Original Article

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Reasons and Associated Factors for Emergency Room Visits of Cancer Patients in a Tertiary Hospital, Thailand

Thammasin Ingviya, M.D., Ph.D.[1,2], Chanavee Toh[3], Suppalerk Chavasiri[3], Orapan Fumaneeshoat, M.D.[1]

[1]Department of Family and Preventive Medicine, Faculty of Medicine, Prince of Songkla University, Hat Yai, Songkhla 90110, Thailand.
[2]Division of Digital Innovation and Data Analytics, Faculty of Medicine, Prince of Songkla University, Hat Yai, Songkhla 90110, Thailand.
[3]Faculty of Medicine, Prince of Songkla University, Hat Yai, Songkhla 90110, Thailand.

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Abstract:

Objective: To investigate the reasons leading cancer patients to visit an emergency room (ER) and the associated factors, which will suggest policies to reduce unnecessary ER visits.

Material and Methods: A cross-sectional study was done in Songklanagarind Hospital, the major referral center in Southern Thailand. The data of cancer patients aged 18 years or older diagnosed during 2011 to 2018 were retrieved from our Hospital Information System. The reasons for the ER visits were defined and classified using the "chief complaints" from doctors' notes. A negative binomial regression model was used to assess factors associated with the ER visits.

Results: A total of 42,574 cancer patients were identified during the study period. 8,307 (19.5%) had visited the ER at least once. The most common cancer type was of the digestive organs (28.1%). The top 5 reasons for an ER visit were pain (25.4%), dyspnea (11.5%), abdominal discomfort (6.0%), fever (5.9%), and stoma and catheter device-related problems (5.2%). The most common factors associated with ER visits were age, metastasis, palliative chemotherapy or radiotherapy, previous hospitalization, years with cancer, type of cancer and healthcare scheme.

Conclusion: Pain and dyspnea were the two most common chief complaints leading cancer patients to visit the ER. These two symptoms should be given special attention in cancer patients, especially those receiving chemotherapy or radiation, to ensure they are well controlled and do not lead to unnecessary ER visits.

Keywords: cancer, chief complaint, ER visits, palliative care, symptoms

Contact: Orapan Fumaneeshoat, M.D.
Department of Family and Preventive Medicine, Faculty of Medicine,
Prince of Songkla University, Hat Yai, Songkhla 90110, Thailand.
E-mail: Orapan.f@psu.ac.th

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Introduction

Cancer is a major cause of morbidity and mortality.[1] The physical and psychological symptoms of cancer patients often worsen in the later stages as death approaches.[2] These symptoms can be severe enough to require emergency room (ER) visits where they can access unscheduled medical care, often including specialists of various kinds for symptoms they are experiencing, thus placing increased burdens on the ER staff.[3] Commonly reported physical problems in cancer patients visiting the ER are pain, respiratory distress, gastrointestinal problems, fatigue, delirium and loss of consciousness.[4] Apart from physical symptoms, patients and their families may also visit an ER for psychological symptoms such as death anxiety or feeling reassured by the presence of healthcare professionals and desiring to have their condition monitored, especially when the distress is severe or in out-of-hours.[5] Some patients consider ER visits as undesirable and to be considered only as a last-resort solution for relief of their problem, but the distress caused by their disease and the required burden of care leads to many ER visits.[6]

The high rate of ER visits by cancer patients is of increasing concern to the international health care community and efforts have been made to develop strategies to reduce ER visits that are potentially avoidable.[7] A patient-focused team approach including assessing the patient's understanding of the disease and its prognosis and providing necessary and adequate information, and providing specific treatments or managements at the patient's home, have been proven to reduce unplanned ER visits of patients and their caregivers.[8] Recent studies have suggested that around 40% of these emergency visits by cancer patients could be avoided.[9]

The purpose of this study was to identify the characteristics of the cancer patients visiting the ER of the major tertiary care and referral center in southern Thailand and the reasons leading to their visits. Factors deemed to be modifiable were then assessed in an attempt to identify possible actions in which the number of ER visits from this patient group could be reduced without in any way lessening the quality of the patient's care. Our paper also introduces a novel method for analyzing the large amount of medical data often included in doctors' notes, in order to enable efficient retrieval and classification of "chief complaints" from our hospital information system. And as most of the doctors' notes in our hospital are in the Thai language, we thus also used a Natural Language Processing technique for the Thai language, which has special difficulties as it is a tonal and analytic language like Vietnamese and Chinese, as part of this novel analysis.

Material and Methods

Study design, settings and participants

A retrospective chart review study was done in 2020 in Songklanagarind Hospital, the largest tertiary care institution and the major referral center in southern Thailand. The data sources were the Hospital Information System (HIS) and cancer registry. The records of cancer patients registered in the registry between 2011 and 2018 aged 18 years or older were retrieved as the initial dataset for the analysis.

The exclusion criteria were non-Thai ethnicity, International Statistical Classification of Diseases and Related Health Problems-Tenth Revision-Thai Modification (ICD-10-TM) diagnosis D37 to D48, uncertain tumor behavior, or confirmed cancer diagnosis before 1st January 2011.

The time from diagnosis to the end of the study period on 31st December 2018 was calculated as the observation time for each patient.

Study procedures and data management

The study protocol was approved by the Office of the Human Research and Ethics Committee, Faculty of Medicine, Prince of Songkla University, number REC.63-280-9-1.

Patient information including gender, age, medical care coverage, diagnosis based on the ICD-10-TM, chief complaint, cancer type, diagnostic date, metastatic site(s), palliative care consultation and history of previous hospitalization(s) within 90 days prior to the ER visit(s) were retrieved.

The cancer patients who visited the ER were identified using hospital numbers recorded in both the cancer registry and the HIS. The chief complaint was defined as the main reason prompting the ER visit. The chief complaints were recorded in the Thai language as a part of the doctors' notes. The Prince of Songkla University (PSU) HIS was developed over 10 years ago, and since then all doctors' notes have been electronically recorded in the HIS. The doctors' notes were extracted from the HIS using "query" in the Structured Query Language (SQL) by a data scientist. To identify the chief complaints from the free-text doctors' digitalized notes, natural language processing was performed using R Program version 4.0.3 (R Core Team, Austria) with the 'LexTo' package. The chief complaints in the Thai language were extracted using a tokenization technique and regular expressions from the doctors' notes which were written in a mixture of Thai and English words. Then the chief complaints in Thai were classified into symptom groups using 'regular expressions' in Thai. The group names were then translated into English for the purpose of the English report as shown in Supplementary Table 1. A single complaint could be associated with multiple symptom groups; for example, abdominal pain was grouped into both the pain and gastrointestinal groups.

Sample size

The required sample size to quantify the prevalence of different symptoms leading cancer patients to visit the Emergency Department was calculated using the formula to estimate a proportion of samples drawn from an infinite population.

The Z score value of a type 1 error was set at 1.96. The estimated proportion of patients visiting the ER due to pain was set at 0.621 following the study of Caterino et al. The margin of error (€) was set at 0.025, and finally the calculated required sample size was 1,447 patients. From the cancer registry, the total number of cancer patients included in our study was 42,574. Thus, the number of patients included was considered adequate for the objectives of this study.

Statistical analysis

R program version 4.0.3 was used for data management, statistical analysis and text mining. A data dictionary was created for converting Thai language words to common words for chief complaints in English. To do this, the chief complaints in Thai were retrieved from the free-text doctor annotations using a string marker 'cc'. The retrieved text was then converted from the Thai language into English common terminology using the created data dictionary. The chief complaints were then grouped into the 10 most common groups of complaints, namely pain, dyspnea, stoma and catheter device problems, fever, abdominal discomfort, fatigue, nausea/vomiting, diarrhea, wound care and alteration of consciousness.

The results were then summarized into tables with numbers and percentages. To compare the characteristics of the cancer patients who had visited the ER with the patients who had never visited the ER, Fisher's exact test was performed. A Wordcloud was created to graphically portray the most common chief complaints. To assess the possible effects of observation time on the number of visits of each patient, Spearman's rank correlation coefficient was calculated. For inferential statistics to assess the factors associated with the rates of ER visits, a negative binomial regression model was used rather than Poisson regression because the over-dispersion test was statistically significant.

Results

From 2011–2018, 42,574 cancer patients 18 years and older were identified from the cancer registry of our institution. Of these patients, 8,307 (19.5%) had visited the ER at least once while the rest of the patients had never visited the ER.

Of the enrolled patients who had visited the ER, 3,935 (47.4%) were female and 4,372 (52.6%) were male, with ages ranging from 18 to 100 years with the most common age group from 41 to 80 years. The most common cancer type was cancer of the digestive organs (28.1%). About half of the patients were under the Thai Universal Coverage Scheme (UCS) (50.1%). The characteristics of the study patients including gender, age, type of cancer and healthcare scheme are shown in Table 1.

Table 1 Characteristics of study cancer patients

Characteristic	No ER visits (%)	ER visits (%)	p-value[1]
Total number	34,267 (80.5)	8,307 (19.5)	
Gender			<0.001
Female	18,283 (53.4)	3,935 (47.4)	
Male	15,983 (46.6)	4,372 (52.6)	
Age group (years)			<0.001
18–30	1,285 (3.7)	247 (3.0)	
31–40	2,905 (8.5)	566 (6.8)	
41–50	6,220 (18.2)	1,350 (16.3)	
51–60	8,746 (25.5)	2,202 (26.5)	
61–70	7,692 (22.4)	2,037 (24.5)	
71–80	5,333 (15.6)	1,378 (16.6)	
81–90	1,950 (5.7)	483 (5.8)	
91–100	1,36 (0.4)	44 (0.5)	
Cancer group (by ICD-10)			<0.001
Digestive organs	7,812 (22.8)	2,333 (28.1)	
Respiratory and intrathoracic organs	4,776 (13.9)	1,341 (16.1)	
Female genital organs	4,748 (13.9)	1,211 (14.6)	
Lip, oral cavity and pharynx	3,375 (9.8)	995 (12.0)	
Breast	4,233 (12.4)	636 (7.7)	
Lymphoid and hematopoietic tissue	2,581 (7.5)	588 (7.1)	
Male genital organs	965 (2.8)	283 (3.4)	
Urinary tracts	884 (2.6)	219 (2.6)	
Melanoma and skin	883 (2.6)	174 (2.1)	
Eye, brain and central nervous system	488 (1.4)	153 (1.8)	
Ill-defined and unspecified sites	631 (1.8)	116 (1.4)	
Thyroid and other endocrine glands	2,125 (6.2)	116 (1.4)	
Mesothelial and soft tissue	527 (1.5)	114 (1.4)	
In-situ neoplasm	66 (0.2)	1 (0.0)	
Bone and articular cartilage	99 (0.3)	13 (0.2)	
Neoplasm of uncertain behavior	70 (0.2)	12 (0.1)	
Other disorders of blood	4 (0.0)	2 (0.0)	
Healthcare Scheme			<0.001
Universal care coverage	20,764 (60.6)	4,164 (50.1)	
Social security scheme	2,483 (7.2)	439 (5.3)	
Civil servant medical benefit scheme	6,605 (19.3)	2,612 (31.4)	
Local government	591 (1.7)	188 (2.3)	
Cash	3,756 (11.0)	893 (10.7)	
Other	68 (0.2)	11 (0.1)	

Table 1 (continued)

Characteristic	No ER visits (%)	ER visits (%)	p-value[1]
Palliative chemotherapy and/or radiotherapy			<0.001
Ever	2,501 (7.3)	890 (10.7)	
Never	31,766 (92.7)	7,417 (89.3)	
Metastasis			<0.001
Any	5,344 (15.6)	2,232 (26.9)	
None	28,923 (84.4)	6,074 (73.1)	
Years after diagnosis (median (Q1–Q3)) (years)[2]		0.5 (0.1–2.0)	NA
Time from diagnosis to end of study period (median (Q1–Q3)) (years)		4.6 (2.6–6.3)	NA
Number of ER visits per patient (median (Q1–Q3)) (visits)		3.0 (1.0–6.0)	NA
Number of ER visits per patient per year (median (Q1–Q3)) (visits)		1.0 (1.0–2.0)	NA

[1]p-value was calculated by Fisher's exact test. [2]Years after diagnosis of the ER visits thus cancer patients who never visited the ER not included. NA due to no comparison group

Figure 1 Wordcloud showing reasons for study cancer patients visiting the emergency room
(The size of the word indicates the relative frequency of the reason)

The median (IQR) number of ER visits was 3.0 (1.0–6.0) visits per patient throughout the study period. The median number was 1.0 (1.0–2.0) visits per patient per year. The median (IQR) time from diagnosis to the end of the study period (observation time) was 4.6 (2.6–6.3) years. The correlation between the observation time and the number of ER visits was quite low with a Spearman's rank correlation coefficient of 0.063. Notably, the median (IQR) number of ER visits by the subgroup of 890 patients receiving palliative chemotherapy and/or radiotherapy was 3.0 (1.0–7.0) visits per patient, which was slightly higher than the median number for the 7,417 patients not receiving palliative chemotherapy and/or radiotherapy while the observation times of the two groups were similar (Supplementary Table 2).

The reasons for the ER visits are summarized by the Wordcloud shown in Figure 1. The size of each word represents the prevalence of that reason for the ER visits. Pain ("ปวด" in Thai) was the most common reason (Figure 1).

The top 5 reasons for the ER visits were all related to worsening or active symptoms, except for stoma and catheter device-related problems: pain (25.4%), dyspnea (11.5%), abdominal discomfort (6.0%), fever (5.9%), and stoma and catheter device-related problems (5.2%) (Table 2).

The top 5 most common pain locations leading to ER visits were abdomen (41.6%), chest (12.0%), head and skull (6.6%), lower extremities (6.6%), and back (6.6%) (Table 3).

The top 3 types of medical device problem related to ER visits were percutaneous feeding tube (51.6%), nasogastric tube (18.4%) and percutaneous drainage devices (9.0%) (Supplementary Table 3).

Table 2 Ten most common reasons for study cancer patients to visit the emergency room

Reason for ER visit	Number of visits (% of total number of visits) (N=17,125)
1. Pain	4,357 (25.4)
2. Dyspnea	1,970 (11.5)
3. Abdominal discomfort	1,035 (6.0)
4. Fever	1,013 (5.9)
5. Stoma or catheter device problem	884 (5.2)
6. Malaise	812 (4.7)
7. Nausea and vomiting	612 (3.6)
8. Diarrhea	511 (3.0)
9. Animal-related	336 (2.0)
10. Dizziness	317 (1.9)

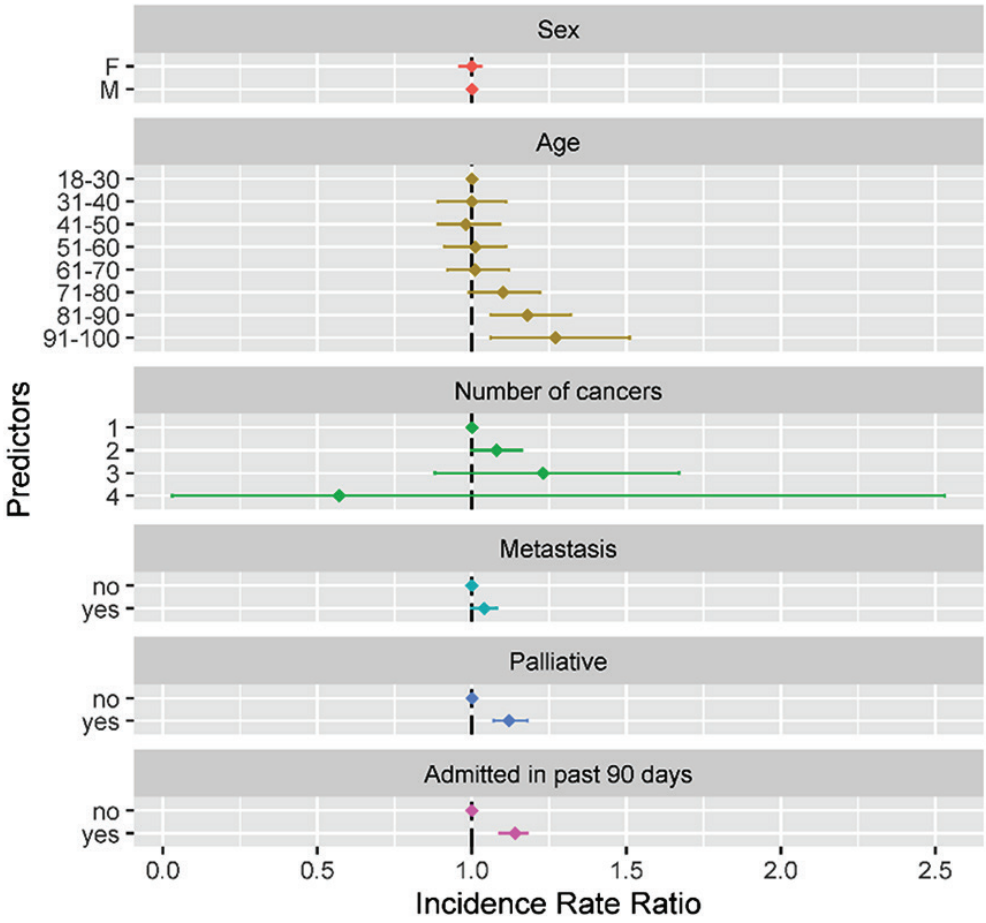
ER=emergency room

Table 3 Top 10 locations of pain of study cancer patients

Location of pain	Number of visits (% of total number of visits due to pain) (N=4,357)
1. Abdomen	1,811 (41.6)
2. Chest	523 (12.0)
3. Head and skull	290 (6.6)
4. Lower extremities	289 (6.6)
5. Back	288 (6.6)
6. Oral cavity	245 (5.6)
7. Neck	124 (2.8)
8. Upper extremities	106 (2.4)
9. Anus	99 (2.3)
10. Bone	98 (2.2)

The main factors associated with a higher probability of an ER visit were age, metastasis, currently receiving palliative chemotherapy or radiotherapy, hospitalization within 90 days prior to the ER visit, years after the cancer diagnosis, type of cancer and healthcare scheme. With each year in time since a cancer diagnosis, the incidence rate of visiting the ER increased by 4%. Patients under the

Civil Servant Medical Benefit Scheme (CSMBS) were more likely to visit the ER than those under the UCS (incidence rate ratio=1.1; 95% confidence interval: 1.0–1.1). Compared to patients with cancer of the respiratory and intrathoracic organs, patients with ill-defined or unspecified site of cancer were more likely to visit the ER, while patients with cancer of the breast, lymphoid or hematopoietic tissue or thyroid and other endocrine glands were less likely to visit the ER (Figure 2, Figure 3 and Supplementary Table 4). Sex and number of types of diagnosed cancers for each patient were not associated with a higher probability of ER visits.

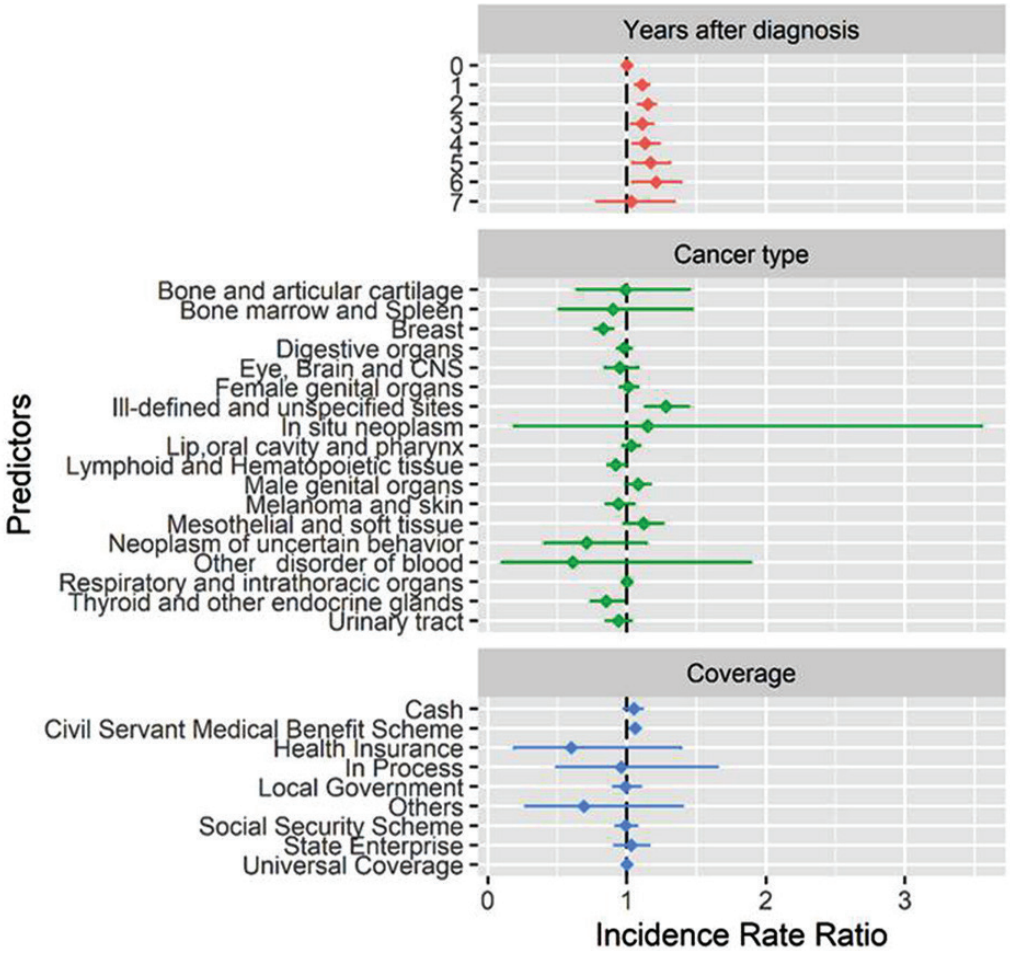


F=female, M=male

Number of cancers=Number of types of diagnosed cancer for each patient. A patient may be diagnosed with more than 1 type of cancer

Palliative=Previous treatment with palliative chemotherapy and/or radiotherapy

Figure 2 Adjusted incidence rate ratios by poisson regression assessing factors associated with emergency room visits.



Coverage=Healthcare Scheme

Figure 3 Adjusted incidence rate ratios by negative binomial regression assessing factors associated with emergency room visits

Discussion

With the aim of identifying ways to decrease visits to the ER to reduce ER overload without compromising patient care, we investigated the reasons leading cancer patients to visit our ER. The patients' clinical characteristics and factors associated with the ER visits were also assessed. The top reason leading these cancer patients to visit the ER was pain (25.4%), a finding consistent with previous studies.[10–12]

Abdominal pain was the most common pain location in 41.6% of our cases, a finding consistent with previous studies. A previous study reported that abdominal pain in cancer patients was associated with solid cancers and metastasis to adjacent organs, especially cancers involving the digestive organs.[13] Abdominal pain can arise from metastasis or gut obstruction from tumors of various gastrointestinal or other organ systems.[14]

Controlling cancer-related pain has always been a challenging problem, and even today only about 50.0% of cancer patients worldwide receive adequate pain relief.[15] Inadequate pain control in cancer patients can lead to repeated ER visits and a poor quality of life.[16] Insufficient assessment of active symptoms and suboptimal drug prescriptions during regular outpatient visits may result in inadequate pain control.[17] Ongoing assessment and re-assessment of the patient and their pain are key points in cancer pain management to reduce emergency room visits due to inadequately controlled pain.[18]

Older cancer patients were more likely to visit the ER than younger ones, as previous studies have also found that unscheduled ER visits are more common in older adults with cancer than in younger adults.[19] Older cancer patients are more likely to have physical and functional limitations compared to older noncancer individuals, and these limitations impact the independent functioning of these patients, leading them to require more health care services and more rehospitalizations than younger patients.[20]

Patients with metastasis were more likely to visit the ER, as found in previous studies which also reported that these patients were also associated with poor prognosis and pain and chest symptoms.[21,22] This study found, as in other studies, that cancer patients who had recently received palliative radiotherapy and/or palliative chemotherapy were more likely to visit the ER.[23–26] Palliative chemotherapy and/or radiation are not equal to palliative care. The aim of palliative care is to preserve the quality of life of the patient by alleviating both mental and physical symptoms, and is not only limited to patients but also considers their families and caregivers, while the aims of palliative chemotherapy and/or radiation are to alleviate specific symptoms of the patient. The side effects from palliative radiotherapy are dose-dependent[27], and although improvements in radiotherapy techniques have reduced RT-related toxicity over the years, most patients still experience burdensome RT side effects which can lead to ER visits.[28] An earlier study found that the most common side effects of RT leading cancer patients to visit an ER were fever, febrile neutropenia, weakness, fatigue and nausea-vomiting.[29]

ERs are designed for the management of acute problems, and do not have sufficient resources for standard cancer treatment. With the increasing number of cancer patients as shown in the southern Thailand Cancer Registry, it is important to look for ways to reduce the number of ER visits of these cancer patients without compromising their care. One recent study reported that palliative care combined with oncologic care improved the symptom control of cancer patients.[30] Palliative care is an important aspect of health management that can improve cancer patients' quality of life through symptom management, psychosocial and spiritual care, close patient-clinician communication, facilitation of complex decision making, and end-of-life care planning.[31] Integration of palliative care early in the cancer patient's treatment plan can improve their quality of life and decrease symptom intensity in patients with advanced cancer.[32] Other studies have reported that community-based palliative care, including palliative home care, effectively reduced the number of ER visits and lowered the mean rate of unplanned hospitalizations in the final six months of life.[33] These and other studies indicate that initiating a palliative care program for cancer patients, especially in earlier stages, is possible and can help to avoid unnecessary ER visits of these patients. However, in this study, information regarding palliative care consultations was mostly unavailable during the ER visits and the palliative home care service was not fully implemented at the time of the study. Therefore, the effects of palliative care on ER visits could not be assessed.

Although early palliative care can lead to a reduction in ER visits, some patients will still visit the ER when they have distressing symptoms that are not manageable at home or occur after working hours.[34] So having a comprehensive

palliative home care team is also important in reducing unnecessary ER revisits. Many studies have reported that palliative home care consultations helped improve quality of life, decrease length of stay of patients admitted to the hospital, and decrease intensive care unit admissions through timely management of active symptoms.[35,36] There are various tools available which can be used to identify home care patients who would benefit from palliative care, such as the Supportive and Palliative Care Indicators tool for Low-Income Settings (SPICT-LIS) and the Palliative Performance Scale (PPS).[37,38]

Like most retrospective review studies, this study had several limitations. Since the data were obtained from electronic medical records, some missing data, including data on metastatic sites, cointerventions and complimentary medicines used, was inevitable. In addition, the onset dates of the cancers in the study were based on the date of confirmed pathological results, which could have resulted in underreporting of ER visits which could have occurred before the pathological results were available. The main outcome of prevalence of chief complaints was without missing data since it is a required field of the hospital information system, although misinterpretation or incorrect recording of the chief complaint by the admitting doctor was possible, especially if they were busy. In addition, due to cultural differences, the groups of symptoms translated from Thai into English might not reflect the actual meaning of the original Thai words, for example in the group of pain symptoms. Therefore, the symptom groups should be interpreted with caution (Supplementary Table 1). Due to our large sample size, the statistically significant results should be interpreted with caution since some of them might not be clinically significant.

To our knowledge, this study is the first study to use text mining and tokenization techniques to classify the chief complaints of patients in a tonal language using an available large medical database. Performing the text mining in this study had many challenges. The first was writing regular expressions to cover and differentiate between Thai and English words. Second, the Thai sentence structure has no clear word boundaries. There is not really even the concept of a sentence in the way that there is in English and therefore tokenization or extracting specific meaningful Thai words was challenging. Nonetheless, the text-mining technique reduced the time needed to manually review a hundred thousand medical records. For quality assurance, 100 records of the machine translations were randomly selected for the researchers to check the accuracy of the text mining which had been performed.

Future studies should explore if the ER visits of cancer patients, especially those due to pain and dyspnea, are all necessary or some could be adequately managed at the patient's home to reduce ER overcrowding.

Conclusion

Pain and dyspnea were the two most common chief complaints leading cancer patients to visit our ER in this study. This is an indication that improved management of such symptoms at patients' homes, which could be done by a palliative care team, could reduce unnecessary ER visits in cancer patients, especially those receiving chemotherapy or radiation.

Conflict of interest

All authors had full access to the data, contributed to the study, approved the final version for publication, and take responsibility for its accuracy and integrity. All authors have no conflicts of interest to disclose.

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References

1. World Health Organization. Global health estimates: leading causes of death [homepage on Internet]. Geneva: WHO; 2020 [cited 2021 May 26]. Available from: https://www.who.int/data/maternal-newborn-child-adolescent-ageing/advisory-groups/gama/gama-advisory-group-members
2. Cuthbert CA, Boyne DJ, Yuan X, Hemmelgarn BR, Cheung WY. Patient-reported symptom burden and supportive care needs at cancer diagnosis: a retrospective cohort study. Support Care Cancer 2020;28:5889–99.
3. Philip J, Remedios C, Breen S, Weiland T, Willenberg L, Boughey M, et al. The experiences of patients with advanced cancer and caregivers presenting to Emergency Departments: A qualitative study. Palliat Med 2018;32:439–46.
4. Caterino JM, Adler D, Durham DD, Yeung S-CJ, Hudson MF, Bastani A, et al. Analysis of diagnoses, symptoms, medications, and admissions among patients with cancer presenting to Emergency Departments. JAMA Netw Open 2019;2:e190979.
5. Henson LA, Higginson IJ, Daveson BA, Ellis-Smith C, Koffman J, Morgan M, et al. 'I'll be in a safe place': a qualitative study of the decisions taken by people with advanced cancer to seek emergency department care. BMJ Open 2016;6:e012134.
6. Cooper E, Hutchinson A, Sheikh Z, Taylor P, Townend W, Johnson MJ. Palliative care in the emergency department: a systematic literature qualitative review and thematic synthesis. Palliat Med 2018;32:1443–54.
7. Young A, Marshall E, Krzyzanowska M, Robinson B, Brown S, Collinson F, et al. Responding to acute care needs of patients with cancer: recent trends across continents. Oncologist 2016;21:301–7.
8. Ferrell BR, Temel JS, Temin S, Alesi ER, Balboni TA, Basch EM, et al. Integration of palliative care into standard oncology care: american society of clinical oncology clinical practice guideline update. J Clin Oncol 2017;35:96–112.
9. Higdon ML, Atkinson CJ, Lawrence KV. Oncologic emergencies: recognition and initial management. AFP 2018;97:741–8.
10. Gallaway MS, Idaikkadar N, Tai E, Momin B, Rohan EA, Townsend J, et al. Emergency department visits among people with cancer: frequency, symptoms, and characteristics. JACEP Open 2021;2:e12438.
11. Yang Z, Yang R, Kwak MJ, Qdaisat A, Lin J, Begley CE, et al. Oncologic emergencies in a cancer center emergency department and in general emergency departments countywide and nationwide. PLoS One 2018;13:e0191658.
12. Hsu J, Donnelly JP, Xavier Moore J, Meneses K, Williams G, Wang HE. National characteristics of emergency eepartment visits by patients with cancer in the United States. Am J Emerg Med 2018;36:2038–43.
13. Koo MM, von Wagner C, Abel GA, McPhail S, Hamilton W, Rubin GP, et al. The nature and frequency of abdominal symptoms in cancer patients and their associations with time to help-seeking: evidence from a national audit of cancer diagnosis. J Public Health (Oxf) 2018;40:e388–95.
14. Batalini F, Gomes M, I F, Kuwae F, Macanhan G, Pereira JLB. Cancer complaints: the profile of patients from the emergency department of a Brazilian oncology teaching hospital. F1000Res 2017;6:1919.
15. van den Beuken-van Everdingen MHJ, Hochstenbach LMJ, Joosten EAJ, Tjan-Heijnen VCG, Janssen DJA. Update on prevalence of pain in patients with cancer: systematic review and meta-analysis. J Pain Symptom Manage 2016;51:1070-90.e9.
16. Barbera L, Atzema C, Sutradhar R, Seow H, Howell D, Husain A, et al. Do patient-reported symptoms predict emergency department visits in cancer patients? A population-based analysis. Ann Emerg Med 2013;61:427-37.e5.
17. Lavand'homme P. The progression from acute to chronic pain. Curr Opin Anaesthesiol 2011;24:545–50.
18. Fallon M, Giusti R, Aielli F, Hoskin P, Rolke R, Sharma M, et al. Management of cancer pain in adult patients: ESMO clinical practice guidelines. Ann Oncol 2018;29:iv166–91.
19. Mills S, Buchanan D, Guthrie B, Donnan P, Smith B. Factors affecting use of unscheduled care for people with advanced cancer: a retrospective cohort study in Scotland. Br J Gen Pract 2019;69:e860–8.
20. Chavan PP, Kedia SK, Yu X. Impact of physical and functional limitations on health care utilization in older cancer survivors: a medicare current beneficiary survey. J Aging Health 2020;32:987–97.
21. Rogers MJ, Matheson LM, Garrard B, Mukaro V, Riches S, Sheridan M, et al. Cancer diagnosed in the emergency department of a regional health service. Aust J Rural Health 2016;24:409–14.
22. Markar SR, Mackenzie H, Jemal S, Faiz O, Cunningham D, Hanna GB. Emergency presentation of esophagogastric cancer: predictors and long-term prognosis. Ann Surg 2018;267:711–5.

23. Chan W, Lam K, Siu W, Yuen K. Chemotherapy at end-of-life: an integration of oncology and palliative teams. Support Care Cancer 2016;24:1421–7.
24. Wu C-C, Hsu T-W, Chang C-M, Lee C-H, Huang C-Y, Lee C-C. Palliative chemotherapy affects aggressiveness of end-of-life care. Oncologist 2016;21:771–7.
25. Wu SY, Singer L, Boreta L, Garcia MA, Fogh SE, Braunstein SE. Palliative radiotherapy near the end of life. BMC Palliative Care 2019;18:29.
26. Bayrak Aykan E, Kitiş Y. The main reasons for emergency department visits in cancer patients. Haseki Tıp Bülteni 2018;56:6–13.
27. Spencer K, Parrish R, Barton R, Henry A. Palliative radiotherapy. BMJ 2018;360:k821.
28. Dilalla V, Chaput G, Williams T, Sultanem K. Radiotherapy side effects: integrating a survivorship clinical lens to better serve patients. Curr Oncol 2020;27:107–12.
29. Grewal K, Krzyzanowska MK, McLeod S, Borgundvaag B, Atzema CL. Outcomes after emergency department use in patients with cancer receiving chemotherapy in Ontario, Canada: a population-based cohort study. CMAJ Open 2020;8:E496–505.
30. Hui D, Hannon BL, Zimmermann C, Bruera E. Improving patient and caregiver outcomes in oncology: Team-based, timely, and targeted palliative care. CA Cancer J Clin 2018;68:356–76.
31. Evangelista CB, Lopes MEL, Costa SFG da, Batista PS de S, Batista JBV, Oliveira AM de M. Palliative care and spirituality: an integrative literature review. Rev Bras Enferm 2016;69:591–601.
32. Haun MW, Estel S, Rücker G, Friederich H-C, Villalobos M, Thomas M, et al. Early palliative care for adults with advanced cancer. Cochrane Database Syst Rev 2017;6:CD011129.
33. 33. Hsu H-S, Wu T-H, Lin C-Y, Lin C-C, Chen T-P, Lin W-Y. Enhanced home palliative care could reduce emergency department visits due to non-organic dyspnea among cancer patients: a retrospective cohort study. BMC Palliative Care 2021;20:42.
34. Verhoef M-J, de Nijs E, Horeweg N, Fogteloo J, Heringhaus C, Jochems A, et al. Palliative care needs of advanced cancer patients in the emergency department at the end of life: an observational cohort study. Support Care Cancer 2020;28:1097–107.
35. Grudzen CR, Richardson LD, Johnson PN, Hu M, Wang B, Ortiz JM, et al. Emergency department-initiated palliative care in advanced cancer: a randomized clinical trial. JAMA Oncol 2016;2:591–8.
36. Grudzen C, Richardson LD, Baumlin KM, Winkel G, Davila C, Ng K, et al. Redesigned geriatric emergency care may have helped reduce admissions of older adults to intensive care units. Health Aff (Millwood) 2015;34:788–95.
37. Sripaew S, Fumaneeshoat O, Ingviya T. Systematic adaptation of the Thai version of the supportive and palliative care indicators tool for low-income setting (SPICT-LIS). BMC Palliative Care 2021;20:35.
38. Baik D, Russell D, Jordan L, Dooley F, Bowles KH, Masterson Creber RM. Using the palliative performance scale to estimate survival for patients at the end of life: a systematic review of the literature. J Palliat Med 2018;21:1651–61.

Supplementary Table 1 Symptom groups and chief complaints

Symptom group	Symptoms/reasons (translated from Thai language)
Abdominal discomfort	Abdominal discomfort, fullness, bloating, distended abdomen, difficult digestion
Abnormal laboratory results	International normalized ratio, (hypo/hyper) kalemia, (hypo/hyper)natremia, low blood sugar, abnormal electrolytes
Abnormal uterine bleeding	Vaginal bleeding, abnormal menstruation, heavy menstruation
Alteration of consciousness	Drowsy, Sleepiness, Sleep a lot, Not responsive
Animal related	Bite, scratch, bee, wasp, insect, cat, dog
Anorexia	Cannot eat, cannot swallow, eat little
Anuria	Cannot urinate, not urinate, little amount of urine
Ataxia	Gait ataxia, abnormal gait
Behavioral changes	Confused, forgetful, delirium, behavioral changes, not talkative, not responsive, delayed response
Bleeding	Blood, epistaxis, nosebleed
Constipation	Difficulty passing stool, cannot pass stool, hard stool, little stool, constipation
Cough	Cough
Dialysis related	Arteriovenous fistula, arteriovenous graft, dialysis, dialysis fluid
Diarrhea	Diarrhea, watery stool, frequent stool, high amount of stool, loose stool
Dizziness	Dizzy, light headedness, dizziness
Dysarthria	Unclear speech
Dysphagia	Difficulty swallowing, pain on swallowing, dysphagia
Dyspnea	Dyspnea, shortness of breath, chest tightness, difficulty breathing, decreased capillary oxygen
Dysuria	Pain with urination
Edema	Edema
Eye symptoms	Red eye(s), inflamed eye(s), swollen eye(s), itchy eye(s)
Facial Palsy	Drooping mouth, drooping eyelids, weakness of tongue muscle
Fever	Fever, shivering, chills
Follow up	F/U, appointment, lab results
Hematemesis	Bloody vomit, vomiting with blood
Hematochezia	Bloody stool, black stool, blood-stained stool
Hematuria	Bloody urine, red urine, coke-like urine, tissue-colored urine, urine with blood
Hemoptysis	Bloody cough, cough with blood, bloody sputum
Hiccup	Hiccups
Hypertension	High blood pressure, hypertension, elevated blood pressure
Hypotension	Hypotension, blood pressure drop, decreased blood pressure
Immobility	Cannot move, cannot grab things, cannot lift hand, cannot move hand, shoulder dislocation
Insomnia	Sleepless, insomnia, decrease in sleep time, Cannot sleep
Limb Deformity	Misshapen limbs
Lower urinary tract symptoms	Pain with urination, frequent urination, cloudy urine, smelly urine
Malaise	Discomfort, fatigue
Masses and Lesions	Mass
Nausea/Vomiting	Nausea, vomiting
Numbness	Numbness
Pain	Chest discomfort, pain, chest tightness, sharp pain, stinging pain
Palpitations	Palpitations, rapid pulse, irregular pulse, high pulse rate
Physical assault	Hurt, punched, kicked, hit
Psychiatric symptoms	Stress, depression, suicidal ideas, drug overdose, hallucination, afraid, scared
Rash	Skin rash, blebs, itching, urticaria, hematoma
Refer	Referred
Request for medication	Medication requests, request for medical certificate, lack of medicine
Seizure	Seizure
Spasm	Spasm, clench, hand clenching, eye bulging
Stomal device related	Line, catheter, stoma, ostomy, percutaneous nephrostomy, percutaneous drainage, jackson tube, oral gastrointestinal tube, naso-jejunal tube, gastrostomy, percutaneous endoscopic gastrostomy
Syncope	Loss of consciousness, stupor, fainting
Tinnitus	Ringing in the ears

Supplementary Table 1 (continued)

Symptom group	Symptoms/reasons (translated from Thai language)
Traffic accident	Motorcycle accident, accident, car crash, motorbike crash, deviated from track, motorbike, bike
Trauma related	Struck, fall, cut wound, blunt wound, scald, burn, electrocuted, hit, crashed, stepped on, foreign body, needle, sprain, strain
Upper respiratory tract symptoms	Runny nose, itchy nose, sputum, sore throat
Vertigo	Vertigo
Visual symptoms	Blurred vision, abnormal vision, unclear vision, foggy vision, dotted vision, diplopia, double vision
Weakness	Weakness
Wound	Wound, aphthous, abscess, furuncle

Supplementary Table 2 Median number of emergency room visits and median observation time per patient by patient factors

Variable	Medium numbers of ER visits per patient (IQR) (visits)	Medium observation time (IQR) (years)
Gender		
Male	3.0 (1.0–6.0)	4.6 (2.5–6.3)
Female	3.0 (1.0–5.8)	4.6 (2.6–6.4)
Age group (years)		
18–30	2.0 (1.0–5.0)	5.1 (3.2–6.6)
31–40	2.0 (1.0–5.0)	4.3 (2.5–6.3)
41–50	2.0 (1.0–4.0)	4.7 (2.7–6.4)
51–60	2.0 (1.0–5.0)	4.4 (2.4–6.3)
61–70	3.0 (1.0–5.0)	4.4 (2.5–6.2)
71–80	3.0 (2.0–7.0)	4.8 (2.7–6.6)
81–90	4.0 (2.0–11.0)	5.0 (3.0–6.4)
91–100	4.0 (2.5–8.8)	4.7 (2.8–5.7)
Cancer group by ICD–10		
Bone and articular cartilage	2.0 (1.0–3.0)	4.1 (1.9–6.5)
Bone marrow and spleen	2.5 (2.0–3.8)	2.5 (2.1–3.3)
Breast	2.0 (1.0–4.0)	4.4 (2.8–6.2)
Digestive organs	3.0 (1.0–6.0)	4.4 (2.5–6.2)
Eye, brain and CNS	2.0 (1.0–5.0)	4.2 (2.4–6.4)
Female genital organs	3.0 (1.0–5.0)	4.6 (2.7–6.4)
Ill–defined and unspecified sites	3.0 (1.0–80.0)	6.1 (3.3–6.1)
In–situ neoplasm	2.0 (2.0–2.0)	0.6 (0.6–0.6)
Lip, oral cavity and pharynx	3.0 (1.0–5.0)	4.2 (2.3–6)
Lymphoid and hematopoietic tissue	3.0 (1.0–5.0)	4.8 (2.7–6.5)
Male genital organs	4.0 (2.0–31.0)	5.1 (3.8–6.3)
Melanoma and skin	3.0 (2.0–8.0)	5.3 (3.6–6.6)
Mesothelial and soft tissue	4.0 (1.0–19.0)	5.0 (1.6–6.6)
Neoplasm of uncertain behavior	1.0 (1.0–2.0)	0.5 (0.4–0.6)
Other disorder of blood	1.0 (1.0–1.0)	1.9 (1.7–2.1)
Respiratory and intrathoracic organs	3.0 (1.0–5.0)	4.6 (2.5–6.6)
Thyroid and other endocrine glands	2.0 (1.0–5.0)	5.7 (3.7–6.6)
Urinary tract	3.0 (1.0–6.0)	5.2 (3.0–6.6)

Supplementary Table 2 (continued)

Variable	Medium numbers of ER visits per patient (IQR) (visits)	Medium observation time (IQR) (years)
Healthcare scheme		
Universal coverage	2.0 (1.0–5.0)	4.5 (2.5–6.3)
Social security scheme	2.0 (1.0–5.0)	3.8 (2.3–5.9)
Civil servant medical benefit scheme	3.0 (2.0–7.0)	4.8 (2.8–6.5)
Local government	3.0 (1.0–5.0)	4.1 (2.3–5.0)
Cash	3.0 (1.0–5.0)	4.8 (2.6–6.4)
Health insurance	1.0 (1.0–1.0)	2.9 (2.0–4.2)
Others	1.0 (1.0–1.8)	2.2 (0.5–3.9)
Palliative chemotherapy and/or radiotherapy		
No	2.0 (1.0–5.0)	4.6 (2.6–6.4)
Yes	3.0 (1.0–7.0)	4.4 (2.5–6.2)
Metastasis		
No	3.0 (1.0–5.0)	4.6 (2.6–6.4)
Yes	3.0 (1.0–6.0)	4.5 (2.5–6.1)

ER=emergency room, IQR=interquartile range, CNS=central nervous system, ICD-10=international classification of diseases, tenth revision

Supplementary Table 3 Types of stoma and catheter device-related problems

Type of device-related problem	Number of visits related to device problem (% per total number of device-related ER visits)
1. Percutaneous feeding tube	456 (51.6)
2. Nasogastric tube (NG tube)	163 (18.4)
3. Percutaneous drainages	80 (9)
4. Tracheostomy	78 (8.8)
5. Colostomy	53 (6.0)
6. Foley catheter	37 (4.2)
7. Hickman	16 (1.8)
8. Others	1 (0.1)

ER=emergency room

Supplementary Table 4 Adjusted incidence rate ratio (irr) from negative binomial regression

Variable	IRR	95% confidence interval	p-value
Sex			
Male	Ref		
Female	1.00	(0.96, 1.03)	0.899
Age (years)			
18-30	Ref		
31-40	1.00	(0.89, 1.11)	1.000
41-50	0.98	(0.89, 1.09)	0.700
51-60	1.01	(0.91, 1.11)	0.889
61-70	1.01	(0.92, 1.12)	0.800
71-80	1.10	(0.99, 1.22)	0.075
81-90	1.18	(1.06, 1.32)	0.003
91-100	1.27	(1.06, 1.51)	0.009
Number of cancers			
1	Ref		
2	1.08	(1.00, 1.16)	0.057
3	1.23	(0.88, 1.67)	0.210
4	0.57	(0.03, 2.53)	0.599
Metastasis			
No	Ref		
Yes	1.04	(1.00, 1.08)	0.048
Palliative chemotherapy and/or radiotherapy			
No	Ref		
Yes	1.12	(1.07, 1.18)	<0.001
Previously admitted in past 90 days			
No	Ref		
Yes	1.14	(1.09, 1.18)	<0.001
Years after diagnosis			
0	Ref		
1	1.11	(1.06, 1.16)	<0.001
2	1.15	(1.08, 1.21)	<0.001
3	1.11	(1.03, 1.19)	0.006
4	1.13	(1.04, 1.23)	0.006
5	1.17	(1.04, 1.31)	0.009
6	1.21	(1.04, 1.39)	0.012
7	1.03	(0.78, 1.34)	0.800
Type of cancer			
Respiratory and intrathoracic organs	Ref		
Bone and articular cartilage	0.99	(0.64, 1.45)	0.901
Bone marrow and spleen	0.90	(0.51, 1.47)	0.699
Breast	0.83	(0.77, 0.90)	<0.001
Digestive organs	0.98	(0.93, 1.03)	0.039
Eye, brain and CNS	0.95	(0.84, 1.08)	0.401
Female genital organs	1.01	(0.95, 1.08)	0.689
Ill-defined and unspecified sites	1.28	(1.13, 1.44)	<0.001
In-situ neoplasm	1.15	(0.19, 3.55)	0.780
Lip, oral cavity and pharynx	1.03	(0.97, 1.09)	0.300
Lymphoid and hematopoietic tissue	0.92	(0.86, 0.99)	0.030
Male genital organs	1.08	(0.99, 1.17)	0.085
Melanoma and skin	0.94	(0.85, 1.05)	0.298
Mesothelial and soft tissue	1.12	(0.98, 1.26)	0.085
Neoplasm of uncertain behavior	0.71	(0.41, 1.14)	0.200
Other disorder of blood	0.61	(0.10, 1.89)	0.500
Thyroid and other endocrine glands	0.85	(0.74, 0.98)	0.030
Urinary tract	0.94	(0.85, 1.03)	0.201

Supplementary Table 4 (continued)

Variable	IRR	95% confidence interval	p-value
Coverage			
Universal coverage	Ref		
Cash	1.05	(0.98, 1.11)	0.200
Civil servant medical benefit scheme	1.06	(1.02, 1.10)	0.001
Health insurance	0.60	(0.19, 1.39)	0.289
In process	0.96	(0.49, 1.65)	0.921
Local government	0.99	(0.90, 1.10)	0.911
Others	0.69	(0.27, 1.40)	0.412
Social security scheme	0.99	(0.92, 1.07)	0.911
State enterprise	1.03	(0.91, 1.16)	0.601

CNS=central nervous system