Time to treatment of esophageal cancer in Ontario: A population-level cross-sectional study

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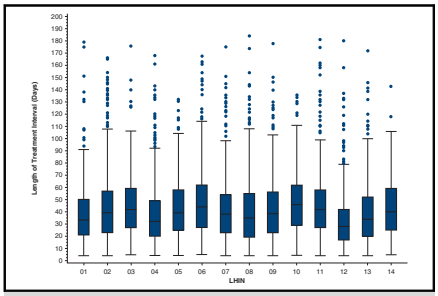
ABSTRACT

Objective: Timely cancer treatment improves survival and anxiety for some sites. Patients with esophageal cancer require specific workup before treatment, which can prolong the time from diagnosis to treatment (treatment interval [TI]). The geographical variation of this interval remains uninvestigated in patients with esophageal cancer.

Methods: This retrospective population-level study conducted in Ontario used linked administrative health care databases. Patients treated for esophageal cancer between 2013 and 2018 were included. The TI was time from diagnosis to treatment. Patients were assigned a geographical Local Health Integration Network on the basis of postal code. Covariates included patient, disease, and diagnosing physician characteristics. Quantile regression modeled TI length at the 50th and 90th percentile and identified associated factors.

Results: Of 7509 patients, 78% were male and most were aged between 60 and 69 years. The 50th and 90th percentile TI was 36 (interquartile range, 22-55) and 77 days, respectively. The difference between the Local Health Integration Network with the longest and shortest TI at the 50th and 90th percentile was 18 and 25 days, respectively. Older age ($P < .0001$), greater comorbidity ($P = .0005$), greater material deprivation ($P = .001$), rurality ($P = .03$), histology ($P = .02$), and treatment group ($P < .0001$) were associated with a longer median TI. Older age ($P = .03$), greater comorbidity ($P = .003$), greater material deprivation ($P = .005$), rurality ($P = .04$), and treatment group ($P < .0001$) were associated with a longer 90th percentile TI.

Conclusions: Geographic variability of time to treatment exists across Ontario. Investigation of facility-level differences is warranted. Patient and disease factors are associated with longer wait times. These results might inform future health care policy and resource allocation. (JTCVS Open 2022;12:430-49)



Geographical variability exists in the length of the esophageal cancer treatment interval.

CENTRAL MESSAGE

Despite adjusting for numerous confounding variables, geographic variability exists in the time to treatment of esophageal cancer.

PERSPECTIVE

Esophageal cancer management is a complex, multistep process. In Ontario, health regions coordinate the care of their own patients. We found differences in time to first health care encounter and time to treatment between health regions, despite adjusting for numerous covariates. Older, comorbid, and rurally located patients waited longer than others.

Timely access to cancer treatment has improved survival outcomes for many disease sites,[1,2] and reduced anxiety[3] and symptom progression while patients await treatment. Patients require time to accommodate staging investigations and specialist visits before treatment begins. Expediting these is crucial in patients with esophageal cancer because of the number of patients who present with locally advanced disease.

Between 2005 and 2010, Ontario Health Cancer Care Ontario regionalized thoracic cancer management. Only hospitals that maintained adequate surgical volumes for lung and esophageal resection, including the appropriate personnel and equipment, received funding to manage these patients.[4] They postulated that having 1 institution centralize the workup and treatment of esophageal cancer in that region might reduce the number of missed appointments, repeat investigations, and therefore reduce the overall time between diagnosis and treatment (treatment interval [TI]).[5] Since regionalization, little has been reported on wait times for esophageal cancer treatment in Ontario.

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Abbreviations and Acronyms

AC = adenocarcinoma
ADG = Aggregated Diagnosis Group
CIHI = Canadian Institute for Health Information
ED = Emergency Department
ICES = Institute for Clinical Evaluative Sciences
IQR = interquartile range
LHIN = Local Health Integration Network
NACRS = National Ambulatory Care Reporting System
OCR = Ontario Cancer Registry
PCCF = Postal Code Conversion File
SCC = squamous cell carcinoma
TI = treatment interval

Few studies have examined subintervals within the TI. One research group[6,7] partitioned the TI of patients with breast, lung, colon, or rectal cancer into time from diagnosis to the first oncologist consult, and time from the first oncologist consult to treatment. These subintervals have not yet been investigated for esophageal cancer in Canada.

A detailed understanding of the esophageal cancer TI might help improve equitable access to necessary investigations and treatments. Knowledge of the subinterval that contributes most to the TI might inform refinements to the patient pathway and resource allocation. In this study, we aimed to describe the lengths of the TI and subintervals, to investigate the geographical variation of the TI across Ontario, and to evaluate factors associated with the length of those intervals in Ontario esophageal cancer patients.

METHODS

Study Design

We conducted a population-level cross-sectional study using linked administrative health care databases housed at Institute for Clinical Evaluative Sciences (ICES). ICES is an independent, nonprofit research institute funded by an annual grant from the Ontario Ministry of Health and the Ministry of Long-Term Care. As a prescribed entity under Ontario's privacy legislation, ICES is authorized to collect and use health care data for the purposes of health system analysis, evaluation, and decision support. Secure access to these data is governed by policies and procedures that are approved by the Information and Privacy Commissioner of Ontario. In Canada, health care is delivered under a universal government-funded system. A population of 14.7 million residents makes Ontario the most inhabited Canadian province. This study was approved by the Research Ethics Board of Queen's University (approval number 6030561; approval date: October 5, 2020).

Data Sources

Patients were identified in the Ontario Cancer Registry (OCR), a province-wide database that captures >96% of all incident cancers.[8] The OCR was linked to other health administrative databases to obtain demographic, disease, billing, and outcomes data. We used the Registered Persons Database, National Ambulatory Care Reporting System (NACRS), Discharge Abstract Database, Ontario Health Insurance Plan (OHIP), Same Day Surgery, Postal Code Conversion File (PCCF), Local Health Integration Network (LHIN),[9] Ontario Marginalisation Database, Immigration, Refugees, and Citizenship Canada Permanent Resident Database, Activity Level Reporting, and ICES Physician Database (Table E1). These databases were linked using unique encoded identifiers at ICES.

Study Population

Adult patients diagnosed with incident esophageal cancer between 2013 and 2018 who received treatment were included. Cancer site was identified using topography codes; histology was not restricted (Table E2). Patients were excluded if there was no biopsy procedure, if there was no investigation or consultation between diagnosis and treatment, or if treatment was <4 days or 6 months after diagnosis (Figure 1). Less than 4 days was chosen to exclude patients who presented emergently and had expedited treatment and so were unlikely to have followed the Cancer Care Ontario treatment pathway,[10] and has been previously reported.[11]

TIs

TI length was defined as the number of days from diagnosis to the first treatment. Secondary outcomes were the length of subinterval 1 (time from diagnosis to the first cancer-related event thereafter) and subinterval 2 (time from the first cancer-related event to treatment). The first cancer-related event could be either a specialist visit or an investigation (Table E3).

Date of Diagnosis

We first identified the diagnosis date in the OCR, and then used NACRS, Canadian Institute for Health Information (CIHI), and Ontario Health Insurance Plan billing date to identify the date of an endoscopic biopsy within 2 weeks of the OCR date. For those with a biopsy record on the same day as the OCR, this date was assigned the diagnosis date. For the remainder, the earliest biopsy date was used. For those for whom the biopsy date was >2 weeks before or after the corresponding OCR date, we used that OCR date as the diagnosis date.

Covariates

Age and sex were categorized. Comorbidity information was gathered from 6 to 30 months before the diagnosis date and categorized on the basis of the Johns Hopkins Aggregated Diagnosis Groups (ADGs). The ADGs were created using the Johns Hopkins ACG System v10.0.1 (build 879). Rurality was dichotomized into urban/rural using the PCCF. LHINs are geographical health regions within Ontario tasked to fund and distribute health care to residents living within their borders.[9] During the study period, there were 14 LHINs. Each patient was assigned a LHIN depending on their postal code at diagnosis using the PCCF and LHIN databases. Material deprivation is an objective marker of socioeconomic status[12,13] and is widely used in health services research. We used the Ontario Marginalisation Database to assign each patient a dissemination area via the PCCF using their postal code on the day of diagnosis. Each patient was given a score, and then categorized into quintiles, with quintile 1 being the least deprived. Recent immigration was labeled as yes or no depending on whether the number of years from the date of landing to the diagnosis date was 5 years or less. Histology and tumor location were categorized. Stage was defined using the American Joint Committee on Cancer eighth edition.[14] First, we used the OCR to identify the best stage information for each patient. The OCR uses an algorithm that provides the stage from a pathological diagnosis if available. If no such diagnosis exists, the algorithm assigns stage on the basis of radiology results, followed by cancer center patient chart entries. Second, we created a separate stage variable for those with missing OCR stage using individual American Joint Committee on Cancer eighth edition T, N, and M categories from the Activity Level Reporting. Diagnosing physician characteristics included specialty (if there was more than one specialty then "mainspecialty" was used),

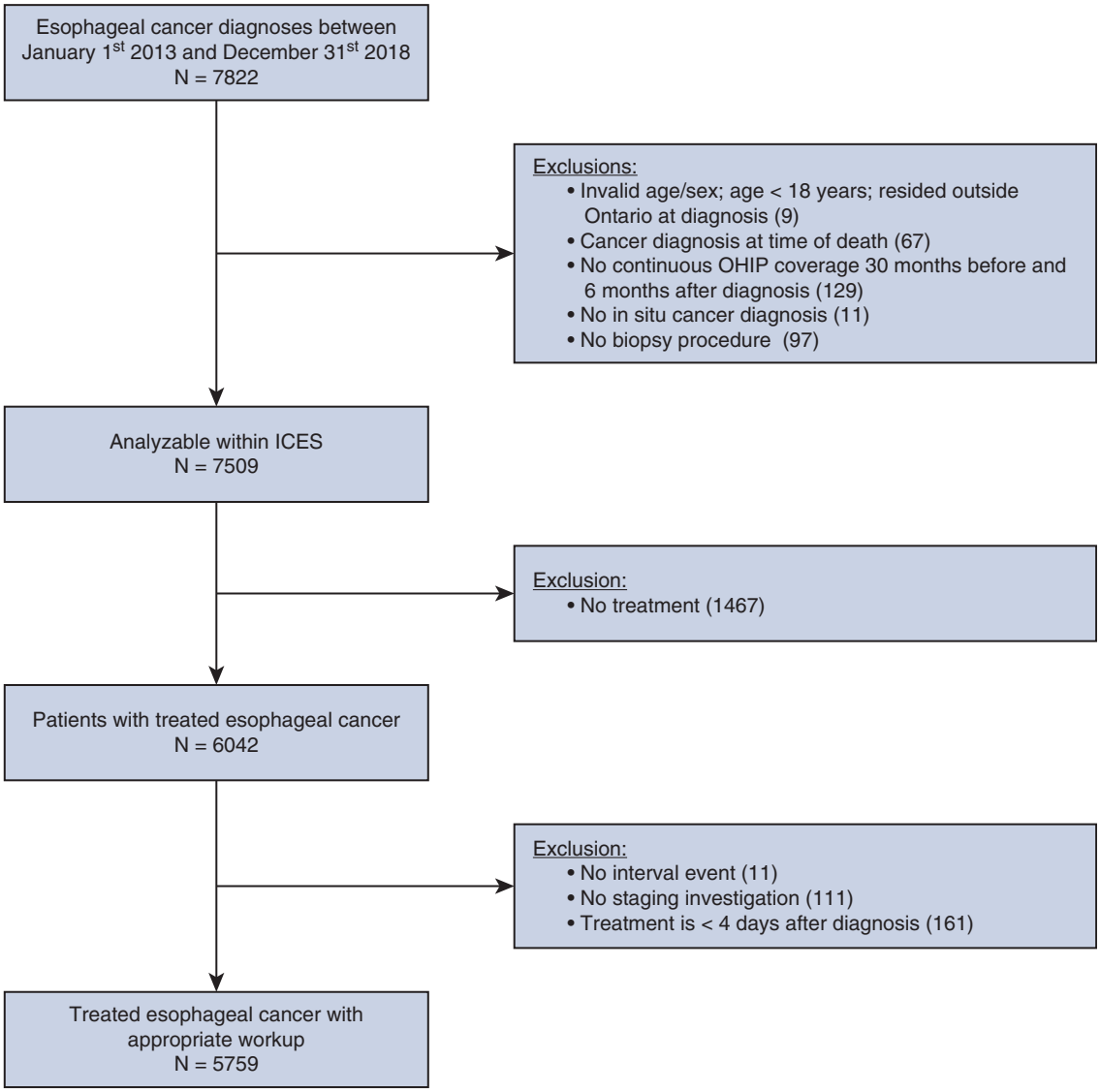

FIGURE 1. Cohort creation. *OHIP*, Ontario Health Insurance Plan; *ICES*, Institute for Clinical Evaluative Sciences.

years in practice, and academic affiliation. We operationalized health care utilization as the use of the emergency department (ED) and/or a hospital admission between diagnosis and treatment.

Statistical Analyses

Descriptive statistics were used to describe baseline demographic characteristics. We conducted bivariate analyses of each independent variable against the 50th and 90th percentile of the TI and subintervals using nonparametric tests. We used multivariable quantile regression models, adjusting simultaneously for patient factors, disease factors, treatment group, and LHIN. We used stage in the sensitivity analyses described in the following paragraph. All data processing and analyses were performed at ICES Queen's using the SAS software version 9.4 (SAS Institute Inc).

We conducted 6 sensitivity analyses on the adjusted quantile regression analysis. The first removed LHIN from the original model to determine if LHIN-based patient characteristic variations had distorted the patient characteristic associations. For the second, third, and fourth, immigration and rurality, separately then combined, were removed from the original model to assess whether those variables influenced the LHIN effects. The fifth removed the treatment group from the original model to assess the independence of the other factors from treatment. Last, we added stage to the original model to assess its effect on those associations.

RESULTS

Of 7822 patients diagnosed with esophageal cancer, 7509 patients had a recorded biopsy procedure, and 6042 received at least 1 treatment modality. After exclusions, the final study cohort comprised 5759 patients (Table 1). Most patients were male (77.6%), had a total ADG of between 4 and 6 (32.3%), were not recent immigrants (93.5%), lived in an urban area (84.6%), had adenocarcinoma (AC; 71.6%), and had lower esophagus (39.9%) or gastroesophageal junction (39.8%) tumors. Staging was as follows: I: 5.1%, II: 9.6%, III: 14.8%, IV: 23.9%, and

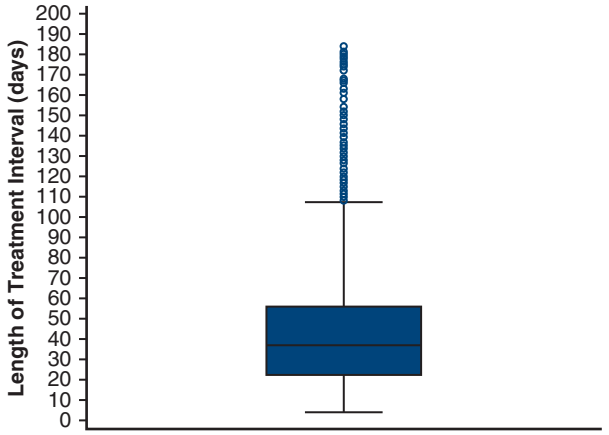

FIGURE 2. Box and whisker plot depicting the distribution of the Ontario esophageal cancer treatment interval between 2013 and 2018. *Upper whisker* = maximum observation excluding outliers; *lower whisker* = minimum observation excluding outliers; *upper box bar* = 75th percentile; *lower box bar* = 25th percentile; *middle box bar* = 50th percentile; *dots* = outliers (observations outside 1.5 times interquartile range).

missing: 46.7%. Gastroenterologists diagnosed the most cancers (41.3%). Chemoradiotherapy was the most common first treatment modality (26.8%).

Length of TI and Subintervals

The median TI length was 36 days (interquartile range [IQR], 22-55 days) and the 90th percentile was 77 days (Figure 2). The subinterval 1 median length was 2 days (IQR, −3 to 10 days; 90th percentile, 20 days); the subinterval 2 median length was 34 days (IQR, 20-51 days; 90th percentile, 73 days).

Geographical differences were seen (Figures 3 and 4, Table 2). The difference between the LHINs with the longest and shortest TI at the 50th and 90th percentile was 18 and 25 days, respectively. Except LHIN 14, all exhibited similar distributions of width and skew, suggesting similar variability within each LHIN. Both subinterval lengths differed across LHINs ($P < .0001$).

Differences remained between LHINs after adjusting for confounding. The biggest change was seen in LHIN 12, which had a 5-day longer median TI (−11 to

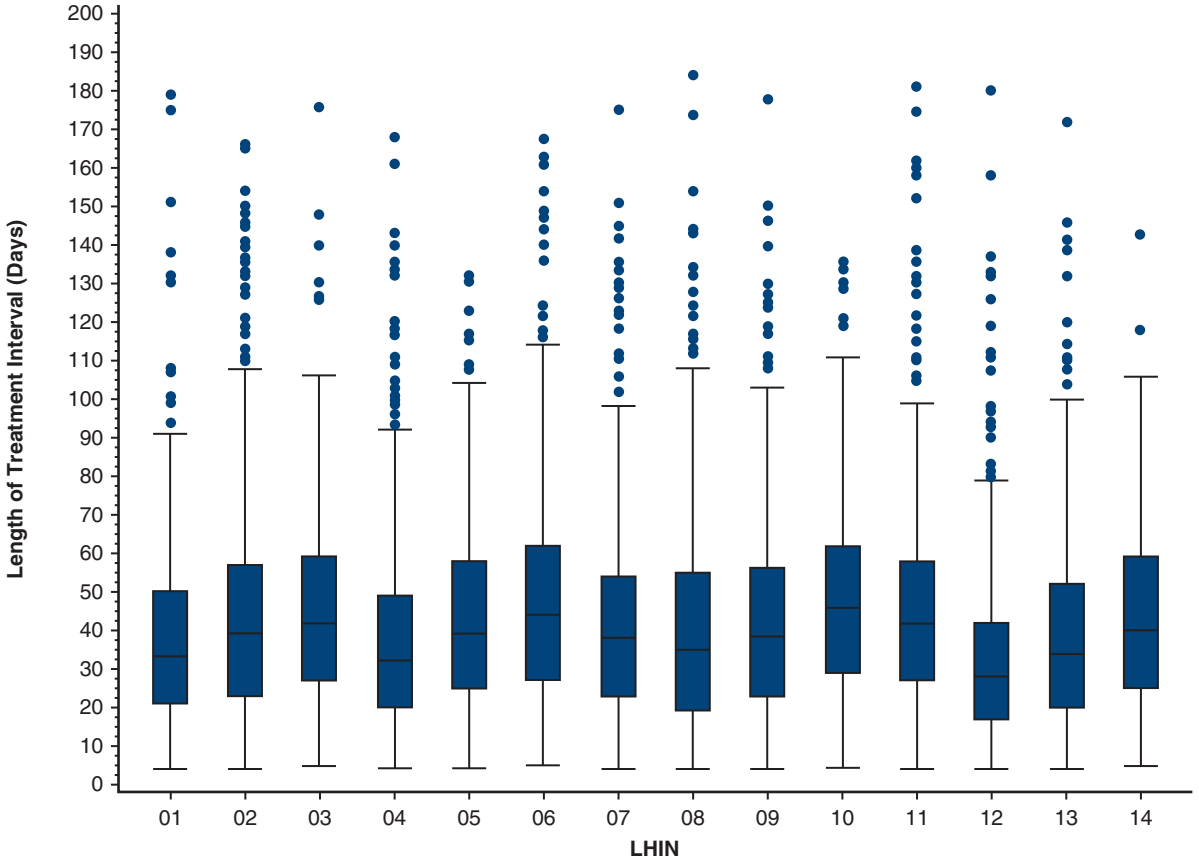

FIGURE 3. Box and whisker plot showing the comparison of the esophageal cancer treatment interval length distribution among LHINs in Ontario between 2013 and 2018. *Upper whisker* = maximum observation excluding outliers; *lower whisker* = minimum observation excluding outliers; *upper box bar* = 75th percentile; *lower box bar* = 25th percentile; *middle box bar* = 50th percentile; *dots* = outliers (observations outside 1.5 times interquartile range). *LHIN*, Local Health Integration Network.

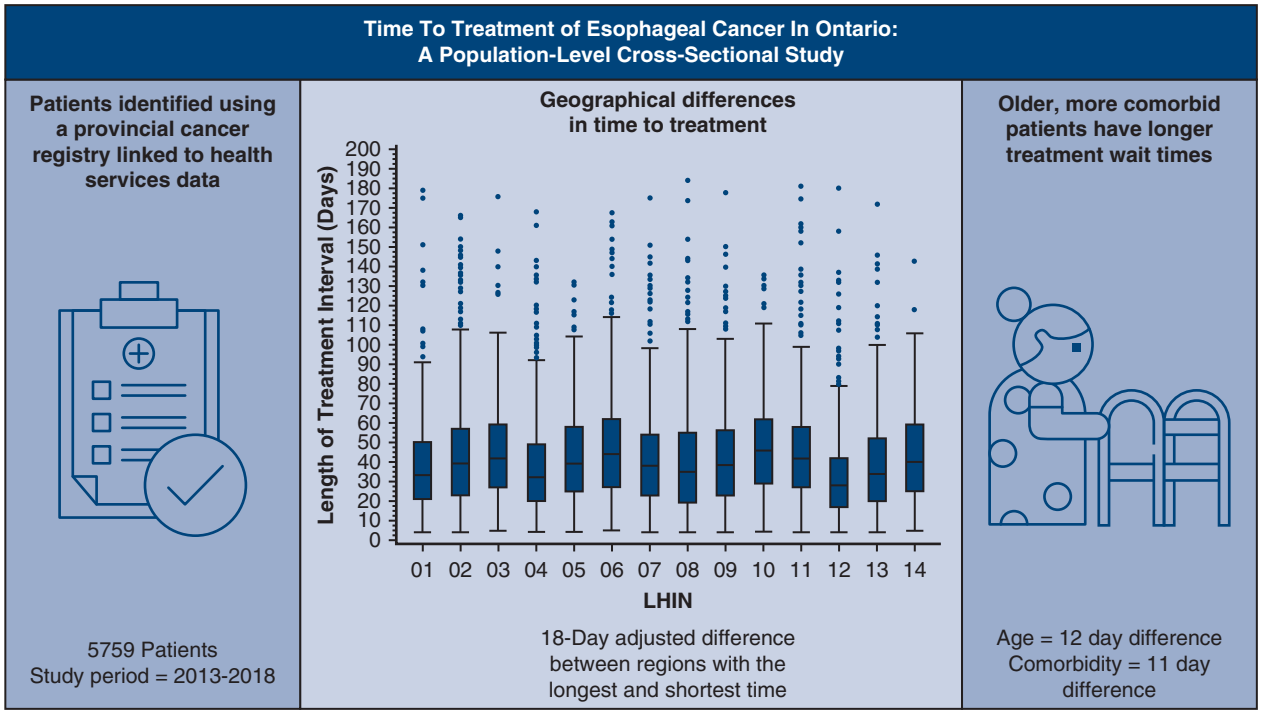

FIGURE 4. Different distributions of the esophageal cancer treatment interval length among Local Health Integration Networks in Ontario between 2013 and 2018. *Upper whisker* = maximum observation excluding outliers; *lower whisker* = minimum observation excluding outliers; *upper box bar* = 75th percentile; *lower box bar* = 25th percentile; *middle box bar* = 50th percentile; *dots* = outliers (observations outside 1.5 times interquartile range).

−6 days longer than the referent group). The remainder demonstrated change of 3 days or less in median TI, suggesting minimal confounding by other covariates in those LHINs.

Bivariate Analysis of Associated Factors

Younger patients (18-49 years) had shorter median TIs than older patients (70-79 years); 30 days (IQR, 15-45) versus 38 days (IQR, 23-57 days; $P = .01$). Those with a total ADG score of ≥10 waited a median of 40 days (IQR, 23-62 days) versus 33 days (IQR, 18-49 days) for those with no comorbidity. The median TI did not differ statistically on the basis of sex ($P = .30$), immigration ($P = .64$), rurality ($P = .46$), nor deprivation ($P = .49$).

Those with histology other than AC or squamous cell carcinoma (SCC) had a shorter median TI (29 days; IQR, 16-51 days) than those with AC (37 days; IQR, 22-56 days) or SCC (35 days; IQR, 22-52 days). Cancer stage was inversely proportional to the median and 90th percentile of the TI length; stage I, 48 days (IQR, 35-66 days) versus stage IV, 28 days (IQR, 17-44 days; $P < .0001$).

Patients diagnosed by a thoracic surgeon had a shorter median TI; 33 days (IQR, 18-49 days) compared with those diagnosed by a general surgeon; 38 days (IQR, 24-56 days) or gastroenterologist; 37 days (IQR, 22-56 days). However, those diagnosed by a physician in the "other" category had the shortest median (29 days) and the 90th percentile (71 days) TI. There was no statistical difference in median TI regarding the number of years the diagnosing physician had been in practice ($P = .13$), however there was a difference at the 90th percentile ($P = .0004$; 10-14 years, 70 days vs 20-24 years, 82 days). Academic affiliation was not associated with the median ($P = .08$) or 90th percentile ($P = .26$) TI length. The median and 90th percentile TI was longer in patients who had one or more ED visits or hospital admissions between diagnosis and treatment; >1 ED visit, 54 days (IQR, 31-76 days) versus 0 ED visits, 35 days (IQR, 21-52 days); >1 admission, 48 days (IQR, 29-73 days) versus 0 admissions, 36 days (IQR, 22-54 days).

Adjusted Regression Analysis of Associated Factors

In the adjusted models (Table 3), age, comorbidity, deprivation, rurality, histology, and LHIN were associated with statistical differences in the median TI length. There was a 9-day difference in the age variable between those with the longest (≥80 years old) and shortest TI (18-49 years old). The remainder of the variables that showed statistical adjusted differences had differences of <5 days.

At the 90th percentile, age, comorbidity, material deprivation, rurality, LHIN, and treatment group were associated with differences in the TI length. Those who underwent

TABLE 1. Patient, disease, diagnosing physician, health care system, and health care utilization characteristics of Ontario patients with esophageal cancer between 2013 and 2018

Cohort characteristic	Number of patients (%)
Age group, y	
18-49	296 (5.1)
50-59	1105 (19.1)
60-69	1923 (33.3)
70-79	1596 (27.6)
≥80	855 (14.8)
Sex	
Female	1293 (22.4)
Male	4482 (77.6)
Sum of minor AGDs	
0	338 (5.9)
1-2	1054 (18.2)
3-4	1481 (25.7)
5-6	1421 (24.6)
≥7	1481 (25.7)
Sum of major ADGs	
0	2097 (36.3)
1	1799 (31.2)
2	1048 (18.2)
≥3	831 (14.4)
Total number of ADGs	
0	288 (5.0)
1-3	1346 (23.3)
4-6	1866 (32.3)
7-9	1309 (22.7)
≥10	966 (16.7)
Recent immigration	
No	5401 (93.5)
Yes	374 (6.5)
Material deprivation	
Least deprived	1075 (18.6)
2	1155 (20.0)
3	1130 (19.6)
4	1176 (20.4)
Most deprived	1198 (20.7)
Unknown	41 (0.7)
Rurality	
Rural	884 (15.3)
Urban	4885 (84.6)
Unknown	6 (0.1)
Calendar year of diagnosis	
2013	930 (16.1)
2014	892 (15.5)
2015	957 (16.6)
2016	948 (16.4)
2017	1002 (17.4)
2018	1046 (18.1)
Histology	
Adenocarcinoma	4133 (71.6)
Squamous cell carcinoma	1195 (20.7)
Other	447 (7.7)
Tumor site	
Cervical esophagus	94 (1.6)
Upper esophagus	192 (3.3)
Middle esophagus	564 (9.8)
Lower esophagus	2305 (39.9)
Gastroesophageal junction	2298 (39.8)
Other	322 (5.6)
Stage	
I	294 (5.1)
II	552 (9.6)
III	852 (14.8)
IV	1382 (23.9)
Unknown	2695 (46.7)
Diagnosing physician main specialty	
Gastroenterology	2384 (41.3)
General surgery	1777 (30.8)
Thoracic surgery	584 (10.1)
Other	554 (9.6)
Unknown	476 (8.2)
Diagnosing physician years in practice	
1-9	247 (4.3)
10-14	835 (14.5)
15-19	592 (10.3)
20-24	512 (8.9)
25-29	452 (7.8)
≥30	451 (7.8)
Unknown	2686 (46.5)
Diagnosing physician academic affiliation	
No	3462 (60.6)
Yes	1484 (25.7)
Unknown	829 (14.4)
LHIN of residence at diagnosis	
01	345 (6.0)
02	523 (9.1)
03	323 (5.6)
04	832 (14.4)
05	246 (4.3)
06	375 (6.5)
07	374 (6.5)
08	496 (8.6)
09	674 (11.7)
10	307 (5.3)
11	517 (9.0)
12	281 (4.9)
13	353 (6.1)
14	129 (2.2)
Treatment group	
Endoscopy with or without subsequent treatment	543 (9.4)
Chemotherapy only	792 (13.7)
Radiotherapy only	1177 (20.4)
Surgery with or without subsequent treatment	571 (9.9)

(Continued)

TABLE 1. Continued

Cohort characteristic	Number of patients (%)
Chemotherapy and radiotherapy	1550 (26.8)
Chemotherapy or radiotherapy then surgery	164 (2.8)
Chemotherapy and radiotherapy then surgery	733 (12.7)
Other	245 (4.2)
ED visits between diagnosis and treatment	
0	4911 (85.0)
1	661 (11.4)
>1	203 (3.6)
Hospital admissions between diagnosis and treatment	
0	4228 (73.2)
1	1323 (22.9)
>1	224 (3.9)

ADG, Aggregate diagnostic group; *LHIN*, Local Health Integration Network; *ED*, Emergency Department.

endoscopic resection (alone or initially) waited 53 days less for treatment compared with those who underwent surgery (alone or initially). Patients aged ≥80 years waited 12 days longer for treatment than those aged 18-49 years old. Those with 3 or more comorbidities waited 11 days longer than those without any comorbidities. Patients living in the most materially deprived areas waited 6 days longer than those in the least deprived areas, and those in rural locations waited 6 days longer than their urban counterparts. Rurality and material deprivation variables became significant in the adjusted analysis at both percentiles.

Sensitivity Analyses

At the 50th percentile, only the exclusion of LHIN and immigration affected other variables, resulting in rurality no longer being significant compared with the original model (Table E4). At the 90th percentile, in 4 of the 6 sensitivity analyses, deprivation and rurality became insignificant, whereas number of minor comorbidities and disease histology and site became significant. The addition of stage resulted in age and rurality no longer being significant but did not affect other variables (Table E5).

DISCUSSION

The key finding of this study was an absolute difference of 18 and 25 days between the LHINs with the longest and shortest median and 90th percentiles, respectively. Furthermore, we identified those who are older, more comorbid, and diagnosed by a physician other than a thoracic surgeon to be vulnerable patient populations that might be more at risk of a prolonged TI.

In contrast to our results, in one Ontario study[15] it was reported that the median time to treatment was 46 days (IQR, 29-66 days) in 79% of their patients. Our cohorts were created differently, which might explain the difference. We labeled the day of diagnosis as the date of endoscopic biopsy if one was available (>80%), and the date of diagnosis in the OCR otherwise, whereas those authors used the OCR date as the day of diagnosis for all. In an older study[16] a median wait time from esophageal cancer diagnosis to surgery of 32 days, was reported, but that study's cohort was restricted only to patients who underwent surgery, and the study period was 1984 to 2000, which preceded the provincial regionalization of thoracic cancer services. In contrast, our cohort included patients who had treatment modalities other than surgery. This difference might explain why our median TI was shorter, because the patients in our study who underwent surgery first had a longer TI than those who had another treatment before surgery. A more recent study from the United States[17] calculated a median time to surgery of 54 days in patients with cT1N0M0 esophageal carcinoma who underwent surgery from 2004 to 2015. This also corroborates our findings that patients with an early-stage cancer, or patients having surgery as their first treatment modality, have a longer TI than others.

We found variability across LHINs in all time intervals, at the 50th and 90th percentile. The goal of regionalization was to provide optimal patient care for those who require specialist services, regardless of their location in the province.[5] An Ontario study from 2013[18] demonstrated that median wait times for lung cancer treatment did not shorten over the period from 2007 to 2011, but there was a reduction in 30-day mortality after pneumonectomy. All LHINs have a thoracic center located within their borders except one. One LHIN contains 3 thoracic centers. Neither of these 2 LHINs had the shortest or longest TI, suggesting the difference is explained by factors other than regionalization. Our sensitivity analyses (Tables E4 and E5) showed persistent LHIN differences at the 50th and 90th percentiles, suggesting there might be systemic inefficiencies meriting further study. Table E6 shows the distribution of patient factors within each LHIN.

At the 50th percentile, older, more comorbid, nonurban, and patients living in the most deprived areas waited up to 9 days, 3 days, 2 days, and 4 days longer than their counterparts, respectively. These differences were greater at the 90th percentile (12 days, 11 days, 6 days, and 5 days, respectively). Despite being statistically significant, these differences might not be clinically meaningful on survival[19] but they likely affect patient anxiety levels[3] and symptom progression. These associations are consistent with previously published literature on other cancer sites. Gillis and colleagues[20] reported that older patients, those living in rural areas, and those with a lower income had a longer wait time to colorectal cancer surgery in Ontario than others. Kulkarni and colleagues[21] also reported that older age and more severe comorbidity burden were associated with a longer wait time for urology cancer treatment. Bardell and colleagues[16] also reported that increasing age,

TABLE 2. Lengths of the treatment interval, subinterval 1, and subinterval 2 at the 50th and 90th percentile according to category of associated factors in Ontario patients with esophageal cancer between 2013 and 2018

Variable	Treatment interval		Subinterval 1*		Subinterval 2†	
	50th (IQR)	90th	50th (IQR)	90th	50th (IQR)	90th
Whole cohort	36 (22-55)	77	2 (−3 to 10)	20	34 (20-51)	73
LHIN	$P < .0001$	$P < .0001$	$P < .0001$	$P < .0001$	$P < .0001$	$P < .0001$
01	33 (21-49)	71	1 (−3 to 8)	18	32 (17-48)	65
02	40 (23-57)	82	4 (−2 to 12)	22	35 (20-54)	79
03	40 (27-59)	81	4 (−3 to 10)	20	38 (25-56)	77
04	30 (19-48)	71	2 (−5 to 9)	20	30 (17-47)	65
05	39 (26-55)	79	2 (−4 to 8)	19	37 (23-56)	76
06	44 (27-63)	93	1 (−2 to 9)	21	38 (24-59)	89
07	37 (22-55)	80	1 (−6 to 8)	20	37 (22-55)	79
08	30 (16-49)	68	3 (−2 to 11)	20	28 (14-44)	65
09	37 (22-56)	71	3 (−4 to 11)	19	34 (21-50)	71
10	46 (29-63)	82	7 (−1 to 15)	24	38 (22-55)	75
11	42 (27-58)	83	3 (−2 to 11)	19	39 (24-55)	77
12	28 (17-41)	69	1 (−3 to 10)	21	26 (14-40)	70
13	35 (20-53)	72	1 (−3 to 9)	18	34 (20-50)	66
14	41 (26-60)	88	2 (−4 to 8)	17	38 (26-53)	77
Age group, y	$P = .01$	$P < .0001$	$P = 1.00$	$P = .002$	$P < .0001$	$P < .0001$
18-49	30 (15-45)	67	1 (−2 to 7)	14	28 (14-44)	64
50-59	35 (21-54)	73	3 (−3 to 9)	19	33 (19-49)	69
60-69	36 (22-54)	75	2 (−4 to 10)	19	35 (21-50)	71
70-79	38 (23-57)	80	3 (−4 to 11)	21	36 (22-54)	76
≥80	36 (20-58)	84	3 (−2 to 11)	21	32 (16-53)	78
Sex	$P = .30$	$P = .37$	$P = .07$	$P = .37$	$P = 1.00$	$P = .25$
Female	37 (22-55)	75	3 (−3 to 11)	20	34 (19-50)	70
Male	36 (22-55)	78	2 (−3 to 10)	19	34 (20-51)	75
Sum of minor ADGs	$P < .0001$	$P < .0001$	$P = .0005$	$P < .0001$	$P < .0001$	$P < .0001$
0	32 (17-49)	67	0 (−3 to 7)	13	31 (17-48)	63
1-2	35 (21-51)	71	2 (−3 to 9)	17	33 (20-49)	65
3-4	35 (22-53)	75	2 (−2 to 10)	18	33 (19-48)	70
5-6	38 (23-57)	80	3 (−3 to 11)	20	35 (21-54)	76
≥7	39 (23-58)	85	3 (−4 to 12)	24	35 (21-54)	79
Sum of major ADGs	$P = .009$	$P < .0001$	$P = .55$	$P = .0006$	$P = .11$	$P < .0001$
0	35 (21-50)	69	2 (−2 to 9)	16	33 (20-48)	67
1	36 (21-56)	76	2 (−3 to 10)	20	34 (20-52)	73
2	38 (23-59)	82	3 (−3 to 12)	22	35 (20-55)	78
≥3	39 (22-62)	87	2 (−4 to 13)	24	35 (20-56)	79
Total ADGs	$P < .0001$	$P < .0001$	$P = .05$	$P < .0001$	$P = .0015$	$P < .0001$
0	33 (18-49)	65	0 (−2 to 7)	13	33 (19-47)	63
1-3	34 (20-50)	71	2 (−3 to 9)	16	32 (19-48)	65
4-6	37 (22-55)	77	3 (−2 to 10)	19	34 (20-50)	73
7-9	37 (23-56)	78	3 (−3 to 12)	21	35 (20-53)	76
≥10	40 (23-62)	91	2 (−5 to 13)	25	36 (20-57)	81
Recent immigration	$P = .64$	$P = .25$	$P = .14$	$P = .35$	$P = .08$	$P = .28$
No	36 (22-55)	77	2 (−3 to 10)	20	34 (20-51)	73
Yes	37 (21-56)	83	1 (−5 to 9)	19	37 (20-54)	79
Material deprivation	$P = .49$	$P = .88$	$P = .73$	$P = .69$	$P = .09$	$P = .06$
Least deprived	36 (22-54)	80	3 (−3 to 11)	20	34 (20-50)	73
2	36 (22-53)	76	2 (−3 to 10)	21	33 (19-49)	68
3	36 (22-55)	76	2 (−3 to 10)	19	35 (20-52)	73
4	36 (22-54)	76	2 (−3 to 9)	19	33 (21-50)	74
Most deprived	37 (22-58)	80	2 (−3 to 11)	20	36 (20-55)	76

(Continued)

TABLE 2. Continued

Variable	Treatment interval		Subinterval 1*		Subinterval 2†	
	50th (IQR)	90th	50th (IQR)	90th	50th (IQR)	90th
Rurality	$P = .46$	$P = .16$	$P = 1.00$	$P = 1.00$	$P = .16$	$P = .13$
Rural	37 (23-58)	83	3 (−3 to 11)	20	35 (21-54)	79
Urban	36 (21-54)	76	2 (−3 to 10)	20	34 (20-50)	71
Year of diagnosis	$P = .56$	$P = .98$	$P = .31$	$P = .55$	$P = .48$	$P = .82$
2013	36 (21-57)	79	4 (−2 to 11)	21	34 (19-51)	73
2014	35 (21-53)	76	2 (−3 to 9)	17	34 (20-50)	73
2015	36 (22-55)	76	2 (−3 to 9)	20	34 (20-50)	77
2016	35 (20-55)	78	2 (−4 to 11)	21	33 (20-51)	74
2017	38 (23-56)	78	2 (−3 to 11)	20	35 (20-53)	74
2018	37 (22-54)	77	2 (−3 to 10)	19	33 (21-49)	71
Histology	$P = .02$	$P = .11$	$P < .0001$	$P = .01$	$P = .27$	$P = .18$
Adenocarcinoma	37 (22-56)	79	3 (−2 to 11)	21	34 (20-51)	75
Squamous cell carcinoma	35 (22-52)	73	1 (−4 to 9)	18	34 (20-50)	70
Other	29 (16-51)	69	0 (−7 to 7)	15	32 (18-49)	68
Tumor site	$P = .16$	$P = .0006$	$P < .0001$	$P = .05$	$P = .83$	$P = .46$
Cervical esophagus	34 (19-47)	63	0 (−7 to 4)	16	34 (19-49)	66
Upper esophagus	35 (23-52)	81	2 (−3 to 10)	17	34 (21-49)	77
Middle esophagus	37 (21-56)	72	2 (−5 to 10)	19	34 (20-51)	70
Lower esophagus	36 (22-55)	75	3 (−2 to 10)	19	34 (20-50)	72
Gastroesophageal junction	36 (22-56)	81	2 (−3 to 11)	21	34 (20-52)	76
Other	32 (19-53)	76	0 (−8 to 9)	19	32 (18-53)	75
Stage	$P < .0001$	$P < .0001$	$P < .0001$	$P < .0001$	$P < .0001$	$P < .0001$
I	48 (35-66)	101	7 (0-15)	27	42 (27-61)	85
II	43 (29-60)	79	5 (0-13)	21	37 (25-55)	75
III	42 (27-57)	75	4 (0-9)	18	37 (24-54)	72
IV	28 (17-44)	63	1 (−5 to 8)	14	28 (17-44)	63
Unknown	36 (21-56)	80	2 (−4 to 11)	23	34 (19-52)	77
Specialty	$P < .0001$	$P = .07$	$P < .0001$	$P < .0001$	$P < .0001$	$P < .0001$
Gastroenterology	37 (22-56)	79	4 (0-12)	21	33 (18-50)	73
General surgery	38 (24-56)	77	4 (−1 to 11)	19	34 (21-50)	70
Thoracic surgery	33 (18-49)	77	−7 (−19 to 0)	8	41 (26-60)	84
Other	29 (17-49)	71	2 (−2 to 9)	19	28 (16-45)	65
Years in Practice	$P = .14$	$P = .0004$	$P = .03$	$P = .03$	$P = .03$	$P = .002$
1-9	37 (24-58)	81	3 (−2 to 9)	19	36 (21-52)	77
10-14	35 (22-51)	70	2 (−4 to 9)	19	34 (21-49)	68
15-19	38 (23-57)	75	3 (−2 to 10)	18	35 (21-52)	71
20-24	37 (23-56)	82	4 (−3 to 12)	21	33 (21-51)	73
25-29	35 (20-53)	77	3 (−2 to 12)	21	31 (18-47)	70
≥30	37 (22-56)	76	2 (−1 to 13)	22	34 (18-48)	70
Unknown	36 (21-56)	79	2 (−4 to 10)	19	34 (20-53)	76
Academic affiliation	$P = .08$	$P = .26$	$P < .0001$	$P = .47$	$P = .22$	$P = .02$
No	37 (22-55)	77	3 (−1 to 11)	20	34 (20-50)	70
Yes	35 (20-55)	78	0 (−9 to 8)	19	35 (20-52)	77
Treatment group‡	$P < .0001$	$P < .0001$	$P < .0001$	$P < .0001$	$P < .0001$	$P < .0001$
A	23 (14-36)	50	5 (0-13)	21	16 (7-30)	48
B	39 (24-60)	87	0 (−7 to 8)	17	39 (26-57)	79
C	29 (16-49)	73	0 (−7 to 7)	15	29 (17-48)	71
D	58 (38-82)	111	7 (−4 to 18)	31	50 (34-77)	101
E	36 (22-55)	74	2 (−3 to 9)	18	34 (21-50)	67
F	40 (26-54)	63	3 (−1 to 10)	20	35 (21-48)	65
G	40 (28-52)	64	5 (0-11)	18	35 (26-48)	59
H	39 (26-50)	63	8 (0-15)	35	28 (14-42)	60

(Continued)

TABLE 2. Continued

Variable	Treatment interval		Subinterval 1*		Subinterval 2†	
	50th (IQR)	90th	50th (IQR)	90th	50th (IQR)	90th
ED visits	$P < .0001$	$P < .0001$	$P = .10$	$P = 1.0000$	$P < .0001$	$P < .0001$
0	35 (21-52)	73	2 (−3 to 10)	20	33 (19-48)	69
1	45 (26-67)	91	2 (−3 to 9)	20	42 (24-62)	91
>1	54 (31-76)	99	1 (−5 to 7)	19	48 (31-72)	98
Hospital admissions	$P = .004$	$P < .0001$	$P < .0001$	$P < .0001$	$P < .0001$	$P < .0001$
0	36 (22-54)	76	4 (−3 to 12)	21	33 (20-49)	70
1	35 (20-56)	79	1 (−3 to 6)	14	35 (20-54)	76
>1	48 (29-73)	106	0 (−5 to 3)	13	48 (32-71)	109

50th, 50th percentile; *IQR*, interquartile range; *90th*, 90th percentile; *LHIN*, Local Health Integration Network; *ADG*, Aggregate Diagnostic Group; *ED*, Emergency Department. *Subinterval 1 = diagnosis to first health care encounter. †Subinterval 2 = first health care encounter to treatment start. ‡Treatment group: A = endoscopy with or without subsequent treatment; B = chemotherapy only; C = radiotherapy only; D = surgery with or without subsequent treatment; E = chemotherapy and radiotherapy; F = chemotherapy or radiotherapy then surgery; G = chemotherapy and radiotherapy then surgery; and H = other.

decreasing household income, and female sex were predictors of longer wait times between diagnosis and surgery for a cohort comprised of 12 different cancers, but did not stratify their analysis on the basis of cancer type. Possible reasons for differences according to patient characteristics have been postulated. Elderly patients might have more missed or rescheduled appointments, which might contribute to a longer TI.[22,23] Those living in rural locations might struggle to keep appointments that require a long travel distance.[22,23] Patients living in an area of higher material deprivation, which we used as a surrogate for individual-level socioeconomic status, might miss appointments because of difficulty getting time off work or paying for transport to their appointments.[24]

Many previous studies have restricted their cohorts to patients with AC or SCC.[17,25-28] It is unclear why histological subtypes other than AC or SCC would have a shorter TI. Rare diagnoses are more likely to be brought to the multidisciplinary team for discussion and this might expedite pretreatment investigations and specialist visits. Patients with a stage IV cancer had a TI that was 20 days shorter than those with a stage I cancer. At the 90th percentile, this difference increased to 38 days. Previous studies conducted in Ontario have shown the same phenomenon in other cancer sites.[29-33] Large population studies from the United States have also shown the same effect in a range of different solid organ cancers.[34,35] Possible explanations exist. First, patients with a later stage are more likely to have symptoms from their disease than those with early-stage cancers. At the system level, symptomatic patients might have their investigations and specialist visits expedited because of the concerning symptom severity. Second, there might be a lower sense of urgency with lower-stage cancers, and in a resource-constrained health care system, those with a higher stage will likely take priority for investigations and treatment. Third, possible treatment options vary between stage I and stage IV. Most stage IV patients will undergo palliative treatment that does not include surgery.[36] Our results have shown that patients who are receiving radiotherapy alone have a much shorter TI length than those who undergo surgery.

Patients diagnosed by a thoracic surgeon had a shorter TI than those diagnosed by a gastroenterologist or a general surgeon. Those latter patients will be referred to a thoracic surgeon for a consultation; patients diagnosed by a thoracic surgeon might have that consultation at the same time as the diagnosis, thereby skipping a step on the clinical pathway and shortening the interval.

Patients who had one or more ED visits or hospital admissions between diagnosis and treatment had a longer median TI than those who had neither. These patients might have been too sick to undergo their cancer treatment and require treatment of the illness that prompted the ED visit or admission first.

Strengths and Limitations

To our knowledge, this is the first Ontario-wide population-level study to include such an extensive number of risk factors for a prolonged TI including the assessment of its geographical variation. Previous Ontario studies were either performed on a heterogenous cohort of cancer patients[16] or did not assess differences in TI length according to geography.[15] By partitioning the TI into 2 distinct subintervals, we also identified other potentially modifiable risk factors that were not present on analysis of the overall TI. We used routinely collected health administrative data that allowed us to study the entire esophageal cancer population in Ontario during our time frame. Mandatory submissions from all hospitals in the province to CIHI and NACRS decreases the likelihood of institutions being overrepresented. Our definition of the diagnosis date is more refined than in previous studies that used the cancer registry date as the diagnosis date. We used the date of endoscopic biopsy to create a TI definition that was as accurate as possible, and is in line with national efforts to standardize

TABLE 3. Unadjusted and adjusted differences of the treatment interval at the 50th and 90th percentile according to category in Ontario patients with esophageal cancer between 2013 and 2018

Variable	50th Percentile		90th Percentile	
	Unadjusted difference (95% CI)	Adjusted difference (95% CI)	Unadjusted difference (95% CI)	Adjusted difference (95% CI)
Adjusted intercept		38 (35-42)		55 (45-65)
Age	$P = .03$	$P < .0001$	$P < .0001$	$P = .03$
Unadjusted intercept	37 (35-38)		75 (72-78)	
18-49	−3 (−7 to 1)	−7 (−10 to −4)	−10 (−19 to −1)	−6 (−14 to 2)
50-59	−1 (−3 to 1)	−2 (−3 to 0)	1 (−5 to 7)	2 (−2 to 6)
60-69	Referent	Referent	Referent	Referent
70-79	3 (0-6)	2 (1-4)	7 (2-12)	4 (0-7)
≥80	0 (−3 to 3)	2 (0-5)	11 (5-17)	6 (0-12)
Sex	$P = .31$	$P = .69$	$P = .35$	$P = .96$
Unadjusted intercept	38 (36-40)		77 (73-81)	
Female	Referent	Referent	Referent	Referent
Male	−1 (−3 to 1)	0 (−1 to 2)	2 (−2 to 6)	0 (−4 to 4)
Sum of minor ADGs	$P < .0001$	$P = .0005$	$P < .0001$	$P = .39$
Unadjusted intercept	35 (34-36)		71 (67-75)	
0-2	Referent	Referent	Referent	Referent
3-4	0 (−2 to 2)	0 (−2 to 2)	4 (−2 to 10)	2 (−2 to 6)
5-6	5 (3-7)	3 (1-5)	9 (3-15)	3 (−1 to 8)
≥7	5 (3-7)	3 (1-6)	15 (9-21)	4 (−1 to 9)
Sum of major ADGs	$P = .02$	$P = .70$	$P < .0001$	$P = .003$
Unadjusted intercept	36 (35-40)		71 (68-74)	
0	Referent	Referent	Referent	Referent
1	1 (−1 to 3)	1 (−1 to 2)	7 (3-11)	4 (0-8)
2	2 (−1 to 5)	1 (−1 to 4)	12 (6-18)	8 (3-13)
≥3	4 (1-7)	1 (−1 to 3)	17 (11-24)	11 (4-17)
Material deprivation	$P = .33$	$P = .001$	$P = .78$	$P = .005$
Unadjusted intercept	36 (34-38)		80 (75-85)	
1	Referent	Referent	Referent	Referent
2	0 (−2 to 2)	1 (−1 to 4)	−4 (−12 to 4)	−3 (−8 to 2)
3	1 (−1 to 3)	3 (1-6)	−2 (−9 to 5)	1 (−4 to 6)
4	1 (−1 to 3)	3 (1-5)	−2 (−8 to 4)	2 (−4 to 7)
5	3 (−0 to 6)	4 (2-7)	0 (−7 to 7)	5 (0-11)
Rurality	$P = .45$	$P = .04$	$P = .15$	$P = .04$
Unadjusted intercept	37 (36-38)		78 (75-80)	
Urban	Referent	Referent	Referent	Referent
Rural	1 (−2 to 4)	2 (0 to 4)	5 (−2 to 12)	6 (0-11)
Recent immigration	$P = .62$	$P = .15$	$P = .27$	$P = .78$
Unadjusted intercept	37 (36-38)		78 (76-80)	
No	Referent	Referent	Referent	Referent
Yes	1 (−3 to 4)	2 (−1 to 5)	5 (−4 to 14)	1 (−6 to 8)
Histology	$P = .007$	$P = .02$	$P = .15$	$P = .23$
Unadjusted intercept	38 (37-39)		80 (78-82)	
Adenocarcinoma	Referent	Referent	Referent	Referent
Squamous cell carcinoma	−1 (−3 to 1)	−1 (−3 to 2)	−5 (−10 to 0)	−4 (−9 to 1)
Other	−6 (−10 to −2)	−5 (−8 to −2)	−3 (−11 to 5)	−2 (−8 to 5)
Tumor location	$P = .19$	$P = .22$	$P = .0007$	$P = .10$
Unadjusted intercept	37 (36-38)		83 (80-86)	
Cervical esophagus	−3 (−11 to 5)	−3 (−9 to 3)	−12 (−26 to 2)	−9 (−23 to 4)
Upper esophagus	−2 (−5 to 1)	0 (−4 to 4)	−8 (−21 to 5)	−3 (−15 to 18)
Middle esophagus	0 (−3 to 3)	1 (−2 to 4)	−10 (−17 to 3)	−1 (−9 to 6)
Lower esophagus	0 (−2 to 2)	−1 (−2 to 1)	−8 (−12 to −4)	−4 (−8 to 0)

(Continued)

TABLE 3. Continued

Variable	50th Percentile		90th Percentile	
	Unadjusted difference (95% CI)	Adjusted difference (95% CI)	Unadjusted difference (95% CI)	Adjusted difference (95% CI)
Gastroesophageal junction	Referent	Referent	Referent	Referent
Other	−5 (−9 to −1)	−3 (−6 to 0)	−0 (−12 to 12)	4 (−6 to 13)
LHIN	$P < .0001$	$P < .0001$	$P = .0002$	$P < .0001$
Unadjusted Intercept	39 (36-41)		78 (72-84)	
01	−6 (−10 to −2)	−6 (−10 to −2)	−4 (−14 to 6)	−9 (−17 to 1)
02	0 (−3 to 4)	−2 (−5 to 1)	4 (−6 to 14)	−2 (−11 to 6)
03	3 (0-7)	3 (−1 to 7)	3 (−5 to 11)	−1 (−8 to 6)
04	−7 (−10 to −3)	−8 (−11 to −5)	−7 (−15 to 1)	−12 (−18 to −7)
05	0 (−4 to 5)	−2 (−7 to 2)	0 (−18 to 18)	−1 (−10 to 9)
06	5 (1-9)	4 (0-8)	14 (2-26)	7 (−1 to 16)
07	−1 (−4 to 3)	−2 (−6 to 1)	3 (−8 to 14)	−3 (−11 to 4)
08	−4 (−8 to 0)	−4 (−7 to −1)	−1 (−11 to 9)	−3 (−10 to 4)
09	Referent	Referent	Referent	Referent
10	7 (3-11)	6 (1-11)	2 (−8 to 16)	−2 (−10 to 5)
11	3 (−1 to 7)	2 (0 to 5)	5 (−2 to 12)	−1 (−9 to 7)
12	−11 (−14 to −7)	−6 (−9 to −2)	−7 (−19 to 5)	−2 (−12 to 8)
13	−5 (−8 to −2)	−8 (−12 to −5)	−7 (−16 to 2)	−12 (−18 to −6)
14	1 (−5 to 7)	1 (−5 to 3)	11 (−4 to 26)	−9 (−19 to 1)
Treatment group*	$P < .0001$	$P < .0001$	$P < .0001$	$P < .0001$
Unadjusted Intercept	41 (39-43)		64 (60-68)	
A	−17 (−20 to −14)	−16 (−19 to −14)	−9 (−18 to −1)	−16 (−22 to −10)
B	0 (−3 to 3)	0 (−3 to 3)	27 (20-34)	21 (14-27)
C	−10 (−13 to −7)	−11 (−13 to −8)	13 (7-19)	6 (0-13)
D	15 (12-18)	15 (12-18)	45 (35-55)	37 (29-44)
E	−4 (−7 to −2)	−3 (−5 to −1)	10 (5-15)	8 (4-12)
F	−1 (−6 to 4)	−2 (−7 to 3)	−3 (−13 to 7)	0 (−9 to 9)
G	Referent	Referent	Referent	Referent
H	−2 (−6 to 2)	−2 (−5 to 2)	0 (−8 to 8)	−4 (−10 to 2)

CI, Confidence interval; *ADG*, Aggregate Diagnostic Group; *LHIN*, Local Health Integration Network. *Treatment group: A = endoscopy with or without subsequent treatment; B = chemotherapy only; C = radiotherapy only; D = surgery with or without subsequent treatment; E = chemotherapy and radiotherapy; F = chemotherapy or radiotherapy then surgery; G = chemotherapy and radiotherapy then surgery; and H = other.

time intervals.[7] Last, our results are generalizable to other countries because we have found specific patient groups more at risk of longer intervals that transcend geography. Although the magnitude of differences might be specific to Ontario, the wait time variation is unlikely to be on clinical grounds and is generalizable to regions with similar health care models.

Stage was only 54% complete despite capturing data from several databases. A recent study using the same databases[15] had similar completeness. The sensitivity analysis that included stage showed that stage had no effect on the association of the other variables at the 50th percentile. The unknown group had a longer TI than stage IV patients, but shorter than the others (stage I-III) and are likely to be stage IV patients, receive nonsurgical treatment,[15] and were equal across all LHINs. There was uncontrolled confounding by using administrative databases. Patient factors not included that might have affected the TI length include a patient's social situation (eg, access to reliable public transportation).

CONCLUSIONS

To our knowledge, this population-level study is the first to investigate the esophageal cancer TI length across different LHINs and examine numerous factors. We identified geographical variation despite adjusting for several factors. Patients who are older, more comorbid, or in rural areas are at greater risk for protracted wait times. Future research will be aimed at investigating an association between wait times and survival in our study population.

Conflict of Interest Statement

The authors reported no conflicts of interest.

The *Journal* policy requires editors and reviewers to disclose conflicts of interest and to decline handling or reviewing manuscripts for which they may have a conflict of interest. The editors and reviewers of this article have no conflicts of interest.

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Key Words: esophageal cancer, treatment interval, epidemiology, geographical variability

TABLE E1. Health administrative databases used in this study to obtain demographic, disease, billing, and outcomes data

Database	Description
Ontario Cancer Registry	Cancer information, including site, histology, and diagnosis date
Registered Persons Database	Patient demographic data including age, sex, vital status, and dates of last health care encounter
Ontario Health Insurance Plan Database	Physician billing database for inpatient and outpatient services, including diagnoses, services provided, and dates
Discharge Abstract Database	Mandatory submissions from hospitals to the Canadian Institute for Health Information; includes information on hospital admission such as dates and diagnoses
Same Day Surgery Database	Stores information such as date and service for same-day procedures
National Ambulatory Care Reporting Database	Receives mandatory submissions from institutions for visits made to hospital and community ambulatory care centers
PCCF	Converts a patient's postal code into a dissemination area to ascribe certain characteristics to each patient such as rurality and median household income
Activity Level Reporting	Stores information on chemotherapy and radiotherapy dates and services, at regional centers and outreach clinics
LHIN	Stores information including population and number and type of hospitals within each LHIN
Ontario Marginalisation	This database comprises separate elements (eg, material deprivation) and is used in conjunction with PCCF to assign patients a score
IRCC Permanent Resident Database	This includes information on people who applied to land in Ontario such as country of citizenship and date of landing
ICES Physician Database	Demographic information on Ontario physicians including age, specialty, location of work, and year of graduation

PCCF, Postal Code Conversion File; *LHIN*, Local Health Integration Network; *IRCC*, Immigration, Refugees, and Citizenship Canada; *ICES*, Institute for Clinical Evaluative Sciences.

TABLE E2. ICD-O-3 codes for morphology and topography

Description	Code
Adenocarcinoma	8140-8141, 8143-8145, 8190-8231, 8260-8263, 8310, 8401, 8480-8490, 8550-8551, 8570-8574, 8576
Squamous cell carcinoma	8050-8078, 8083-8084
Other	80001-80003, 80103, 80203, 80223, 80303, 80313, 81482, 81490, 84903, 85603
C15.0	Cervical esophagus
C15.1	Thoracic esophagus
C15.2	Abdominal esophagus
C15.3	Upper third of esophagus
C15.4	Middle third of esophagus
C15.5	Lower third of esophagus
C15.8	Overlapping lesion of esophagus
C15.9	Esophagus, NOS
C16.0	Cardia, NOS • Gastric cardia • Cardioesophageal junction • Esophagogastric junction Gastroesophageal junction

NOS, Not otherwise specified.

TABLE E3. Codes for diagnosis, consultations, investigations, and treatment

Event	Code	Data source
Biopsy	2NA71, 2NC70BN	CCI
	Z515, Z399, +E702	OHIP fee
	150	OHIP diagnosis code
Consultations		
Surgery	A643-A646, C643-C646, W645, W646	OHIP
Medical oncology	A441-A448, A845, C441-C446, C845, W445, W446, W842-W847	
Radiation oncology	A340-A348, A745, C341-C346, C745	
Investigations		
CT (C/A/P)	X125, X406, X407/X126, X409, X410/X231, X232, X233	OHIP
CT (head)	X188, X400, X401, X402, +E874	
PET	J710	
EUS	S236, E800	
PFTs	J301, J303, J304, J305, J306, J308, J310, J311, J324, J327, J340	
Treatment		
Endoscopic resection	S093, Z527, +E674/E675	OHIP
Chemotherapy	G281, G339, G345, G359, G381, G382	
Radiotherapy	519, 530-542, 548, 549, 575, 592, 594, 596, 597	ALR
Surgery	X310-X313	OHIP
	1NA87-1NA92	CCI
	S089, S090	OHIP

CCI, Canadian Classification of Health Information; *OHIP*, Ontario Health Insurance Plan; *CT*, computed tomography; *C/A/P*, chest, abdomen, pelvis; *PET*, positron emission tomography; *EUS*, endoscopic ultrasound; *PFT*, pulmonary function test; *ALR*, Activity Level Reporting.

TABLE E4. Comparison of original model with SA

	Original model	SA.1*	SA.2†	SA.3‡	SA.4§	SA.5‖	SA.6¶
Adjusted intercept	38 (35-42)	37 (34-40)	38 (34-42)	38 (35-42)	38 (34-42)	35 (31-39)	41 (37-46)
Age	$P < .0001$	$P < .0001$	$P < .0001$	$P < .0001$	$P < .0001$	$P < .0001$	$P < .0001$
18-49	−7 (−10 to −4)	−6 (−10 to 13)	−7 (−10 to 5)	−7 (−10 to −5)	−7 (−10 to −5)	−5 (−8 to −2)	−6 (−9 to −3)
50-59	−1 (−4 to 0)	−2 (−4 to 0)	−2 (−4 to 0)	−2 (−4 to 0)	−2 (−4 to 1)	−2 (−4 to 0)	−1 (−3 to 1)
60-69	Referent	Referent	Referent	Referent	Referent	Referent	Referent
70-79	2 (1-4)	3 (1-4)	2 (0-4)	2 (1-4)	3 (1-4)	2 (0-4)	2 (0-3)
≥80	2 (0-5)	3 (1-6)	2 (−1 to 4)	2 (0-5)	2 (−1 to 5)	−1 (−4 to 2)	3 (0-5)
Sex	$P = .70$	$P = .81$	$P = .79$	$P = .80$	$P = .82$	$P = .91$	$P = .39$
Female	Referent	Referent	Referent	Referent	Referent	Referent	Referent
Male	0 (−1 to 2)	0 (−2 to 2)	0 (−2 to 2)	0 (−1 to 2)	0 (1−2)	1 (−2 to 2)	2 (−1 to 2)
Sum of minor ADGs	$P = .0005$	$P = .0005$	$P = .004$	$P = .0002$	$P = .001$	$P = .0006$	$P = .0007$
0-2	Referent	Referent	Referent	Referent	Referent	Referent	Referent
3-4	0 (−2 to 2)	−1 (−3 to 2)	0 (−2 to 2)	0 (−2 to 2)	0 (−2 to 2)	0 (−2 to 2)	0 (−2 to 2)
5-6	3 (1-5)	3 (1-5)	3 (1-5)	3 (1-5)	3 (1-5)	3 (1-5)	3 (2-6)
≥7	4 (1-6)	3 (1-6)	3 (1-6)	3 (1-5)	3 (1-5)	3 (1-6)	3 (1-5)
Sum of major ADGs	$P = .70$	$P = .97$	$P = .58$	$P = .57$	$P = .34$	$P = .30$	$P = .62$
0	Referent	Referent	Referent	Referent	Referent	Referent	Referent
1	01 (−1 to 2)	0 (−2 to 2)	1 (−1 to 3)	0 (−2 to 2)	0 (−2 to 2)	1 (−1 to 2)	1 (−1 to 2)
2	1 (−1 to 4)	0 (−2 to 3)	1 (−1 to 4)	1 (−1 to 4)	2 (0-4)	2 (0-4)	1 (−1 to 3)
≥3	1 (−1 to 3)	1 (−2 to 3)	1 (−1 to 4)	1 (−1 to 3)	2 (−1 to 4)	2 (−1 to 5)	1 (−2 to 3)
Material deprivation	$P = .001$	$P = .003$	$P = .002$	$P = .003$	$P = .0008$	$P = .009$	$P = .002$
1	Referent	Referent	Referent	Referent	Referent	Referent	Referent
2	1 (−1 to 4)	2 (−1 to 4)	1 (−1 to 3)	1 (−1 to 4)	1 (−1 to 4)	0 (−2 to 3)	1 (−2 to 3)
3	3 (1-6)	3 (1-5)	3 (1-6)	4 (1-6)	4 (1-6)	2 (−1 to 4)	3 (1-5)
4	3 (1-5)	3 (1-5)	3 (1-5)	3 (1-5)	3 (1-5)	2 (0-5)	2 (0-5)
5	4 (2-7)	4 (2-6)	4 (2-6)	4 (2-6)	4 (2-6)	4 (2-6)	4 (2-6)
Rurality	$P = .04$	$P = .09$	$P = .10$			$P = .05$	$P = .02$
Urban	Referent	Referent	Referent			Referent	Referent
Rural	2 (0-4)	2 (0-4)	2 (0-4)			2 (0-4)	2 (0-4)
Recent immigration	$P = .15$	$P = .12$		$P = .23$		$P = .66$	$P = .50$
No	Referent	Referent		Referent		Referent	Referent
Yes	2 (−1 to 5)	2 (−1 to 5)		2 (−1 to 5)		1 (−2 to 4)	1 (−2 to 4)
Histology	$P = .02$	$P = .0001$	$P = .02$	$P = .01$	$P = .02$	$P = .0006$	$P = .02$
Adenocarcinoma	Referent	Referent	Referent	Referent	Referent	Referent	Referent
Squamous cell carcinoma	−1 (−3 to 2)	−1 (−3 to 1)	−1 (−3 to 2)	−1 (−3 to 1)	−1 (−3 to 1)	−2 (−4 to 1)	−1 (−3 to 1)
Other	−5 (−8 to −2)	−6 (−8 to −3)	−5 (−8 to −1)	−5 (−8 to −2)	−5 (−8 to −1)	−6 (−10 to −3)	−4 (−7 to −1)
Tumor site	$P = .22$	$P = .55$	$P = .28$	$P = .30$	$P = .23$	$P = .10$	$P = .48$
Cervical esophagus	−3 (−9 to 3)	−1 (−8 to 6)	−3 (−8 to 3)	−2 (−8 to 4)	−3 (−8 to 3)	−3 (−9 to 3)	−5 (−11 to 1)
Upper esophagus	0 (−4 to 4)	1 (−3 to 6)	1 (−3 to 4)	0 (−3 to 4)	1 (−3 to 4)	−2 (−7 to 3)	−1 (−4 to 3)

(Continued)

TABLE E4. Continued

	Original model	SA.1*	SA.2†	SA.3‡	SA.4§	SA.5‖	SA.6¶
Middle esophagus	1 (−2 to 4)	0 (−2 to 4)	1 (−2 to 4)	1 (−2 to 4)	1 (−2 to 4)	1 (−2 to 4)	1 (−2 to 4)
Lower esophagus	−1 (−2 to 1)	1 (−1 to 2)	−1 (−2 to 1)	−0 (−2 to 1)	−1 (−2 to 1)	−1 (−3 to 1)	−0 (−2 to 1)
Gastroesophageal junction	Referent	Referent	Referent	Referent	Referent	Referent	Referent
Other	−3 (−6 to 0)	−2 (−5 to 1)	−3 (−6 to 1)	−3 (−6 to 0)	−3 (−6 to 1)	−4 (−8 to −1)	−2 (−5 to 1)
LHIN	$P < .0001$		$P < .0001$	$P < .0001$	$P < .0001$	$P < .0001$	$P < .0001$
01	−6 (−10 to −2)		−6 (−10 to −3)	−6 (−10 to −3)	−6 (−10 to −3)	−5 (−9 to −2)	−6 (−9 to −2)
02	−2 (−5 to 1)		−1 (−5 to 2)	−1 (−4 to 2)	−1 (−5 to 2)	1 (−2 to 4)	−4 (−7 to −1)
03	3 (−1 to 7)		3 (−1 to 8)	4 (−1 to 7)	3 (−1 to 7)	5 (1-9)	1 (−3 to 5)
04	−8 (−11 to −5)		−8 (−11 to −5)	−8 (−11 to 5)	−8 (−11 to −5)	−5 (−8 to −2)	−8 (−10 to −5)
05	−2 (−7 to 2)		−2 (−7 to 2.0)	−2 (−7 to 2)	−2 (−7 to 2)	1 (−3 to 5)	−2 (−6 to 3)
06	4 (0-8)		4 (0-8)	4 (1-8)	4 (1-8)	8 (4-12)	4 (0-8)
07	−2 (−6 to 1)		−2 (−6 to 1)	−2 (−6 to 1)	−2 (−5 to 1)	1 (−2 to 5)	−4 (−7 to −0)
08	−4 (−7 to −1)		−4 (−7 to 0)	−4 (−8 to −1)	−4 (−7 to −1)	−3 (−7 to 1)	−4 (−8 to −1)
09	Referent		Referent	Referent	Referent	Referent	Referent
10	6 (1-11)		6 (0-10)	6 (1-11)	6 (1-11)	8 (4-13)	5 (1-8)
11	3 (0-5)		3 (−1 to 6)	3 (0-6)	3 (0-6)	5 (2-9)	1 (−2 to 4)
12	−6 (−9 to −2)		−6 (−9 to −2)	−5 (−8 to −2)	−5 (−9 to −2)	−10 (−13 to −6)	−6 (−10 to −3)
13	−8 (−12 to −5)		−8 (−12 to −5)	−8 (−11 to −4)	−8 (−11 to −4)	−4 (−8 to −1)	−8 (−11 to −5)
14	1 (−5 to 3)		−1 (−6 to 4)	−1 (−6 to 4)	−1 (−6 to 4)	3 (−3 to 9)	−2 (−7 to 4)
Treatment group#	$P < .0001$	$P < .0001$	$P < .0001$	$P < .0001$	$P < .0001$		$P < .0001$
A	−16 (−19 to 14)	−18 (−20 to 15)	−16 (−18 to 14)	−16 (−19 to 13)	−16 (−18 to −13)		−12 (−15 to −10)
B	0 (−3 to 3)	1 (−2 to 4)	0 (−3 to 3)	0 (−3 to 3)	0 (−3 to 3)		6 (3-9)
C	−11 (−13 to −8)	−11 (−14 to −9)	−11 (−13 to −8)	−11 (−14 to −9)	−11 (−14 to −9)		−5 (−8 to −2)
D	15 (12-18)	14 (11-17)	15 (11-19)	14 (11-18)	15 (11-19)		17 (13-20)
E	−3 (−5 to −1)	−4 (−6 to −2)	−3 (−5 to −1)	−3 (−5 to −1)	−3 (−5 to −2)		1 (−1 to 3)
F	−2 (−7 to 3)	0 (−5 to 6)	−2 (−7 to 3)	−2 (−7 to 3)	−2 (−6 to 2)		1 (−5 to 6)
G	Referent	Referent	Referent	Referent	Referent		Referent
H	−2 (−5 to 2)	−3 (−7 to 0)	−2 (−6 to 2)	−2 (−6 to 1)	−2 (−6 to 1)		0 (−4 to 4)
Stage							$P < .0001$
I							3 (−1 to 6)
II							Referent
III							−1 (−4 to 1)
IV							−12 (−15 to −10)
Unknown							−8 (−10 to −5)

All values are difference (95% CI) in treatment interval length at the 50th percentile. *SA*, Sensitivity analyses; *ADG*, Aggregate Diagnosis Group; *LHIN*, Local Health Integration Network. *SA.1 = removal of LHIN. †SA.2 = removal of immigration. ‡SA.3 = removal of rurality. §SA.4 = removal of immigration and rurality. ‖SA.5 = removal of treatment group. ¶SA.6 = addition of stage. #Treatment group: A = endoscopy with or without subsequent treatment; B = chemotherapy only; C = radiotherapy only; D = surgery with or without subsequent treatment; E = chemotherapy and radiotherapy; F = chemotherapy or radiotherapy then surgery; G = chemotherapy and radiotherapy then surgery; and H = other.

TABLE E5. Comparison of original model with SA

	Original model	SA.1*	SA.2†	SA.3‡	SA.4§	SA.5‖	SA.6¶
Adjusted intercept	55 (45-65)	61 (54-67)	63 (54-72)	64 (56-73)	63 (55-72)	68 (57-78)	66 (57-75)
Age group, y	$P = .03$	$P = .09$	$P = .05$	$P = .01$	$P = .03$	$P = .0006$	$P = .10$
18-49	−6 (−14 to 2)	−7 (−16 to 1)	−6 (−13 to 2)	−6 (−15 to 2)	−6 (−14 to 3)	−9 (−17 to −1)	−4 (−12 to 4)
50-59	2 (−2 to 6)	1 (−3 to 5)	2 (−2 to 6)	2 (−2 to 6)	2 (−3 to 6)	3 (−2 to 8)	2 (−2 to 6)
60-69	Referent	Referent	Referent	Referent	Referent	Referent	Referent
70-79	4 (0-7)	3 (−1 to 7)	4 (0-8)	5 (1-9)	5 (1-9)	7 (2-11)	4 (1-8)
≥80	6 (0-12)	5 (−1 to 12)	6 (0-13)	7 (1-13)	7 (1-13)	7 (1-13)	4 (−2 to 10)
Sex	$P = 1.0$	$P = .44$	$P = .93$	$P = .81$	$P = 1.0$	$P = .42$	$P = .70$
Female	Referent	Referent	Referent	Referent	Referent	Referent	Referent
Male	0 (−4 to 4)	−2 (−5 to 2)	0 (−4 to 4)	−1 (−4 to 3)	0 (−4 to 3)	0 (−4 to 3)	−1 (−4 to 3)
Sum of minor ADGs	$P = .39$	$P = .05$	$P = .35$	$P = .32$	$P = .40$	$P = .05$	$P = .32$
0-2	Referent	Referent	Referent	Referent	Referent	Referent	Referent
3-4	2 (−2 to 6)	4 (−1 to 8)	2 (−2 to 7)	2 (−2 to 7)	2 (−3 to 6)	2 (−3 to 6)	2 (−3 to 6)
5-6	3 (−1 to 8)	5 (0-9)	3 (−1 to 8)	3 (−1 to 7)	3 (−1 to 7)	4 (−1 to 9)	3 (−1 to 7)
≥7	4 (−1 to 9)	7 (2-12)	4 (−1 to 10)	4 (−1 to 9)	4 (−1 to 9)	8 (2-15)	5 (0-10)
Sum of Major ADGs	$P = .003$	$P = .01$	$P = .002$	$P = .002$	$P = .005$	$P = .03$	$P = .003$
0	Referent	Referent	Referent	Referent	Referent	Referent	Referent
1	4 (0-8)	3 (−1 to 6)	4 (0-8)	3 (−1 to 7)	3 (−1 to 7)	3 (−1 to 7)	3 (0-7)
2	8 (3-13)	8 (2-14)	8 (3-13)	7 (2-12)	7 (2-13)	8 (2-15)	8 (3-13)
≥3	11 (4-17)	9 (3-15)	10 (4-17)	11 (5-17)	10 (4-17)	8 (0-16)	9 (3-14)
Material deprivation	$P = .005$	$P = .01$	$P = .003$	$P = .02$	$P = .02$	$P = .20$	$P = .04$
1	Referent	Referent	Referent	Referent	Referent	Referent	Referent
2	−3 (−8 to 2)	−2 (−7 to 3)	−3 (−8 to 2)	−2 (−8 to 3)	−2 (−7 to 3)	0 (−6 to 7)	−3 (−7 to 2)
3	2 (−4 to 7)	2 (−3 to 7)	2 (−3 to 6)	1 (−4 to 6)	2 (−3 to 6)	2 (−4 to 7)	−1 (−5 to 4)
4	1 (−4 to 6)	3 (−2 to 9)	1 (−4 to 6)	2 (−4 to 7)	2 (−3 to 7)	2 (−5 to 8)	1 (−5 to 6)
5	6 (0-11)	5 (0-9)	6 (1-10)	5 (1-10)	6 (1-10)	6 (0-12)	5 (0-9)
Rurality	$P = .04$	$P = .15$	$P = .04$			$P = .14$	$P = .05$
Urban	Referent	Referent	Referent			Referent	Referent
Rural	6 (0-11)	3 (−1 to 7)	6 (0-12)			5 (−2 to 13)	5 (0-11)
Recent immigration	$P = .78$	$P = .45$		$P = .61$		$P = .39$	$P = .91$
No	Referent	Referent		Referent		Referent	Referent
Yes	1 (−6 to 8)	2 (−4 to 8)		2 (−6 to 10)		4 (−5 to 12)	0 (−6 to 7)
Histology	$P = .23$	$P = .82$	$P = .21$	$P = .16$	$P = .26$	$P = .02$	$P = .21$
Adenocarcinoma	Referent	Referent	Referent	Referent	Referent	Referent	Referent
Squamous cell carcinoma	−4 (−9 to 1)	−1 (−6 to 3)	−4 (−9 to 0)	−4 (9 to 0)	−34 (−8 to 1)	−8 (−13 to −2)	−3 (−7 to 1)
Other	−2 (−8 to 5)	−1 (8 to 5)	−2 (−8 to 4)	−2 (−8 to 5)	−1 (−8 to 5)	−5 (−12 to 2)	−3 (−10 to 4)
Tumor site	$P = .10$	$P = .08$	$P = .21$	$P = .05$	$P = .10$	$P = .008$	$P = .08$
Cervical esophagus	−10 (−23 to 4)	−10 (−23 to 3)	−10 (−24 to 5)	−9 (−23 to 5)	−11 (−24 to 3)	−10 (−26 to 6)	−5 (−17 to 7)
Upper esophagus	−3 (−15 to 18)	−4 (−22 to 13)	−3 (−16 to 10)	−5 (−17 to 8)	−4 (−17 to 8)	−3 (−20 to 14)	−5 (−18 to 8)

(Continued)

TABLE E5. Continued

	Original model	SA.1*	SA.2†	SA.3‡	SA.4§	SA.5‖	SA.6¶
Middle esophagus	−1 (−9 to 6)	−2 (−8 to 4)	−1 (−8 to 6)	−1 (−7 to 5)	−1 (−8 to 6)	−7 (−13 to 0)	−3 (−9 to 3)
Lower esophagus	−4 (−8 to 0)	−5 (−8 to −1)	−4 (−7 to 0)	−4 (−7 to −1)	−4 (−7 to −1)	−7 (−11 to −3)	−4 (−7 to −1)
Gastroesophageal junction	Referent	Referent	Referent	Referent	Referent	Referent	Referent
Other	4 (−6 to 13)	2 (−9 to 12)	4 (−6 to 14)	4 (−6 to 14)	4 (−6 to 14)	4 (−7 to 15)	4 (−7 to 14)
LHIN	$P < .0001$		$P < .0001$	$P < .0001$	$P < .0001$	$P < .0001$	$P < .0001$
01	−9 (−17 to 1)		−10 (−18 to 0)	−10 (−18 to −1)	−9 (−17 to −1)	−5 (−14 to 3)	−9 (−17 to −1)
02	−2 (−11 to 6)		−3 (−11 to 5)	−2 (−10 to 6)	−2 (−9 to 5)	5 (−4 to 14)	−2 (−9 to 6)
03	−1 (−8 to 6)		−1 (9 to 7)	−1 (−9 to 7)	−1 (−8 to 6)	6 (−2 to 14)	1 (−5 to 8)
04	−12 (−18 to −7)		−12 (−19 to −6)	−13 (−19 to −7)	−12 (−18 to −6)	−7 (−13 to 0)	−12 (−17 to −6)
05	−1 (−10 to 9)		−0 (−10 to 10)	−1 (−11 to 9)	0 (−9 to 9)	2 (−10 to 13)	1 (−8 to 11)
06	7 (−1 to 16)		7 (−2 to 16)	7 (−2 to 15)	7 (−2 to 16)	14 (2-26)	5 (−4 to 13)
07	−4 (−11 to 4)		−4 (−11 to 4)	−4 (−12 to 3)	−3 (−13 to 6)	2 (−8 to 12)	−5 (−13 to 3)
08	−3 (−10 to 4)		−2 (−10 to 6)	−4 (−13 to 4)	−2 (−10 to 6)	−1 (−11 to 9)	−3 (−11 to 4)
09	Referent		Referent	Referent	Referent	Referent	Referent
10	−2 (−10 to 5)		−3 (−10 to 5)	−2 (−9 to 5)	−1 (−9 to 7)	4 (−5 to 13)	−1 (−7 to 5)
11	−1 (−9 to 7)		−1 (−9 to 6)	−2 (−9 to 6)	−1 (−8 to 7)	8 (−1 to 17)	−0 (−7 to 6)
12	−1 (−12 to 8)		−2 (−13 to 9)	−2 (−11 to 9)	−1 (−12 to 10)	−8 (−21 to 6)	−4 (−14 to 6)
13	−12 (−18 to −6)		−12 (−19 to −5)	−12 (−18 to −5)	−11 (−18 to −4)	−7 (−15 to 1)	−11 (−18 to −5)
14	−9 (−19 to 1)		−9 (−21 to 3)	−6 (−18 to 5)	−56 (−16 to 4)	3 (−7 to 13)	−8 (−17 to 1)
Treatment group#	$P < .0001$	$P < .0001$	$P < .0001$	$P < .0001$	$P < .0001$		$P < .0001$
A	−16 (−22 to −10)	−15 (−21 to −8)	−15 (−21 to −10)	−16 (−22 to −9)	−15 (−21 to −9)		−11 (−18 to −5)
B	21 (14-27)	19 (13-26)	21 (15-27)	20 (13-27)	20 (13-27)		27 (21-33)
C	6 (0-13)	5 (0-11)	7 (1-12)	6 (0-12)	7 (0-13)		11 (5-17)
D	37 (29-44)	38 (30-46)	37 (29-45)	38 (30-46)	38 (30-47)		34 (27-42)
E	8 (4-12)	7 (3-12)	8 (4-12)	8 (4-12)	8 (4-12)		11 (6-15)
F	0 (−9 to 9)	−3 (−12 to 6)	0 (−8 to 9)	−0 (−9 to 9)	0 (−9 to 9)		−2 (−8 to 5)
G	Referent	Referent	Referent	Referent	Referent		Referent
H	−4 (−10 to 2)	−4 (−10 to 2)	−3 (−9 to 2)	−3 (−9 to 3)	−4 (−11 to 3)		−4 (−10 to 3)
Stage							$P < .0001$
I							13 (4-22)
II							Referent
III							−4 (−8 to 1)
IV							−16 (−21 to −11)
Unknown							−1 (−5 to 3)

All values are difference (95% CI) in treatment interval length at the 90th percentile. *SA*, Sensitivity analyses; *ADG*, Aggregate Diagnosis Group; *LHIN*, Local Health Integration Network. *SA.1 = removal of LHIN. †SA.2 = removal of immigration. ‡SA.3 = removal of rurality. §SA.4 = removal of immigration and rurality. ‖SA.5 = removal of treatment group. ¶SA.6 = addition of stage. #Treatment group: A = endoscopy with or without subsequent treatment; B = chemotherapy only; C = radiotherapy only; D = surgery with or without subsequent treatment; E = chemotherapy and radiotherapy; F = chemotherapy or radiotherapy then surgery; G = chemotherapy and radiotherapy then surgery; and H = other.

TABLE E6. LHIN of residence at diagnosis

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total	*P* value
Total	345	523	323	832	246	375	374	496	674	307	517	281	353	129	5775	
Age, y																.04
18-49	20	19	21	40	18	28	32	24	26	11	21	14	16	6	296	
50-59	73	88	65	151	47	64	72	82	141	61	94	61	74	32	1105	
60-69	115	186	104	272	78	138	120	142	218	104	180	100	114	52	1923	
70-79	88	157	78	245	70	100	94	155	184	89	143	63	106	24	1596	
≥80	49	73	55	124	33	45	56	93	105	42	79	43	43	15	855	
Sex																.02
Female	76	107	74	178	62	92	101	135	147	55	102	58	70	36	1293	
Male	269	416	249	654	184	283	273	361	527	252	415	223	283	93	4482	
Minor ADGs																<.0001
0	18	34	22	48	20	18	17	24	44	19	24	17	25	8	338	
1-2	53	98	82	167	28	50	59	75	109	67	101	62	80	23	1054	
3-4	95	151	81	215	57	97	86	105	182	80	128	69	96	39	1481	
5-6	97	120	79	188	50	113	82	139	151	82	137	79	77	27	1421	
≥7	82	120	59	214	91	97	130	153	188	59	127	54	75	32	1481	
Major ADGs																.21
0	125	204	136	296	79	147	129	158	219	112	203	98	140	51	2097	
1	101	157	100	253	74	121	110	158	225	97	154	95	111	43	1799	
2	69	91	54	149	54	67	72	98	126	54	80	53	65	16	1048	
≥3	50	71	33	134	39	40	63	82	104	44	80	35	37	19	831	
Material deprivation																<.0001
1	45	99	91	178	25	99	111	84	83	37	148	32	23	20	1075	
2	66	115	69	161	33	93	55	129	132	73	109	61	46	13	1155	
3	64	90	73	147	57	90	57	107	130	59	95	72	67	22	1130	
4	61	103	47	162	74	62	55	95	182	57	80	61	95	42	1176	
5	105	114	42	175	57	30	94	79	147	76	82	52	115	30	1198	

Immigration and rurality removed because of small cell numbers. *ADG*, Aggregate Diagnosis Group.