening pathological conditions, which may lead to or be part of disease progression and ultimately cause death as well.[25] Thus, the predictive factors of hospitalisation in our study (dyspnoea, ongoing BSC, diagnosis of a gastrointestinal illness and new cancer-related ED visit) indicated the more severe status of disease in these patients.

A recent scoping review identified three main themes which emerged across studies regarding the relationship of cancer diagnosis at the ED, including incidental findings giving rise to the suspicion of cancer, acute conditions caused by the cancer leading to the ED visit and ED use as a pathway to facilitate cancer diagnosis and care.[26] Independent of the main reason, all patients diagnosed with cancer through the ED, had more advanced cancers and subsequently poorer outcomes.[26] These findings of significantly poorer clinical and patient-reported outcomes and worse survival rates were reported in earlier[27] and recent publications as well, including the International Cancer Benchmarking Partnership population-based study.[28] In line with previous reports, our results showed that new cancer-related ED visits more than tripled the odds of death within 3 years, furthermore we also found, that new cancer-related ED visits almost doubled the odds of hospitalisation.

Previous studies have reported that elderly patients with cancer with multiple ED visits had higher hospital admission rates and an increased mortality during admission.[29 30] In accordance with these studies, ongoing BSC or hospice care, cancer of the respiratory tract, hospitalisation and multiple ED visits also increased the odds of death within 3 years among patients with cancer in our analysis.

Limitations

Our study has certain limitations. It was a retrospective study and carried out at a single site, therefore, further analyses need to be made in multiple sites for the confirmation of our findings. Also, due to the classification of certain data (diagnoses, symptoms, types of cancer, etc) into main categories, classification bias cannot be ruled out Finally, although patients with cancer treated at our hospital need to present with their symptoms to our ED centre, some patients with cancer may have been presented elsewhere (eg, when out of the county or country), and so these patients may not have been included. Despite being a single site, our study was a comparatively large, comprehensive study, where data regarding a wide range of parameters were collected and extensive analysis performed.

Conclusions

In our study, we identified predictive factors of multiple ED visits, hospitalisation, preventable visits and death within 3 years of ED presentation of patients with cancer visiting a tertiary-level ED centre. As far as we know, this is the first study to investigate these factors in one analysis and from a Central-Eastern European country. Since most studies have been published from highly developed countries, our investigation may shed some light on the specific challenges faced by countries in the region. Our novel findings include that new cancer-related ED visits and being a resident of a nursing home, both independently increased the odds of hospitalisation and death of patients with cancer visiting the ED; and nursing home residency and hospice care (indicating advanced cancer) increased the odds of multiple ED visits. These results imply the importance of strengthening care and implementing preventive measures related to these risk factors—not just from a regional but—from an international perspective, as well.

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Contributors MK collected, reviewed and analysed the data and prepared the manuscript. ES reviewed the literature, analysed the data and prepared the manuscript. CV, IK and EP reviewed the literature and designed the study. VS developed the software for the automated data collection. LPr and LPo collected and reviewed the data. SB analysed the data and reviewed data collection. JG and KG performed the statistical analysis, analysed the data and prepared the manuscript. EP, IK and CV analysed the data and reviewed the manuscript. All authors read and approved the final manuscript. ÉP is the guarantor of the study.

Funding The study was supported by the János Bolyai Research Scholarship of the Hungarian Academy of Sciences 2022 (no award/grant number) and the University of Pécs 'Dr. Pintér András Medical School Collaboration Foundation (University of Pécs Medical School-TANDEM, 2021)' Grant (no award/grant number).

Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

Ethics approval Ethical permission from the Regional Ethical Committee of the University of Pécs Medical School was gained before the research procedure under the reference number 8280-PTE2020. All methods were carried out in accordance with the Declaration of Helsinki and the relevant guidelines and regulations. All experimental protocols were approved by the Regional Ethical Committee of the University of Pécs Medical School. Consent from participants was not required according to the regulations of the Regional Ethical Committee of the University of Pécs Medical School since no individual identifiable patient data/images were used and/or presented in the current study, thus the need for informed consent for the present study was waived by the Regional Ethical Committee of the University of Pécs Medical School.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available on reasonable request. The datasets generated and/or analysed during the current study are not publicly available due to data privacy of human patients but are available from the corresponding author on reasonable request.

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Supplementary file 1: Definitions and criteria for the categorization of data used in the study.

(As described previously in (1)

Demographic and Clinical Data	**Definition/Categorisation**
Age (years)	≤65 or >65 years
Time of ED visit	
Regular clinic hours	Non-holiday weekdays Monday through Friday between 8:00-16:00,
Off-clinic hours	Weekends or holidays or weekdays 16:01-07:59
Types of Cancer (12 categories)	Colorectal cancer, Breast cancer, Gastroesophageal cancers (including cancers of the stomach and the esophagus), Genitourinary cancers (including all cancers of the genitourinary tract, except prostate cancer), Prostate cancer, Head and neck cancers, Cancers of the pancreas, liver, biliary tract, and the small intestine, Respiratory (mostly lung) cancers, Hematological malignancies, Melanoma, Non-melanoma skin cancers, Other (including all other primary cancers excluded from the other categories and metastases).
Number of comorbidities	0, 1, ≥2
Oncological care prior to ER visit	Any type of inpatient or outpatient oncological care (BSC, palliative care, hospice) or treatment (chemo-, radio-, immunotherapy or surgery), which the patient received closest to the current ED visit's date.
Types of Oncological care	Surgical-, radio-, chemo-, immune- or biological- and hormone treatments as well as supportive care (BSC/palliative care) and hospice
Time elapsed between the given ED visit and prior oncological care	The number of days between the first day of any form of the previous oncological care and the date of the nearest subsequent ER visit, collapsed into two categories: "≤30 days" and ">30 days"

Triage (MSTR, Hungarian Emergency Triage System)	5, Non-urgent 4, Less urgent 3, Urgent 2, Emergent 1, Resuscitation For the purpose of the analysis, Triage level 1-4 patients were classified as „urgent" and Triage level „5" patients as non-urgent.
Chief complaints	Main symptom or complaint of the patient, the reason the patient visited our ED. Classified according to the ICD-10 coding, were collapsed into 21 main categories based on the affected organs and/or the frequency of the given symptom as determined by the expert group.
Diagnosis given following ED admission	Diagnosis given following ED admission indicates the patient's present disease/medical condition for which he/she visited the ED. It is the final diagnosis given by the emergency physician who evaluated the patient after ED admission. Classified according to the ICD-10 coding, diagnoses were collapsed into 24 main categories based on the affected organs and/or the frequency of the given symptom as determined by the expert group.
Destination from ED	Grouped into 3 categories: discharged to place of primary residence, admitted to the inpatient area or discharged against medical advice.
BSC/palliative care	Best supportive care or specialized palliative care, where available

1. Koch M, Varga C, Soós V, Prenek L, Porcsa L, Szakáll A, et al. Main reasons and predictive factors of cancer-related emergency department visits in a Hungarian tertiary care center.

Supplementary file 2: The demographic and clinical characteristics of cancer patients (N=1512) visiting the ED in 2018 (1).

	n	%
Total number of patients with cancer at the ED in 2018	1512	100 %
Age (years)		
≤65	571	37.8%
>65	941	62.2%
Sex		
Male	754	49.9%
Female	758	50.1%
Time of admission		
Regular clinic hours (weekdays/non-holidays 8-16h)	659	43.6%
Off-clinic hours/holidays	853	56.4%
Tumor type		
Colorectal	243	16.1%
Breast	194	12.8%
Urogenital (excepting prostate)	193	12.8%
Respiratory	184	12.2%
Non-melanoma skin cancer	169	11.2%
Prostate	125	8.3%
Hematological	93	6.2%
Pancreas. Small intestine. Liver. Gallbladder and biliary tract	75	5%
Head and neck	62	4.1%
Gastroesophageal	57	3.8%
Melanoma	37	2.4%
Other	80	5.3%
Number of comorbidities		
None	250	16.5%
1	353	23.3%
≥2	909	60.1%
Prior oncological care		
No	207	13.7%
Yes	1305	86.3%
Surgery	422	27.9%
Chemotherapy	298	19.7%
Radiotherapy	209	13.8%
Hormone therapy	165	10.9%
Immune/Biological therapy	69	4.6%
BSC*/palliative care	82	5.4%
Hospice care	60	4%
Frequency of ED visits		
1x	1024	67.7%
≥2x	488	32.3%
New cancer diagnosis-related ED visit	115	7.6%
Treatment requirement following ED presentation		
Admission to inpatient care	685	45.3%

Discharged home	827	54.7%
Residence type		
Home	1462	96.7%
Nursing home	50	3.3%
Death		
<30 days	252	16.7%
30 days-36 months	640	42.3%
>36 months	620	41%
Preventability of ED visits		
Preventable	296	19.6%
Non-preventable	1216	80.4%

1. Koch M, Varga C, Soós V, Prenek L, Porcsa L, Szakáll A, et al. Main reasons and predictive factors of cancer-related emergency department visits in a Hungarian tertiary care center.

Supplementary file 3: The demographic and clinical characteristics of ED cases by cancer patients in 2018 (1).

	n	%
Total number of ED visits by patients with cancer	2383	100%
Age (years)		
≤65	906	38.0%
>65	1477	62.0%
Sex		
Male	1168	49.0%
Female	1215	51.0%
Time of admission		
Regular clinic hours (weekdays/non-holidays 8-16h)	1007	42.3%
Off-clinic hours/holidays	1376	57.7%
Tumor type		
Colorectal	392	16.4%
Respiratory	341	14.3%
Urogenital (excepting prostate)	325	13.6%
Breast	275	11.5%
Non-melanoma skin cancer	229	9.6%
Prostate	201	8.4%
Pancreas. Small intestine. Liver. Gallbladder and biliary tract.	135	5.7%
Hematological	119	5.0%
Gastroesophageal	87	3.7%
Head and Neck	85	3.6%
Melanoma	50	2.1%
Other	144	6.0%
Number of comorbidities		
None	369	15.5%
1	516	21.7%
≥2	1498	62.9%
Prior oncological care		
No	388	16.3%
Yes	1995	83.7%
Surgery	609	25.6%
Chemotherapy	476	20.0%
Radiotherapy	340	14.3%
Hormone therapy	232	9.7%
Immune/Biological therapy	113	4.7%
BSC*/palliative care	135	5.7%
Hospice care	90	3.8%
Frequency of ED visits		
1x	1024	43%

≥2x	1359	57%
New cancer diagnosis-related ED visit	189	7.9%
Treatment requirement following ED presentation		
Admission to inpatient care	983	41.3%
Discharged home	1384	58.1%
Discharged against medical advice	16	0.7%
Discharge type		
Home	2281	95.7%
Nursing home	102	4.3%
Triage categories (MSTR**)		
5. Non-urgent	634	26.6%
4. Less urgent	1028	43.1%
3. Urgent	613	25.7%
2. Emergent	30	1.3%
1. Resuscitation	17	0.7%
Not recorded	61	2.6%
Chief complaints (top 5)		
Other pain (Except extremity-, abdominal pain)	521	21.9%
Extremity pain	442	18.5%
Dyspnea	321	13.5%
Abdominal pain	309	13.0%
Nausea and vomiting	150	6.3%
Diagnosis given following ED admission (top 5)		
Injury	400	16.8%
Gastrointestinal illness	318	13.3%
Pain	275	11.5%
Chest pain	245	10,3%
Cardiovascular illness	242	10.2%
Preventability of ED visits		
Preventable	445	18.7%
Non-preventable	1938	81.3%

*Best Supportive Care
**Magyar Sürgősségi Triage Rendszer (Hungarian Emergency Triage System)

1. Koch M, Varga C, Soós V, Prenek L, Porcsa L, Szakáll A, et al. Main reasons and predictive factors of cancer-related emergency department visits in a Hungarian tertiary care center.

Supplementary file 4: STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2-3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	6
Objectives	3	State specific objectives, including any prespecified hypotheses	7
Methods			
Study design	4	Present key elements of study design early in the paper	8
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	7
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants	NA NA 8
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case	NA NA
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	9
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	9-17 Suppl.file
Bias	9	Describe any efforts to address potential sources of bias	16-17
Study size	10	Explain how the study size was arrived at	8
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	16-17-Suppl.file
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	16-17
		(*b*) Describe any methods used to examine subgroups and interactions	16-17
		(*c*) Explain how missing data were addressed	8
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed	NA NA

Case-control study—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy	16-17
(*e*) Describe any sensitivity analyses	NA

Continued on next page

Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	8-16
		(b) Give reasons for non-participation at each stage	NA
		(c) Consider use of a flow diagram	NA
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	8-16
		(b) Indicate number of participants with missing data for each variable of interest	NA
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)	NA
Outcome data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time	NA
		Case-control study—Report numbers in each exposure category, or summary measures of exposure	NA
		Cross-sectional study—Report numbers of outcome events or summary measures	17-22
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	16-17
		(*b*) Report category boundaries when continuous variables were categorized	Suppl.File
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	NA
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	16-17
Discussion			
Key results	18	Summarise key results with reference to study objectives	22,26-27
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	26
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	22-27
Generalisability	21	Discuss the generalisability (external validity) of the study results	26-27
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	5

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

Supplementary file 5

RESEARCH PROTOCOL

Title: *Prevalence, characteristics and predictors of cancer patients presenting to emergency departments.*

Background and rationale for the study

Cancer is the second leading cause of mortality in developed countries, including Hungary, and the care of cancer patients places an extremely high burden on society. Within the healthcare system, in addition to oncologists, a number of health care professionals are involved in the care of cancer patients, and a significant proportion of patients present to emergency departments as a consequence of their cancer, its treatment or for completely unrelated medical reasons. Although some emergency department visits are justified and necessary, the literature suggests that 12% of presentations do not warrant emergency care and 56% of cases could be prevented.[1] The existing data suggest that patients who are undergoing or have undergone oncological treatment utilize emergency care between 1-83%, but is certainly more frequent than the average non-cancer population.[2] Previous studies in the United States have shown that cancer patients presenting to the emergency room while undergoing treatment have worse overall outcomes and hospital readmissions increase health care costs compared to patients with cancer but without emergency hospitalisation[3].

In our country (nor in the Central-Eastern European region), no study has been conducted to investigate the incidence, characteristics, and predictors of emergency care utilization of cancer patients presenting to emergency departments.

Objectives of the study

The aim of our study is:

-to describe and analyze the characteristics of cancer patients visiting the ED in a tertiary care hospital in Hungary

- identify predictive factors of multiple ED visits, hospitalization and potentially preventable ED visits made by cancer patients.

-to analyze the relationship between frequency of ED visits and the 3-year survival of patients with cancer.

Study design

Observational, retrospective study. Data collected cross-sectional, with follow-up of patients regarding survival.

Outcome measures

-clinical and demographic characteristics of cancer patients visiting the ED

-the predictors of multiple (≥2) ED visits within the study year

-admission to inpatient care following the ED visit (hospitalization)

-potentially preventable ED visits (defined as cases with a non-urgent triage category Triage level 5 plus not hospitalized plus who did not die within 30 days of the ED visit)

-death within 36 months after ED presentation

Target population (participants)

The study will include cancer patients, with an ICD-10 "C" code (C0000-C9670) who present to the emergency department from 01/01/2018 to 31/12/2018

It is a single-site study, conducted in one emergency centers, with a coverage area of the South Transdanubian region.

The site of the study/data collection is:

- The Emergency Care Centre of the Kaposvár Kaposi Mór Teaching Hospital

Sites of data analysis:

- The Emergency Care Centre of the Kaposvár Kaposi Mór Teaching Hospital

- The Department of Emergency Medicine of the University of Pécs Clinical Centre of Kaposi Mór Municipal Hospital

- The Department of Public Health Medicine, Faculty of General Medicine, University of Pécs

- The Department of Primary Care of the Faculty of General Medicine of the University of Pécs

Criteria for patient admission:

-Adult patients over 18 years of age

-who visited the ED between 1 January - 31 December 2018

-had received their diagnosis of cancer within 5 years of their first ED visit in 2018 or received their diagnosis of cancer latest within the study year.

-have an ICD-10 code "C", which has been documented electronically at least twice

- If a patient presented to the ED without a cancer diagnosis, but with symptoms indicative of cancer and which cancer was subsequently histologically confirmed (but within the study year), the patient is categorized as a “new cancer diagnosis-related ED visit”.

Investigated data

I. Demographic and (baseline) clinical data:

- sex and age distribution
- place of residence
- type of cancer
- presence of other diseases (comorbidity)
- smoking/alcohol consumption
- educational level

II. Variable data:

- stage of the tumor
- type and date of oncological treatment
- Hospice care admission (type and date, hospital, or home care)
- admission to palliative specialist care/BSC, type and date
- type of emergency referral (with/without GP referral)
- number of emergency department visits (1 or more) with dates
- complaints +symptoms the complaint(s) justifying the emergency department visit
- medical condition justifying the emergency department visit (emergency department diagnosis)
- the date of the emergency department visit
- the triage classification at the time of admission to the emergency department
- the number of patients discharged from the emergency department to in-patient admission (hospitalization)

- the number of days spent in hospital following admission

- the nature of the inpatient stay (active/chronic)

- the diagnosis justifying the inpatient stay

- mortality in the emergency department or in hospital following admission

-follow-up at 36 months

Planned methods

Data collection will be carried out by automated software system (specifically designed for the study) and reviewed by researchers appointed by the heads of the institutes or departments of the participating institutions, following receiving full ethical approval.

The data will be collected from the electronic databases of the Clinical Centre of the University of Pécs and the eMedSol software of the Kaposi Mór Teaching Hospital.

Patient data are collected in Excel spreadsheets (see Annex 1).

The same patient may present to the emergency department several times after the same oncological treatment. In this case, variable data for the same patient are collected in separate rows in the spreadsheet. If the patient undergoes repeated oncological treatment, the next time of emergency department attendance is counted from the date of the latter. The demographic (baseline) data are recorded according to the documentation of the first emergency department visit, while the other (variable) data depend on the frequency and type of emergency department visit.

The Charlson Comorbidity Index (CCI) is defined as a predictor of 1-year mortality based on a patient's comorbidities. The medical conditions listed in the CCI will be registered as comorbidities besides the cancer diagnosis.

Categories will be made, based on raw data, regarding, symptoms, medical diagnosis at the ED, cancer types, type of hospital admission.

Patients will be followed up for 36 months to determine if they died or not (time and date of death shall be registered.

Processing of data

Statistical processing of the data will be performed using Jamovi 2.2.5. Both descriptive and exploratory approaches will be used. Two data sets will be created for ED patients and ED cases, separately, since one patient may present themselves more than one time within the study year. Standard descriptive statistics, frequency tables, log-rank test (for Kaplan-Meier survival analysis) and mixed effects as well as binary logistic regression analysis will used for data analysis. Multicollinearity will be checked. For statistical tests (t test, Chi-square test or Fisher exact test), $p < 0.05$ is considered significant.

Expected results (benefits of the research)

Patients with cancer visit emergency care more frequently than noncancer patients of the same age and sex. 58% of cancer patients are admitted to an inpatient facility, in contrast to 12.5% of their noncancer counterparts who are hospitalized, although a national study suggests that this figure may be as high as 22.2% in our country.[4,5] Our research aims to identify the risk factors that make cancer patients more likely to visit the emergency department. Such a study of cancer patients in large regional emergency centres has not been conducted in Hungary so far. A novel approach to the problem, also in comparison to foreign literature, is to study the different aspects of the cancer patients' ED visits in one comprehensive study.

By obtaining information on the emergency room attendance of cancer patients, it is possible to highlight high-risk groups, target patient education, and other planned (non-emergency) care. This is expected to increase patient satisfaction and reduce the burden on emergency department staff and improve the quality of patient care.

Planned time of the study

The total duration of the data collection period is expected to be 18 months. Data analysis and preparation of planned publications: 6 months.

Arrangements for handling personal and health data of participants

In the study, patients' data will be treated anonymously, using a unique identifier. Personal and health data will be processed in accordance with the legislation in force.

Ethical permission from the Regional Ethical Committee of the University of Pécs Medical School will be applied for. All methods will be carried out in accordance with the Declaration of Helsinki and the relevant guidelines and regulations

Planned costs

The administrative tasks will be carried out by the staff of the institutions participating in the study and will require a computer system. A dedicated software for screening of data will be developed.

Sincerely,

Eva Pozsgai MD, PhD

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Sources

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