# Waiting Times for the Four Most Prevalent Cancer Types in Ontario

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Background: To evaluate cancer waiting times, defined as the time from when a patient seeks

care to first treatment, for the four most prevalent cancer types in Ontario, Canada.

Methods: Using retrospective, administrative data from The Ontario Cancer Data Linkage

Project (cd-link), new diagnoses with prostate, breast, lung and colorectal cancers were identified

between 2002 and 2012. Treatment interventions were categorized as chemotherapy,

radiotherapy or surgery. Trends for the median waiting time and coefficient of variation of

waiting time were calculated for each cancer type-treatment type pair over the study period.

Results: Over the study period, 95,561 new prostate, 89,244 breast, 82,604 lung, and 80,761

colorectal cancer cases were registered in Ontario. Median waiting times from when a patient

seeks care to first treatment did not have a consistent trend across the four cancer types and the

three treatment interventions. However, the coefficient of variation consistently decreased for all cancer type-treatment type pairs over the study period.

**Interpretation:** Consistency of waiting time has improved for prostate, breast, colorectal, and lung cancer patients between 2002 and 2012, which indicates improvements in waiting time equity for cancer care. This trend aligns with provincial efforts to improve the access and efficiency of the cancer care process in Ontario. However, the median waiting times did not consistently have decreasing trends, which highlights the need to identify improvement opportunities for cancer type-treatment type pairs with increasing median waiting times.

### 1. Introduction

Public concern about cancer and the quality of service that cancer patients receive is considerable. It is predicted that two in five Canadians will develop cancer in their lifetime, and a majority of those cases will be cancers of prostate, breast, lung, and colorectal origin.<sup>1</sup> In recent years, cancer has been the leading death cause in Canada.<sup>2</sup> In 2010, the four cancer types imposed a significant proportion of cancer deaths: prostate 5%, breast 7%, lung 27%, and colorectal 12%.<sup>3</sup>

Quantifying the waiting time from the onset of cancer to the first treatment (i.e., surgery, chemotherapy, or radiotherapy) is highly relevant from both patient and system perspectives. An extended waiting time can be associated with significant mental strain for patients and their family members, and may also worsen prognosis.<sup>4-6</sup> Although components of the waiting time may be unavoidable, or in some cases may be deliberate, it is generally accepted that the waiting time should be shortened as much as possible.<sup>7-10</sup> As interest increases in integrating patient reported outcomes into care quality assessment in Oncology<sup>11</sup>, patient reported waiting time from cancer onset until first treatment is used as a measure to assess the care quality from patients' perspective.<sup>12</sup>

Researchers commonly use median waiting time to measure the quality of the service that patients receive from health care systems. However, in addition to the median, it is necessary to gain some information about the consistency of the waiting times to have a better understanding of the system performance. The Coefficient of Variation (CV), defined as the ratio of the standard deviation to the mean of waiting time, is a commonly used measure in engineering, physics, and manufacturing settings to provide insight on the consistency of a process, where a small CV indicates a more consistent process.<sup>13-15</sup> The main advantage of the CV over other

variability measures, like standard deviation, is that CV is unitless, and therefore, one can compare the CVs of any set of random variables.

The purpose of this study was to evaluate the quality of service that patients with the four most prevalent cancer types (prostate, breast, lung, and colorectal) received in the province of Ontario, Canada, from 2002 to 2012, by studying trends in both the median and the CV of waiting times. We defined waiting times from when the patient starts seeking care to the first treatment, as a proxy for the waiting time from the onset of cancer to the first treatment.

#### 2. Methods

**2.1 Data Sources** In this study, we used retrospective, administrative data from Ontario, Canada, to investigate how waiting times from when the patient seeks care until the first treatment (chemotherapy, radiotherapy, or surgery) changed for the four most prevalent cancer types (prostate, breast, lung, and colorectal) between 2002 and 2012. The Ontario Cancer Registry (OCR) is a dataset that contains details of 98% of incident malignancies in Ontario (2016 population is 14 million). We used OCR to identify patients with the four most prevalent cancers during the study period and followed them up until the end of 2013, to ensure that patients who were diagnosed in 2012 had a minimum of one year follow up. In Ontario, physician services are covered through the universal Ontario Health Insurance Plan (OHIP), and OHIP dataset comprises physician billing claims. We linked OHIP to OCR using encrypted unique patient identifiers to track all relevant diagnostic and treatment services. Our data sets were provided by The Ontario Cancer Data Linkage Program (cd-link), which is an initiative of the Ontario Institute for Cancer Research/Cancer Care Ontario Health Services Research Program, whereby risk-reduced coded data from the ICES Data Repository managed by the

Institute for Clinical Evaluative Sciences is provided directly to researchers with the protections of a comprehensive Data Use Agreement.

This study was approved by the University of Western Ontario Research Ethics Board.

**2.2 Variable Definitions and Main Outcome Measure** For any given cancer type, we searched through all OHIP records of each patient and recorded the earliest date that 1) a potentially-diagnostic procedure took place on the cancer site, and 2) the diagnosis outcome indicated a disease in the cancer site. We defined that date as the "*care seeking date*." We then identified the first date after the care seeking date in which a treatment procedure was carried out at the cancer site, and referred to that date as the "*first treatment date*." The first treatment intervention could be chemotherapy, radiotherapy, or surgery. The waiting time from care seeking date to first treatment date was our primary outcome of interest.

**2.3 Statistical Analyses** We grouped cancer patients based on cancer type, treatment type, and the year of care seeking date. For each cohort, we calculated the median waiting time and the CV of waiting times. To identify how the performance measures changed over the study period for each cancer type-treatment type pair, we obtained a line of best fit across the outcomes using linear regression, and we used the regression to determine the significance of trends over time. We performed all of our analyses with SAS version 9.3 (Cary, North Carolina).

#### 3. Results

There were 348,110 patients diagnosed with one of the four cancer types in Ontario between 2002 and 2012. After excluding the 0.1% of patients who did not have any records in the OHIP dataset, the study cohort included a total of 347,731 patients. The proportion of cancer types in the cohort was: 27% prostate, 26% breast, 24% lung, and 23% colorectal.

For each cancer type-treatment type pair, we calculated the number of patients who received that particular intervention as their first treatment in any given year (Figure 1). Surgery was the most common first treatment method for 53% of prostate, 85% of breast, and 82% of colorectal cancer patients. Lung cancer patients most commonly received radiotherapy (with or without chemotherapy) as the most common first treatment in 47% of cases.

For each cancer type-treatment type pair, we calculated the median of the waiting time from care seeking date to first treatment date for patients who received that particular treatment in any given year (Figure 2). We also calculated the slope of the fitted trend line for median values (Table 1). We found that the median waiting time for surgery had an increasing trend for all of the four cancer types over the study period; the positive trend was 2.6 days per year for prostate, 1.9 days per year for breast, 1.5 days per year for lung, and 0.4 days per year for colorectal. The median waiting time for radiotherapy had a decreasing trend for all cancer types except for lung cancer where there was no significant change in median waiting times over the study period; the negative trend was -2.8 days per year for prostate, -1.6 days per year for breast, and -1.0 day for colorectal. The trend for chemotherapy was not consistent across different cancer and treatment types. The median waiting time for chemotherapy for lung cancer patients had an increasing trend of 0.3 days per year, whereas patients with the other cancer types experienced a decreasing trend in the median waiting time for chemotherapy; the negative trend was -84 days per year for prostate, -3.3 days per year for breast, and -1.8 days per year for colorectal.

For each cancer type-treatment type pair, we calculated the CV of the waiting time from care seeking date to first treatment date for patients who received that particular treatment in any given year (Figure 3). We also calculated the slope of the fitted trend line for CVs (Table 3). The

CVs of the waiting times had a decreasing trend for all cancer type-treatment type pairs over the study period. The maximum average decrease in CV was for surgery waiting times for breast cancer patients whose average CV decreased more than 30% each year.

### 4. Interpretation

In this study of waiting times of the four most prevalent cancer types in Ontario, we observed a continuous improvement in the consistency of waiting times from when patients may seek care to the first treatment between 2002 and 2012. In Ontario, Cancer Care Ontario (CCO) is the agency that is responsible for continually improving cancer services, and in a publically funded universal health care system, acts as the government's cancer health delivery advisor. A 2004 CCO report mentioned "streamlining of clinical services [for cancer patients]" as one of achievements of the initiatives implemented by the agency and outlined further actions to be taken in the future.<sup>16</sup> We hypothesize that these efforts may help explain the continuous improvement in the consistency of waiting times. Unlike the consistency of the waiting times, however, the median waiting times have not always had a decreasing trend. The median trend has been increasing for patients whose first treatment was surgery, across all of the four cancer types, and lung cancer patients whose first treatment was chemotherapy. All other patients either experienced a decreasing trend or did not have significant changes in trends.

Variations in the duration of waiting times for different patient cohorts have been viewed as an indication of equity.<sup>17</sup> With a similar rationale, we interpret the continuous improvement in the consistency of waiting times as increasing the equity in waiting times, which is aligned with other healthcare policies in Canada, like principles suggested by The Canadian Medical Association and the Canadian Nurses Association that listed "equitable access to quality care" as one of the principles of improvements in the Canadian health care system.<sup>18</sup> Other countries, like

Chile, Germany, Greece, New Zealand, Slovenia, Sweden, and the United Kingdom use equal access to health care and equal utilization of health care as elements of equitable access to health care and have policies for improving those elements.<sup>19</sup>

There is a lack of consensus on the definition of waiting time.<sup>22-23</sup> A common alternative definition of waiting time is calculated as the time from diagnostic date (clinical or pathologic) to the first treatment. Using this definition and consistent with our results, another Ontario study found that the median wait time from diagnosis to surgery had an increasing trend from 1984 to 2000 for the same four cancer types.<sup>23</sup> Another study found median waiting times from diagnosis to radiotherapy has also been steadily increasing in Ontario between 1982 and 1991.<sup>24</sup> As shown in Figure 3, the waiting time CVs for chemotherapy for colorectal patients were consistently smaller than those of breast cancer patients, which agrees with a previous finding that there was a less variation in the time from diagnosis to adjuvant chemotherapy for colon cancer patients than for breast cancer patients in Ontario in 2009.<sup>25</sup>

#### 5. Strengths and Limitations

As a strength of this study, we defined care seeking date as the start time for the patient waiting time, and therefore waiting time to visit specialists is included in our primary outcome of interest. One 2012 study stated that almost all policy efforts in Canada, including the 2004 Health Accord, which cost \$5.5 billion, were focused on waiting time from visiting a specialist until the first treatment.<sup>26</sup> Recent policies introduced by the Canadian Institute for Health Information (CIHI) suggests that the waiting time to visit specialists should also be studied.<sup>27</sup> Another strength of this study is that we used administrative data to identify the care seeking date, as a proxy for the onset date, allowing us to investigate very large sample sizes. The literature includes a small number of studies that analyze the total waiting time, from onset to

first treatment.<sup>12,28</sup> However, as these studies rely on questionnaires to obtain data regarding onset date, they rely on self-report rather than time stamps and have small sample size.

One limitation of this study is the lack of granular details about when each patient perceived the symptoms and started seeking the care. We used the first care seeking date as a proxy for the onset date that may be subject to misclassification bias. In a study on 56 lung cancer patients in Ontario, the median time that the patients waited from the onset date to the care seeking date was 21 days, which comprised 15% of their median wait time from the onset to first treatment.<sup>12</sup> Another limitation of this study is that time-trend changes in the standard management of cancer could account for the differences in waiting time observed as calculated through our methodology. As an example, we observed a dramatic decrease in the median waiting time for chemotherapy as the first treatment for prostate cancer patients from 1303 days in 2002 to 406 days in 2012. This finding can be attributed to the fact that chemotherapy was only recently established as a standard first-line treatment for certain metastatic prostate cancer patients.<sup>29-30</sup> Prior to this, chemotherapy was primarily used when prostate cancer was hormone refractory, which would often be over the course of years.<sup>31</sup>

### 6. Conclusions

We found consistent improvements in the CV of waiting times from first care seeking to first treatment for all cancer type-treatment type pairs, suggesting improvements in consistency of care processes, which also suggests improvements in equity in access to care, between 2002 and 2012. The results for median waiting times were mixed, suggesting that further improvements are possible. Specially, we found that the median waiting time for surgery as first treatment had significantly increased for all cancer types between 2002 and 2012.

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Cancer type	First treatment	Slope	
Prostate	Chemotherapy	-84.045***	
	Radiotherapy	-2.782***	
	Surgery	2.605***	
Breast	Chemotherapy	-3.291***	
	Radiotherapy	-1.564***	
	Surgery	1.927***	
Lung	Chemotherapy	0.350*	
	Radiotherapy	-0.555	
	Surgery	1.491***	
Colorectal	Chemotherapy	-1.809**	
	Radiotherapy	-1.014***	
	Surgery	0.373**	
*** $p < 0.01$ ; ** $p < 0.05$ ; * $p < 0.1$			

Table 1. Trend analysis for the median of waiting times

Table 2. Trend analysis for the CV of waiting times

Cancer type	First treatment	Slope
Prostate	Chemotherapy	-0.009**
	Radiotherapy	-0.061***
	Surgery	-0.058***
Breast	Chemotherapy	-0.089***
	Radiotherapy	-0.080***
	Surgery	-0.347***
Lung	Chemotherapy	-0.113***
	Radiotherapy	-0.105***
	Surgery	-0.170***
Colorectal	Chemotherapy	-0.060***
	Radiotherapy	-0.062**
	Surgery	-0.176***
***n < 0.01.**	n < 0.05, * $n < 0.1$	

\*\*\*p < 0.01; \*\* p < 0.05; \* p < 0.1



Figure 1. The number of observations in each cohort



Figure 2. The median of waiting times

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Figure 3. The coefficient of variation of waiting times

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