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Regional variation in the management of metastatic gastric cancer in Ontario

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ABSTRACT

Background Geographic variation in cancer care is common when clear clinical management guidelines do not exist. In the present study, we sought to describe health care resource consumption by patients with metastatic gastric cancer (GC) and to investigate the possibility of regional variation.

Methods In this population-based cohort study of patients with stage IV gastric adenocarcinoma diagnosed between 1 April 2005 and 31 March 2008, chart review and administrative health care data were linked to study resource utilization outcomes (for example, clinical investigations, treatments) in the province of Ontario. The study took a health care system perspective with a 2-year time frame. Chi-square tests were used to compare proportions of resource utilization, and analysis of variance compared mean per-patient resource consumption between geographic regions.

Results A cohort of 1433 patients received 4690 endoscopic investigations, 12,033 computed tomography exams, 12,774 radiography exams, and 5059 ultrasonography exams. Nearly all patients were seen by a general practitioner (98%) and a specialist (99%), and were hospitalized (95%) or visited the emergency department (87%). Fewer than half received chemotherapy (43%), gastrectomy (37%), or radiotherapy (28%). The mean number of clinical investigations, physician visits, hospitalizations, and instances of patient accessing the emergency department or receiving radiotherapy or stent placement varied significantly by region.

Conclusions Variations in health care resource utilization for metastatic GC patients are observed across the regions of Ontario. Whether those differences reflect differential access to resources, patient preference, or physician preference is not known. The observed variation might reflect a lack of guidelines based on high-quality evidence and could partly be ameliorated with regionalization of GC care to high-volume centres.

Key Words Gastric cancer, costs and cost analyses, resource utilization, metastases

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INTRODUCTION

Geographic variation in the provision of cancer care is observed both between and within countries[1]. Variation in care provided can occur at any point along the cancer care continuum, including diagnostic workup, multimodal treatment, and end-of-life care or symptom palliation. Those variations can contribute to avoidable disparities in patient outcomes, negatively affecting access to health care resources, health care system costs, and fiscal sustainability. One of the principal causes of practice variation is clinical equipoise in optimal patient management. Where multiple, non-superior protocols for managing a single clinical scenario exist, physician and patient preference dominate decision-making[2]. Practice variation can be especially common when randomized controlled trial evidence is not available to inform optimal patient management or when a disease is rare and defined protocols do not exist[1–5].

The appropriate and necessary protocols for treating metastatic gastric cancer remain undefined in many countries where gastric cancer is uncommon[6,7]. In North America and Europe, gastric cancer is typically diagnosed when the disease is no longer curable, with a median survival of 6 months from the time of diagnosis[8]. Palliative oncology management options include surgery (partial or total gastrectomy, bypass), chemotherapy, radiotherapy, or stent placement to alleviate obstruction and facilitate oral

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alimentation[6,9–12]. No clear guidelines for how to provide care for these patients exist, although the utility of invasive operations is debated in the literature[10,13,14].

Metastatic gastric cancer has been described as one of the most expensive cancers to treat in the United States and Canada, with estimated mean direct health care costs of approximately $41,790 (in 2009 Canadian dollars) and mean net costs of $54,947 (in 2004 U.S. dollars)[15,16]. In 2012, nearly 1500 patients in Ontario were diagnosed with gastric cancer, and nearly 700 died of the disease[17]. Hospitalizations represent a major contributor to costs, and there is little understanding of how other resource utilization factors contribute to those high costs[15,16,18]. Variations in prognosis for metastatic gastric cancer patients have been identified between geographic areas in many low-incidence countries and within single health systems, and whether variation in clinical practice is a contributing factor is unknown[19–21]. Few investigations of regional variation for the most common treatment modalities (gastrectomy, chemotherapy, radiotherapy) have been published[21,22]. One North American study reported that the proportion of patients receiving noncurative surgery was similar across geographic regions[22]. A study using the U.S. Surveillance, Epidemiology, and End Results database reported a resection rate of 17% for metastatic patients and a 10% rate of radiotherapy use[21].

Existing studies have not reported on the number of emergency room admissions, hospitalizations, physician services, and inpatient hospital days per patient. The picture of resource utilization, including the major cost drivers and a description of regional variation, is consequently incomplete for the metastatic gastric cancer population. The objectives of the present study were therefore to describe the health care resource utilization of metastatic gastric cancer patients and to explore the possibility of geographic variation in the receipt of health care services.

METHODS

Study Design and Population

This population-based retrospective cohort study used administrative health care data to study health care resource utilization. Patients with a registered diagnosis of gastric cancer in the Ontario Cancer Registry between 1 April 2005 and 31 March 2008 were identified. In Ontario, all health services are provided publicly and free of charge in a single-payer system run by the provincial government. Each individual is provided with a unique Ontario Health Insurance Plan (OHIP) number. Ontario health care spending is allocated to 14 local health integration networks (LHINs). Cancer care is further coordinated by Cancer Care Ontario staff within the 15 regional cancer centres in Ontario. Although standards of care are promoted by Cancer Care Ontario, the execution of supplementary medical care, provision of cancer care, and organization of services depends on the LHIN.

Our study took the health care system perspective of the Ontario Ministry of Health and Long-Term Care (MOHLTC). Only direct measures of health care resources provided publicly by the provincial health care system were included, and indirect patient and societal costs were excluded. To capture resource utilization related to staging, treatment planning, clinical management, and end-of-life care, the time horizon included the 2 months preceding the date of diagnosis up to 2 years after the date of diagnosis.

Patients identified in the Ontario Cancer Registry were eligible for inclusion if they were between 18 and 99 years of age, had a valid OHIP number, had a valid Institute for Clinical Evaluative Sciences (ICES) key number (traceable in the Registered Persons Database), had a confirmed diagnosis of gastric adenocarcinoma, and had evidence of distant metastatic disease (stage IV) at the time of diagnosis[23]. Patients were excluded if metastatic stage information (Mx) was missing; if the tumour location was in the upper, middle, or entire esophagus on endoscopy; or if information about their LHIN of residence was missing.

Data Sources

A comprehensive province-wide primary chart review of all patients diagnosed with gastric adenocarcinoma was linked to the following administrative datasets housed at ICES: the Canadian Institute for Health Information (CIHI) Discharge Abstract Database, the National Ambulatory Care Reporting System, the Ontario Home Care Database, OHIP, and the Registered Persons Database. The chart review, which took place between November 2009 and November 2011, provided clinical data and primary information on treatment strategies, including the Union for International Cancer Control and American Joint Committee on Cancer TNM stage[23], burden of metastatic disease, and tumour location. The datasets were linked in January 2012 using unique encoded identifiers and were analyzed at ICES.

The Discharge Abstract Database contains data about all inpatient and outpatient services provided at provincial institutions; it was used to identify hospital admissions, duration of inpatient hospitalizations, blood transfusions received, and other interventions[24]. The National Ambulatory Care Reporting System dataset was used to identify emergency room admissions and was another source of information about blood transfusions[24]. The Home Care Database was used to identify receipt of home care, including number and types of visits[24]. The OHIP dataset contains provincial physician billing claims and captures physician encounters (general practice, medical oncologist, radiation oncologist, surgeon), therapeutic and nontherapeutic procedures. It was also used to assign physician volume categories[24]. The Registered Persons Database provided patient-level information about demographics[24].

Defining Geographic Areas

Using their postal code of residence at the time of diagnosis, patients were assigned to one of the 14 LHINs.

Disease and Patient Characteristics

Disease characteristics were identified using endoscopy, pathology, and radiology reports located in the hospital charts associated with each patient. The data captured consisted of burden of metastatic disease (defined as 1 or >1 site of metastatic disease) and tumour location in the stomach (gastroesophageal junction, cardia, middle, distal, entire, or unknown). Patient characteristics identified included age, sex, residence (postal code), Charlson

comorbidity score[25], rurality (rural or urban, according to cut-points established using the Rurality Index for Ontario)[26], socioeconomic status (based on data from Statistics Canada linking postal codes with median community-level income, categorized from lowest to highest quintile)[27], and Johns Hopkins resource utilization band (lowest to highest quintile of use, based on aggregated diagnosis groups of comorbidity)[28].

Measures of Resource Utilization

Patients with metastatic gastric cancer survive a median of 6 months after diagnosis[14]. We aimed to include all measures of resource utilization involved in both cancer-related care (for example, staging, treatment) and end-of-life care and palliation during the study's time horizon. Given the short prognosis, we assumed that having metastatic cancer was in some way related to health care resource utilization subsequent to the cancer diagnosis. Gastric cancer patient volume for each physician within each specialty (surgeon, medical oncologist, radiation oncologist) was categorized into quartiles by specialty. "High volume" was defined using the cut-off for the highest quartile. Specifically, a high-volume surgeon performed an average of at least 3.5 gastrectomies annually, a high-volume medical oncologist saw an average of at least 6.7 gastric cancer patients annually, and a high-volume radiation oncologist saw an average of at least 15.8 gastric cancer patients annually. Receipt of care or a consult from at least 1 high-volume specialist constituted a "yes" for this variable. Physician procedural billing codes in OHIP were used to identify which patients underwent gastrectomy (partial or total, with or without multivisceral resection), chemotherapy, and radiotherapy. Physician billing codes and hospital records were used to measure additional therapeutic and nontherapeutic resource use, including endoscopy; chest, abdominal, and pelvic computed tomography imaging, ultrasonography, plain radiography, magnetic resonance imaging, and positron-emission tomography; surgical bypass, feeding tube placement, and hospital admissions. Encounters with physicians were measured using consultation billing codes (general practitioner visits and oncologist consultations). Emergency department records were used to identify emergency department visits. The Home Care Database was used to measure home care visits, which could occur for a variety of reasons such as physiotherapy, speech pathology, or personal care, and could be provided by various caregivers such as nurses, personal support workers, and physiotherapists.

Statistical Analysis

Chi-square tests (categorical data) and Kruskal–Wallis tests (continuous data) were used to compare patient and disease characteristics, and resource utilization between LHINs. Two-sided hypothesis testing was performed and an alpha of 0.05 was used to establish statistical significance. At least a 10% difference in resource utilization was defined as clinically meaningful. Defining variation that is clinically important at the policy level, and separating it from non-meaningful differences that are statistically significant or from variation that results from small numbers in one geographic area, is necessary to understand what differences mean for patients in various health care regions. All analyses were performed at ICES Queen's using the SAS software application (version 9.2: SAS Institute, Cary, NC, U.S.A.). Research ethics board approval for this project was obtained through Queen's University and at the 116 institutions for which chart reviews were performed. All procedures accorded with the ethical standards of the Declaration of Helsinki, 1975.

RESULTS

The final cohort consisted of 1433 patients with stage IV disease. Of the 2516 potentially eligible patients registered between 1 April 2005 and 31 March 2008, 1083 were excluded for the following reasons: missing chart review or stage data (n =25); no confirmed diagnosis of gastric adenocarcinoma after the chart review (n =44); no evidence of metastatic disease on pathology, radiology, or clinical consult notes (n =989); tumour located in the upper, middle, or entire esophagus (n =23); or missing LHIN of residence (n =2). Table I sets out the cohort's demographic and cancer-specific characteristics and compares those characteristics between geographic areas.

Health Care Resource Utilization

Table II presents the health care resource utilization for the entire cohort and the average per-patient use. All patients received a diagnosis of metastatic gastric cancer in at least 1 health care encounter, and thus no patient had zero health care resource utilization. The cohort as a whole received more than 12,500 radiography exams and more than 12,000 computed tomography scans. Of patients undergoing upper endoscopy (98%), each underwent an average of 3.4 endoscopy procedures.

Most patients visited a general practitioner (98%) or saw an oncology specialist (99.8%). Among those who visited a general practitioner, the average number of visits was 15 per patient; in comparison, the average number of oncologist visits was 63 per patient. Admissions to hospital were also very common (95%). Individuals who were hospitalized spent an average of 30 days in hospital, for a total of 41,239 days overall, averaging more than 2 admissions per patient (interquartile range: 1–3). Surgical management of the primary tumour was provided to 51% of patients, with 14% of patients undergoing bypass and 37% undergoing gastrectomy. Stent placement was performed for 5% of the cohort.

Regional Practice Variation

Significant regional variation was observed between the LHINs with respect to the use of health care services and the number of times each service was provided to individual patients (Table III). The proportion of patients who visited an emergency department at least once ranged from 78% to 96% (p = 0.0233). Of those who were seen in the emergency department, the average number of such visits varied significantly between the LHINs, ranging from 2 to 6 visits per patient (p = 0.0039). Regional variation in the intensity of specialist visits was observed, with the average number of visits ranging from 44 to 84 per patient depending on the LHIN.

TABLE I Variation in characteristics of patients with metastatic gastric cancer (n =1433) by geographic region in Ontario

Characteristic	Overall [*n* (%)]	Variation (%)		*p* Value
		Lowest	Highest	
Disease factors				
Burden of metastatic disease				
1 site	747 (52)	43	67	0.1694
>1 site	686 (48)	33	57	
Tumor location				
Gastroesophageal junction	390 (27)	19	42	0.1131
Proximal	139 (10)	5	14	
Middle	229 (16)	8	29	
Distal	476 (33)	15	48	
Entire	134 (9)	4	17	
Unknown	65 (5)	0	8	
Patient factors				
Age group				
<65 Years	534 (37)	17	48	0.1724
65–75 Years	404 (28)	9	42	
>75 Years	494 (35)	25	55	
Sex				
Men	934 (65)	58	76	0.2227
Charlson–Deyo score				
0	1279 (89)	86	92	0.7542
≥1	153 (11)	8	14	
Rurality				
Rural	159 (11)	0	43	<0.0001
Median community income (*n*=1432)				
1 (Lowest)	296 (21)	7	36	<0.0001
2	329 (23)	5	32	
3	284 (20)	13	36	
4	268 (19)	9	27	
5 (Highest)	255 (18)	6	43	
Resource utilization band				
<3	90 (6)	2	14	0.3926
3	658 (46)	37	55	
4	386 (27)	22	35	
5	298 (21)	9	28	
Health care system factors				
High-volume gastric cancer specialist consultation or treatment	477 (33)	0	47	<0.0001

Significant variation was observed by LHIN of residence in the proportion of patients having a consultation with at least 1 high-volume gastric cancer specialist: the proportion ranged from 0% in the lowest-use LHIN to 47% in the highest-use LHIN. Whether an individual received a gastrectomy as part of noncurative management was not statistically associated with LHIN of residence ($p = 0.4726$); however, there was 20% variation in receipt of a gastrectomy (range: 32%–53%). Rates of chemotherapy use did not differ significantly between the LHINs, but use of radiotherapy varied significantly ($p < 0.0001$). Stent placement ranged from fewer than 2% of patients in some LHINs to 12% of patients in others ($p = 0.0017$).

DISCUSSION

The present study is the first population-based description of health care resource utilization by metastatic gastric cancer patients in North America or Europe. It identified significant geographic variation, specifically in the proportion and frequency of emergency room visits, imaging studies, blood transfusions, stent placements, and radiotherapy. Substantial clinically meaningful differences in the rates of surgery, chemotherapy, and home care use were also observed. Significant variation in the average numbers of all radiologic imaging visits, of specialist and emergency room visits, and

TABLE II Resource utilization by patients with metastatic gastric cancer (*n* = 1433) in Ontario

Resource	Patients [*n* (%)]	Mean interventions or encounters per patient with use (*n*)	IQR (*n*)	Cohort total count (*n*)	Mean interventions or encounters per patient, total cohort (*n*)
Investigations					
Upper endoscopy	1409 (98)	3±2	2–4	4,690	3±2
Computed tomography	1420 (99)	8±7	3–11	12,033	8±7
Radiography	1379 (96)	9±9	3–12	12,774	9±9
Ultrasonography	1101 (77)	5±5	1–5	5,059	4±5
MRI[a]	196 (14)	—	—	—	—
PET[a]	376 (26)	—	—	—	—
Incisional biopsy[b]	6 (0.4)	—	—	—	—
Laparoscopy[b]	125 (9)	—	—	—	—
Exploratory laparotomy[b]	127 (9)	—	—	—	—
Health care visits					
General practitioner visits	1410 (98)	15±14	6–20	21,662	15±14
Specialist visits	1430 (99)	63±51	25–85	89,497	62±51
Emergency room visits	1236 (87)	3±4	1–3	3,700	3±3
Homecare visits (all)	1110 (78)	63±93	1–62	70,045	49±86
Nursing visits	1007 (70)	40±54	0–44	44,565	31±50
PSW visits	461 (32)	38±77	0–3	17,486	38±77
Hospitalizations					
Hospitalizations	1366 (95)	2±2	1–3	3,240	2±2
Hospital days	1366 (95)	30±30	10–37	41,239	29±30
Nonsurgical management					
Blood transfusions	861 (60)	3±6	0–2	2,655	2±5
Stent placement	78 (5)	—	—	—	—
Chemotherapy	615 (43)	—	—	—	—
Radiotherapy	398 (28)	—	—	—	—
Feeding tube	382 (27)	—	—	—	—
Surgical management					
Bypass or intestinal obstructive surgery	208 (14)	—	—	—	—
Gastrectomy	527 (37)	—	—	—	—
Total gastrectomy	103 (7)	—	—	—	—
Subtotal gastrectomy	238 (17)	—	—	—	—
Multivisceral resection	220 (15)	—	—	—	—
Colectomy	97 (44)	—	—	—	—
Esophagectomy	127 (58)	—	—	—	—
Pancreatectomy	9 (4)	—	—	—	—
Spleen	7 (3)	—	—	—	—

[a] Because of the way in which MRI and PET are billed compared with other investigations, a report of the number of scans per patient or the total number of scans is not reliable.
[b] Only 1 procedure per patient was recorded.
IQR = interquartile range; MRI = magnetic resonance imaging; PET = positron-emission tomography; PSW = personal support worker.

of upper endoscopies per patient was also demonstrated between geographic regions. Significant geographic variation in access to high-volume gastric cancer specialists was also noted.

The present study supports other studies that describe regional variation in cancer care[29–33]. Despite attempts to standardize practice, variations in the provision of gastric cancer care have been demonstrated for multiple health care system variables, especially between geographic regions and centres of care[29–33]. Geographic variation in practice patterns commonly occurs when accepted standards of care do not exist for a particular disease, or if resources are limited or unavailable and alternative approaches are required[1–3,5,32,34]. Even in the presence of clear recommendations for clinical care, uptake of clinical guidelines can be greatly influenced by

TABLE III Variation in the proportion of patients with metastatic gastric cancer utilizing specific health care resources and average use across geographic regions in Ontario

Resource	Variation by LHIN (%)		*p* Value[a]	Variation by LHIN (mean *n*/patient)		*p* Value[a]
	Lowest use	Highest use		Lowest use	Highest use	
Investigations						
Upper endoscopy[b]	95	100	—	3	4	**0.0002**
Computed tomography[b]	98	100	—	6	10	**0.0052**
Radiography	85	99	**0.0205**	7	12	**0.0151**
Ultrasonography	60	84	**0.0022**	3	6	**0.0060**
MRI[c]	5	27	0.2357	—	—	—
PET[c]	19	35	0.1090	—	—	—
Health care visits						
General practitioner visits[b]	94	100	—	13	16	0.1494
Specialist visits[b]	99	100	—	44	84	**0.0025**
Emergency room visits	78	96	**0.0233**	2	6	**0.0039**
Homecare visits	66	85	0.2124	49	80	0.5528
Hospitalizations						
Hospital visits	91	100	0.8560	2	3	**0.0024**
Inpatient days	—	—	—	24	40	**0.0040**
Blood transfusions	50	69	**0.0266**	2	6	**<0.0001**
Nonsurgical management						
Stent placement[c]	2	12	**0.0017**	—	—	—
Chemotherapy[c]	24	51	0.2349	—	—	—
Radiotherapy[c]	18	41	**0.0001**	—	—	—
Gastrectomy[c]	32	53	0.4726	—	—	—

[a] Significant values shown in boldface type.
[b] Only 1 procedure per patient was recorded.
[c] Numbers too small for statistical comparison.
LHIN = local health integration network; MRI = magnetic resonance imaging; PET = positron-emission tomography.

geographic location and prevailing health care system characteristics[1,2]. Ontario has initiatives to decrease the variation between LHINs with respect to barriers to accessing treatment modalities or specialists by tracking the variation, and to optimize equity of cancer care[35]. Despite those initiatives, further centralization of gastric cancer care might be warranted.

The relationship between practice variation and differences in health care resource utilization is important if the differences are related to clinical outcomes for patients. Dixon *et al.*[19] identified geographic differences in mortality for metastatic gastric cancer patients between regions in Ontario. The differences in utilization identified in the present study could suggest avenues of investigation to explain those negative health outcomes and approaches to make access to treatments more equitable across the province. Understanding differences in utilization and practice patterns between high-volume and low-volume institutions or specialists could highlight important areas for intervention or centralization. An understanding of why variations exist (for example, patient preference, physician preference, and barriers to accessing care) and how those variations affect quality of life, symptom relief, and survival for the population with metastatic gastric cancer is necessary. Our population-based description of practice variation is hypothesis-generating, inviting exploration of factors predicting differences both in health care utilization and in clinical outcomes.

CONCLUSIONS

Our study identified significant geographic variation in health care resource utilization by metastatic gastric cancer patients, a cohort that consumes a considerable proportion of health care resources. Geographic variation commonly occurs when accepted standards of care for a particular disease do not exist or can reflect differential access to resources or patient or provider preference (or both). Such variation might be partly amenable to amelioration by regionalization of care to high-volume centres. The present study invites further investigation of the effects of variation on patient outcomes such as quality of life, symptom control, and survival.

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CONFLICT OF INTEREST DISCLOSURES

We have read and understood *Current Oncology*'s policy on disclosing conflicts of interest, and we declare that we have none.

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