Primary care use during, and wait times to receiving, adjuvant breast cancer chemotherapy: a population-based retrospective cohort study using CanIMPACT data

by

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Abstract

OBJECTIVES: To determine how physical and/or mental comorbidities affect primary care physician (PCP) use during adjuvant breast cancer chemotherapy and how PCP continuity affects time to chemotherapy.

METHODS: Population-based, retrospective cohort study of 12,781 women diagnosed with stage I-III breast cancer in Ontario who received adjuvant chemotherapy.

RESULTS: Six-month PCP visit rate increased during chemotherapy (mean 2.3 baseline visits, 3.4 chemotherapy visits). Low physical/mental comorbidity patients saw larger increases (1.4/1.8 baseline, 2.8/3.0 chemotherapy) versus high physical/mental comorbidity (5.6/3.5 baseline, 5.3/4.1 chemotherapy). Median time to chemotherapy (126 days) was shorter by 3.21 days in symptom-diagnosed patients with low PCP continuity, 17.43 days in screen-diagnosed immigrants with high PCP continuity and 10.68 days in symptom-diagnosed patients with no baseline PCP utilization.

CONCLUSIONS: Patients with low physical and/or mental comorbidity showed greater increases in PCP use during adjuvant chemotherapy. Higher PCP continuity was associated with shorter median time to chemotherapy in screen-diagnosed immigrants.

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Statement of contributions

RW was involved in the conception, design, analysis and writing up of the thesis. EG and RM assisted in the conception and design of this thesis. RM was the guide for the statistical methods used. AL, MK, RM and EG were involved in reviewing drafts of the thesis work and ensuring progress. Patti Groome and the quantitative team of CanIMPACT created the cohort used in this thesis. Marlo Whitehead was the ICES analyst involved in cutting the datasets for use.

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Permissions for incorporated published materials are included in appendix A.

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List of abbreviations

ACG	Adjusted Clinical Group
ADG	Adjusted Diagnosis Group
ALR	Activity Level Reporting
ANOVA	Analysis of Variance
CA	Census Agglomerations
CanIMPACT	Canadian Team to Improve Community-Based Cancer Care Along the Continuum
CAPE	Client Agency Program Enrollment
CCM	Community Care Model
CFPC	College of Family Physicians of Canada
CHC	Community Health Centre
CHF	Congestive Heart Failure
CIHI	Canadian Institute for Health Information
CIHR	Canadian Institutes of Health Research
CI	Confidence Interval
CMA	Census Metropolitan Area
COPD	Chronic Obstructive Pulmonary Disease
CPDB	Corporate Provider Database
CRC	Colorectal Cancer
CS	Collaborative Staging
CSA	Community Sponsored Agreements
CT	Computed Tomography
DA	Dissemination Area
DAD	Discharge Abstract Database
DCIS	Ductal Carcinoma In Situ
DCP	Dataset Creation Plan
DID	Difference-in-Difference
ED	Emergency Department
ER	Estrogen Receptor
FFS	Fee-for-service
FHG	Family Health Group
FHN	Family Health Network

FHO	Family Health Organization
FHT	Family Health Team
FNA	Fine Needle Aspiration
GEP	Gene Expression Profiling
GHC	Group Health Centre
GP/FP	General Practitioner or Family Physician
GPO	General Practitioner in Oncology
HER2	Human epidermal growth receptor 2
HRT	Hormone Replacement Therapy
HSO	Health Services Organization
ICBP	International Cancer Benchmarking Partnership
ICD	International Classification of Diseases
ICD-10-CA/CCI	International Classification of Diseases, Tenth Revision, Canada and the Canadian Classification of Health Interventions
ICD-O	International Classification of Diseases for Oncology
IQR	Interquartile Range
LHIN	Local Health Integration Network
HR	Hazard Ratio
IKN	ICES Key Number
IPDB	ICES Physician Database
IRCC	Immigration Refugee and Citizenship Canada
IRR	Incidence Risk Ratio
LTC	Long-term Care
MH	Mental Health
MIZ	Metropolitan Influenced Zones
MOHLTC	Ministry of Health and Long-Term Care
MRI	Magnetic Resonance Imaging
NACRS	National Ambulatory Care Reporting System
NDFP	New Drug Funding Program
OBSP	Ontario Breast Screening Program
OCP	Oral Contraceptive Pill
OCR	Ontario Cancer Registry
ODB	Ontario Drug Benefit
ODF	Overdispersion Factor

OHIP	Ontario Health Insurance Plan
OR	Odds Ratio
PCP	Primary Care Physician
PCCF	Postal Code Conversion Files
PCG	Primary Care Group
PCN	Primary Care Network
PR	Progesterone Receptor
Q	Quintile
RAN	Rural and Northern group
RNPGA	Rural and North Physician Group Agreement
RoR	Ratio of Ratios
RPDB	Registered Persons Database
RUB	Resource Utilization Band
SD	Standard Deviation
SDS	Same Day Surgery
SEAMO	South Eastern Area Medical Organizations
TNM	Tumor-Node-Metastasis
UPC	Usual Provider of Care index
VIF	Variance Inflation Factor
WHA	Weekeebayko Health Ahtuskaywin

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Chapter 1: Introduction

1.1. Significance of the study

Breast cancer patients frequently visit their primary care physicians (PCPs) during the course of their cancer journey [1]. While the role of PCPs during prevention, screening, diagnosis, survivorship and end-of-life care has been relatively well-established, the role of PCPs during breast cancer treatment is less clear [2]. Additionally, how PCPs might impact wait times to receiving chemotherapy has not yet been explored.

1.2. CanIMPACT

This thesis is a part of The Canadian Team to Improve Community-Based Cancer Care Along the Continuum (CanIMPACT) project. The CanIMPACT project began in 2013 and was designed to strengthen the capacity of primary care to provide care to cancer patients and to improve care coordination between primary care providers and cancer specialists across the cancer care continuum [3]. The CanIMPACT project consists of quantitative, qualitative and knowledge translation subgroups. This thesis is a part of the quantitative subgroup.

The CanIMPACT quantitative subgroup focuses on administrative health data analysis. One of their main objectives is “to conduct inter- and intra-provincial comparisons of cancer diagnostic, treatment and survivorship phases of breast cancer care with a focus on aspects of that care which might be influenced by primary care” [4]. The CanIMPACT research program involves data from cohorts of all breast cancer patients who were diagnosed from 2007 to 2011 across five provinces (British Columbia, Alberta, Manitoba, Ontario and Nova Scotia). Parallel datasets were created in each province through a collaborative and iterative process involving the development of common dataset creation plans (DCPs) [5]. This thesis involves the Ontario breast cancer cohort only.

Previous CanIMPACT work has helped identify and clarify some issues pertaining to the role of primary care during breast cancer treatment. As part of the quantitative subgroup, Jiang et al. found that the mean number of PCP visits in British Columbia, Manitoba and Ontario increased during the 6 months after the start of adjuvant chemotherapy (chemotherapy given after breast cancer surgery) compared to during the 6 months prior to diagnosis. They also found that 89.3% of breast cancer patients in Ontario visited their PCP at least once during

adjuvant chemotherapy [6]. Similarly, Bastedo et al. found that in Ontario, there was a 50% increase in primary care visits during breast cancer chemotherapy compared to before the patient's diagnosis and compared to matched controls without cancer and that over a third of these visits were due to breast cancer or chemotherapy-related side effects [7]. However, in the CanIMPACT qualitative subgroup, Easley et al. found that primary care and specialty care providers felt that PCPs' main roles were not to manage urgent issues during chemotherapy treatment, but instead to coordinate cancer care, manage comorbidities and provide psychosocial care [8]. These studies highlight that PCPs are often involved during breast cancer chemotherapy and suggest that the reasons for this are likely not due to PCP management of chemotherapy-related side effects, but rather may be due to greater PCP involvement in the management of patients with higher care needs due to increased comorbidity and/or psychosocial issues as well as those with increased need for care coordination.

CanIMPACT has also done some work looking at wait times along the breast cancer care pathway. Lofters et al. found that, in Ontario, the median breast cancer diagnostic interval (defined as the time from initial breast cancer-related physician encounter, breast cancer diagnostic test or positive breast cancer screening to date of diagnosis) was 28 days in those detected through screening and 33 days in those detected due to symptoms. In Ontario, the adjusted median diagnostic interval was 5.5 days longer in the immigrant population compared to long-term residents. While they determined that primary care access and continuity were similar between immigrants and long-term residents, the effect of primary care continuity on the wait time to diagnosis was not explored [9]. Other mixed-methods work from O'Brien et al. found that the median interval from first postsurgical medical oncology visit to the start of adjuvant chemotherapy was 22 days in Ontario. They found that 37.6% of breast cancer patients in Ontario visited their PCP during this interval. These findings and the findings of their qualitative work suggested that there is a role for PCPs in supporting patients with whom the PCP has an ongoing and trusting relationship in making adjuvant therapy decisions [10]. While this suggests that those with high primary care continuity might be more inclined to visit their PCPs prior to making decisions about adjuvant chemotherapy, the effect of primary care continuity on this wait time was not explored. Additionally, other intervals, such as the larger interval from first breast cancer-related contact with the healthcare system to start of adjuvant chemotherapy, have not been previously explored in the CanIMPACT datasets. Since immigrants have been shown to have longer wait times to diagnosis despite similar primary care access, it will be important to explore wait times in this subgroup separately.

1.3. Purpose of the study

1.3.1. Overall objective

To better understand the role and impact of primary care before and during adjuvant breast cancer chemotherapy.

1.3.2. Specific objectives

We aim to determine 1) how physical and/or mental comorbidity affect PCP use during adjuvant breast cancer chemotherapy and 2) how primary care continuity affects time to chemotherapy.

1.4. Outline of the study

We performed a population-based, retrospective cohort study using linked administrative health databases. Our cohort consisted of women diagnosed with stage I to III breast cancer in Ontario between 2007 and 2011 who had received curative surgery and adjuvant chemotherapy. We hypothesized that:

1) higher patient comorbidity burden or mental health history are associated with a greater increase in PCP visits from the baseline period to during the first 6 months after starting adjuvant chemotherapy;
2) high primary care continuity at baseline is associated with a shorter time to start of adjuvant chemotherapy.

Chapter 2: Literature review

2.1. An overview of primary care in Ontario

Ontario is Canada's largest province. In 2011, approximately 12.85 million people lived in Ontario, which was about 38% of the population of Canada [11].

Most health services in Ontario are covered by the Ontario Health Insurance Plan (OHIP). OHIP is financed by taxes from Ontario residents. To qualify for OHIP coverage, a patient must be physically present in Ontario for 153 days in any 12 month period, be physically in Ontario for at least 153 days of the first 183 days immediately after beginning living in the province, and make Ontario their primary home. Additionally the patient must have a legal status in Canada [12]. OHIP covers a wide range of health services, including doctor and hospital visits and services, but does not cover prescription drugs outside of hospitals, dental care or services that are considered not medically necessary, such as cosmetic surgery. As of January 2018, OHIP covers prescription drugs for those under 25 years of age. Since most health care services in Ontario are free at the point of service, utilization of health care services is assumed to be driven by a patient's needs instead of their ability to pay.

Administration of healthcare services in Ontario is coordinated by Local Health Integration Networks (LHINs). LHINs are regional healthcare agencies that were established by the Ontario government in 2006. They are responsible for planning, integrating and distributing funding for health services within their jurisdictions. This includes the management of hospitals, community health centres, long-term care (LTC) homes, mental health and addiction agencies and community support service agencies. There are 14 LHINs in Ontario that encompass the entire province: Central, Central East, Central West, Champlain, Erie St. Clair, Hamilton Niagara Haldimand Brant, Mississauga Halton, North Simcoe Muskoka, North East, North West, South East, South West, Toronto Central and Waterloo Wellington (figure 2-1). Cancer Care Ontario, the Ontario government's principal cancer advisor agency, provides regional cancer programs within each LHIN.

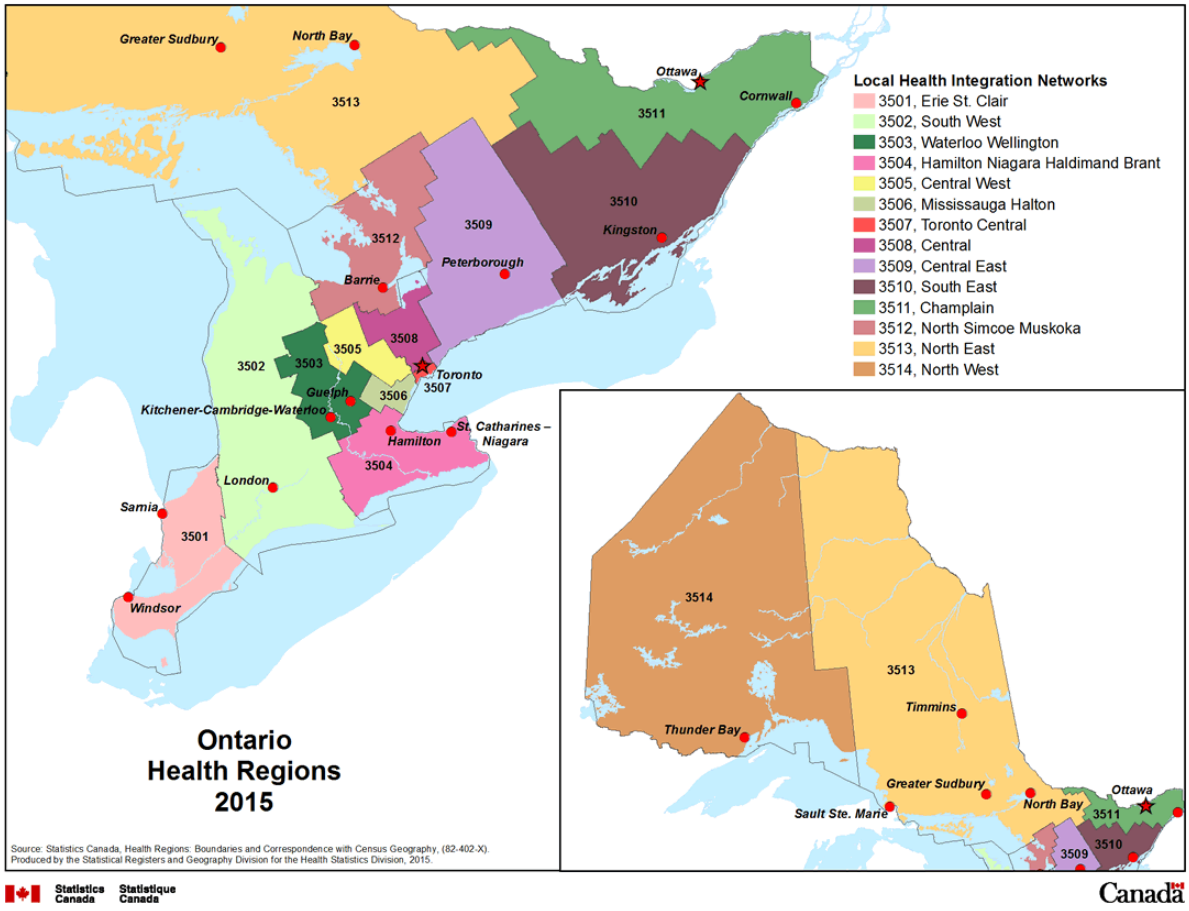

Figure 2-1. Map of the Ontario Local Health Integration Networks (LHINs)

Primary care plays a central role in the Ontario and Canadian healthcare system. Primary care refers to the main point of entry for patients into the health care system. PCPs provide diagnostic and treatment services for the majority of health conditions, as well as patient education, health promotion and disease prevention services. PCPs also act as hubs of access and coordination through the healthcare system. In Ontario, primary care is largely carried out by general practitioners (GPs) or family physicians (FPs). While primary care can also be provided by pediatricians, obstetricians, nurse practitioners and other providers, we define PCPs in our study as GPs or FPs. Of the 27,930 physicians who were practising in Ontario in 2011, 12,920 were PCPs [13]. In 2014, there were approximately 59 million visits to PCPs in Ontario [14]. A systematic review of eighteen studies published prior to January 2016 found that the five most common reasons for visits to primary care in developed countries included hypertension, upper respiratory tract infection, depression or anxiety, back pain and routine

health maintenance [15]. The College of Family Physicians of Canada (CFPC) states that the primary responsibilities of FPs are to "provide a system of front-line health care that is accessible, high-quality, comprehensive, and continuous" [16]. The role of the FP is to "take responsibility for the overarching and proactive medical care of patients, ensuring follow-up and facilitating transitions of care and/or referrals when required". They further state that "it is through relational continuity and a commitment to a broad scope of practice that the complexity of care is meaningfully addressed" [16]. Relational continuity refers to the ongoing relationship between patients and providers [17]. Increased relational continuity in primary care has been found to decrease specialty care utilization, hospitalizations and emergency department (ED) visits while resulting in improvements in preventive care, overall care quality, patient satisfaction, improved self-management and treatment adherence, improved health and reduced mortality [18,19]. In Canada, PCPs often work in teams with other healthcare professionals as part of the "Patient's Medical Home" model of care, which aims to provide accessible, comprehensive and continuous care to patients [16]. PCPs therefore act as the entry point into the Ontario health care system. They provide the majority of health care services to the Ontario population and serve as points of access and coordination with specialist services.

The delivery of primary care in Ontario has changed over the years. Prior to the year 2000, care was mainly delivered by solo or small group practices run by physicians who were paid through a fee-for-service (FFS) system, which means they were paid based on the number of services provided. A small proportion of primary care was delivered by salaried physicians working in community-governed Community Health Centres (CHCs). CHCs target care towards poor and marginalized populations. CHCs do not have formal patient enrollment and continue to exist today [20]. Primary care reform, starting in the early 2000s, saw new physician reimbursement and organizational models, including patient enrollment in a primary care practice and support for inter-professional, team-based care (table 2-1). This new approach was introduced in order to improve access to first-contact primary health care services, to improve coordination, quality and appropriateness of care, to expand team-based approaches to clinical care and to emphasize patient engagement, self-management and self-care [21]. By 2010, 70% of the population of Ontario was enrolled to a PCP [22]. Family Health Networks (FHNs) consist of multiple physicians working in a group practice with nurses and other healthcare providers where extended hours and after-hours assistance are provided through telephone triage. Physicians in a FHN are mostly paid through a blended model of capitation, where physicians are paid based on the number of patients enrolled or rostered to their practice. The capitation

rate covers a certain basket of primary care services, where services outside of the basket are funded via FFS. For services included in the capitation rates, FHN physicians are paid 15% of the regular fee. FHNs introduced incentives for after-hours care, chronic disease management and achieving certain preventive health service targets. Family Health Groups (FHGs) were introduced in 2003. Physicians in a FHG are paid through an "enhanced FFS" system where they are provided with full FFS payments in addition to a monthly comprehensive care fee per enrolled patient with similar incentives as those provided in a FHN [23]. Comprehensive Care Models (CCMs) consist of solo physicians providing primary care to rostered patients with some after-hours care. Physicians in CCMs are paid mainly through FFS with some incentives, similarly to those in FHGs [20]. Family Health Organizations (FHOs) have similar features to FHNs, but with a larger basket of services included in the capitation [24]. Family Health Teams (FHTs) describe an inter-professional team model including health providers beyond doctors and nurses (e.g. nurse practitioners, dietitians, pharmacists, social workers, psychologists, occupational therapists) and do not refer to physician funding. Physicians in a FHT are paid through blended capitation (through a FHN or FHO) or blended salary. In a study from 2008-2010, FHNs and FHTs were shown to be more likely to provide services to rural communities, while FHOs provide care to a patient distribution similar to Ontario overall. Patients in FHN, FHO or FHT models were more likely to be from higher income neighbourhoods, were much less likely to be newcomers and less likely to use the health system or have high comorbidity compared to the general Ontario population [24]. Other primary care payment models include the Group Health Centre (GHC) in Sault Ste. Marie, the Rural and North Physician Group Agreement (RNPGA), Weekeebayko Health Ahtuskaywin (WHA), Blended Salary Models, St. Joseph's Health Centre in Toronto, the Inner City Health Association, GP Focused-HIV Groups, Sherbourne Physician Group and Hamilton Shelter Health Network. These other models are a heterogeneous group where each model has its own unique properties. Services provided by PCPs who are not enrolled in any patient care models are funded through FFS. Since different primary care models may attract patients with different levels of physical and mental comorbidities and potentially impact the frequency of PCP visits, as well as primary care continuity and wait times to receiving care, primary care models are an important potential confounder that we considered in our research questions and analyses.

Table 2-1. Characteristics of selected primary care models in Ontario (Aggarwal, 2009; Marchildon & Hutchison, 2016).

	Community Health Centre	Family Health Network	Family Health Group	Comprehensive Care Model	Family Health Team	Family Health Organization
Year of introduction	1963	2001	2003	2005	2005	2006
Physician reimbursement	Salary	Blended Capitation	Enhanced FFS	Enhanced FFS	Blended Capitation or Blended Salary	Blended Capitation
Rostering	No	Yes	Yes	Yes	Yes	Yes
Minimum physician group size	None	3	3	1	3	3
Inter-professional team members	Yes	Limited	Limited	No	Yes	Limited
After-hours care requirements	Yes	Yes	Yes	Optional	Yes	Yes
Percentage of Ontarians treated per model* *25.8% not rostered in a model*.	0.9%	0.8%	33.3%	Not assessed. *4.5% treated in all other models.*	15.7%	18.9%
Percentage of rostered patients treated per model* *2.1% treated in all other models.* **	N/A	3.8%	41.2%	4.2%	N/A	48.6%

*2010 statistics [24,25].
** Other models include the Group Health Centre (GHC) in Sault Ste. Marie, the Rural and North Physician Group Agreement (RNPGA), Weekeebayko Health Ahtuskaywin (WHA), Blended Salary Models, St. Joseph's Health Centre in Toronto, the Inner City Health Association, GP Focused-HIV Groups, Sherbourne Physician Group and Hamilton Shelter Health Network
FFS=fee-for-service

Various other sociodemographic, clinical and healthcare system factors also affect use of primary care services. Presence of chronic illness and increasing comorbidity burden is consistently shown to have a strong association with increased primary care utilization [26-29]. Other factors associated with use of primary care services have also been explored. In a Norwegian study, increased primary health care utilization was observed with increasing age, whereas education level and income were not shown to influence utilization [27]. In a Canadian review of studies, female sex, higher age, higher education and higher income have been linked

to higher use of various health care services [26]. Immigration also has an effect on primary care utilization. In Ontario, recently arrived immigrants who arrived in Canada within the past five years reported more primary care visits despite similar self-reported access to primary care services compared to the Canadian-born population. However, recent immigrants in FFS practices reported poorer access and fewer primary care visits [30]. Another Ontario study found that female economic class immigrants (selected for immigration based on their ability to become economically established in Canada) had significantly lower primary care utilization compared to long-term residents across the first ten years since arrival. Female private-sponsored refugees had increased primary care utilization after year four. Males arriving as family class or private-sponsored refugees had higher primary care utilization across the first ten years since arrival compared to long-term residents [31]. Globally, access to primary health care has been linked to availability, acceptability and perceived quality, geography and affordability of care [32]. Therefore, increased comorbidity, higher age, immigration status, being a family class or refugee class immigrant and more favourable availability, acceptability, geography and affordability of care have been linked with higher use of primary care services. Sex and education level have been inconsistently associated with higher use of primary care services and being an economic class immigrant is associated with lower use of primary care services.

In summary, primary care is central to health care provision in Ontario. While the structure of primary care delivery in Ontario has undergone changes since the early 2000s, and the best model of care remains to be determined, the core role of primary care providers, which is to serve as entry points into the health care system and provide quality health care for the majority of health care needs - including diagnosis and treatment of disease, health promotion and disease prevention - has remained unchanged. Primary care services are used for a variety of reasons and there are several sociodemographic, clinical and system factors that are linked to use of primary care services. One of the most prominent factors associated with increased primary care utilization is increased level of comorbidity, which highlights the important role of PCPs in managing patients with chronic diseases.

2.2. Primary care use during breast cancer chemotherapy

2.2.1. Breast Cancer in Ontario

Breast cancer is the most commonly diagnosed cancer among women worldwide and the second most common cause of cancer death for women in developed regions of the world

[33]. These trends are echoed in Canadian data [34]. In 2017, an estimated 26,300 women were diagnosed with breast cancer and 5,000 women died from breast cancer in Canada. This represented 25% of all new cancer cases and 13% of all cancer deaths in women that year [35]. In Ontario, an estimated 11,762 women were diagnosed with breast cancer in 2018. In Ontario, the majority of breast cancer cases occur in women ages 50 to 74 [36]. Breast cancer screening and treatment is therefore an important element of Ontario's healthcare system.

Screening tests such as mammograms can detect breast cancer before any symptoms appear. The Ontario Breast Cancer Screening Program (OBSP) is a provincial cancer screening program that was established in 1990. The OBSP recommends that most women ages 50 to 74 years old who are considered average risk get screened every 2 years with mammography. Women aged 30 to 69 years old who are considered high risk of developing breast cancer can also get screened with yearly mammogram and breast magnetic resonance imaging (MRI) through the OBSP. High risk women are those with specific gene mutations, with first-degree relatives who have a specific gene mutation, with a ≥25% lifetime risk of breast cancer as determined by a genetics clinic, or who had radiation therapy to the chest before age 30 and at least 8 years ago. While a physician referral is necessary to be considered by the high risk breast screening program, regular screening with mammography can be done with a physician referral or by self-referral to the OBSP [37]. Women with a personal history of breast cancer can be considered for the high risk breast screening program if a hereditary breast cancer syndrome is suspected, but are otherwise not eligible for enrollment in the OBSP. Screening of women with a personal history of breast cancer therefore usually occurs outside of the OBSP. Of all women screened for breast cancer in Ontario in 2009-2010, 70% of breast cancer screening occurred through the OBSP, this increased to 85% in 2015-2016. Participation in average risk breast cancer screening has remained around 65% since 2009-2010 [38].

Once a diagnosis has been made, breast cancer care in Ontario is often coordinated through regional cancer centres associated with one of the fourteen LHINs that make up the province of Ontario.

2.2.2. An overview of breast cancer treatment

Treatment for breast cancer can be complex, involving several different modalities including surgery, chemotherapy, radiation therapy, hormonal treatment and targeted therapy. Treatment plans for breast cancer are tailored to individual patients after considering various disease characteristics including stage, grade, receptor status and genetic features.

Cancer stage refers to the extent of cancer present when it is first diagnosed. Cancer staging considers the size, location and spread of the tumour. In situ, or stage 0, breast cancer refers to abnormal cancer cells that are found only in the duct or lobule where they started and that have not invaded into nearby breast tissue. Early stage breast cancers are stage I tumours <2cm large or stage IIa breast tumours 2-5cm large that have not spread to more than 3 lymph nodes. Locally advanced breast cancer describes stage IIb and IIIa-c tumours that are >5cm and/or have spread to the surrounding skin, chest wall muscles or to more than 3 lymph nodes. Metastatic, or stage IV, breast cancer involves cancer that has spread to distant parts of the body [39]. In Ontario, the majority of breast cancer cases are diagnosed at stage I or II. In 2013, 42.9% of breast cancers were diagnosed at stage I, 38.3% of breast cancers were diagnosed at stage II, 13.5% of breast cancers were diagnosed at stage III and 5.3% of breast cancers were diagnosed at stage IV [36]. This thesis focuses on early stage and locally advanced breast cancers (stage I to III) that are confined within the breast with or without locoregional lymph node involvement.

Early stage and locally advanced breast cancers (stage I to III) are commonly treated with surgery to remove the disease. Breast conservation therapy, or lumpectomy, is performed for localized disease. Lumpectomy is often followed by radiation therapy to reduce the risk of local recurrence [40]. Excision of the entire breast, or mastectomy, is performed for multicentric disease, high tumour to breast ratio, diffuse microcalcifications, persistent positive margins despite re-excisions, previous breast radiation therapy, scleroderma and pregnancy [41]. Once a surgical or core biopsy sample is received, further testing can reveal the cancer grade, receptor status and gene expression profile, which can help guide whether additional treatments may be of benefit.

Cancer grade refers to how the cancer cells appear compared to normal cells. Cancer grading is determined by a pathologist based on histologic samples of the cancer tissue. Well-differentiated tumours are considered low grade – these tumours tend to grow and spread slowly. Moderately differentiated tumours are considered intermediate grade. Poorly differentiated tumours are considered high grade tumours that tend to grow and spread more rapidly than tumours of lower grades [42].

Breast cancer receptor status refers to the presence or absence of certain receptors found on samples of breast cancer tissue. Hormone receptors that can be found on breast cancer cells include estrogen receptors (ER) and progesterone receptors (PR). Approximately

75% of all breast cancers are hormone receptor positive [43]. Presence of these receptors signifies that estrogen or progesterone molecules attaching to their respective receptors will fuel growth of the breast cancer. Hormone therapy drugs that decrease or block estrogen levels, such as tamoxifen or aromatase inhibitors, can be used to treat ER positive tumours [44]. HER2 (human epidermal growth receptor 2) is another receptor that can be found on breast cancer cells and is overexpressed in approximately 25% of all breast cancers [43]. HER2 positive tumours tend to be more aggressive than HER2 negative tumours. Trastuzumab (Herceptin®) is a targeted, biologic therapy that can be used to treat HER2 positive tumours [45].

In patients with invasive breast cancer, chemotherapy is often recommended if there is a high risk of recurrence, particularly for large tumours and node positive, triple-negative (ER, PR, HER2 negative) or HER2 positive breast cancer. Chemotherapy for breast cancer has traditionally been given in the adjuvant setting, i.e. after breast surgery. Adjuvant chemotherapy involves administration of pharmaceuticals after breast cancer surgery in order to hinder or stop the growth of cancer cells and prevent the cancer from metastasizing. These chemotherapeutics are specialized drugs that are given intravenously or orally in a hospital setting. They are generally given in cycles of 3 to 4 weeks including a recovery period: the whole treatment lasting 3 to 6 months. Common chemotherapeutic regimens involve the administration of anthracyclines (doxorubicin, epirubicin) and/or taxanes (paclitaxel, docetaxel) [43]. Chemotherapy side effects include infection, nausea, vomiting, hair loss, diarrhea, constipation, fatigue, loss of appetite, cognitive changes, nervous system damage, treatment-induced menopause and fertility problems [46]. The decision to offer adjuvant chemotherapy is based on the patient's risk profile demonstrating benefit of adjuvant chemotherapy with acceptable risk of toxicities. In the United States, 37% of stage I or II breast cancer patients and 78% of stage III breast cancer patients received chemotherapy in addition to breast cancer surgery in 2013 [47]. In a CanIMPACT study, 40.7% of stage I to III breast cancer patients diagnosed in Ontario from 2007 to 2011 received adjuvant chemotherapy and 5.7% received neoadjuvant chemotherapy. Receipt of chemotherapy in Ontario was associated with younger age, higher stage, triple-negative receptor status, lower comorbidity burden and higher income [48]. Neoadjuvant chemotherapy, given prior to breast surgery, is increasingly being used to promote tumour shrinkage prior to surgery in hopes of preserving the breast and in triple negative or HER2 positive breast cancer. Neoadjuvant therapy is used mostly for high-risk populations such as young patients and those with more advanced or aggressive disease [41]. If radiation therapy and chemotherapy are both part of the treatment plan, radiation treatments

generally begin after chemotherapy has ended due to increased chemotherapy side effects with concomitant administration of radiation therapy [40].

Due to the specialized nature of these various therapies, the use of these treatments in breast cancer patients is usually managed by breast cancer or oncology specialists. Surgical oncologists are responsible for the surgical aspects of treatment. Medical oncologists direct any hormonal, targeted, or chemotherapy interventions. Radiation oncologists provide radiation therapy. General Practitioners in Oncology (GPOs) are PCPs with focused practice in oncology and are considered alternate providers of cancer care in Ontario. Since GP oncology is not a separate specialty recognized by the Royal College of Physicians and Surgeons of Canada or the College of Family Physicians of Canada, the number of GPOs in Ontario is difficult to tally. A survey sent to 146 members of the Canadian Association of General Practitioners in Oncology in 2011 and forwarded to other GPOs known to the members resulted in 120 survey responses, 44 of which were from Ontario [49]. In comparison, there were 618 medical oncologists practicing in Canada in 2018, 231 of which were in Ontario [50]. GPOs often work closely with medical and radiation oncologists in order to provide cancer care to patients [51]. While the majority of cancer care is provided by medical, radiation or surgical oncologists, GPOs are another set of providers who offer care to cancer patients in Ontario.

2.2.3. The role of primary care during breast cancer chemotherapy

While specialists are generally responsible for organizing and providing breast cancer treatments, it is becoming clear that primary care has an important role to play during treatment as well. While it was traditionally thought that primary care providers had limited capacity to be involved during breast cancer treatment, recent studies have shown that visits to primary care providers actually increase during the adjuvant chemotherapy period. A CanIMPACT study from Ontario revealed that patients receiving chemotherapy show a 50% increase in primary care visits compared to before their diagnosis and compared to matched controls without cancer, and that more than one third of these primary care visits were related to breast cancer or chemotherapy-related side effects [7]. A Spanish randomized controlled trial of an educational intervention found that, in women receiving chemotherapy for breast cancer, 35.5% of non-study protocol healthcare encounters were made to specialists, and 23.3% of non-study protocol encounters were made to general practitioners, where the remainder of extra encounters were ED visits (21.1%), hospital admissions (8.3%), visits to pharmacists or complementary and alternative medicine practitioners (3.3%), or visits to multiple areas (8.3%).

This study additionally found that the majority of these general practitioner visits were chemotherapy-related and that the most frequent reasons for consultation were fever and infection [52]. Similarly, a study from the Netherlands found that general practitioner visits doubled during the breast cancer treatment period, and that these visits were made mostly for breast cancer and treatment-related reasons, including infection, gastrointestinal, psychological, and endocrine therapy issues [53]. Thus, there is a consistency of findings that patients visit PCPs more often while receiving breast cancer chemotherapy and that PCPs, along with cancer specialists, deal with breast cancer chemotherapy-related side effects.

As summarized above, one reason breast cancer patients see their PCPs during their treatment period is to deal with chemotherapy-related side effects. However, the appropriateness of this has been questioned and alternative reasons leading to increases in use of primary care services during chemotherapy are being explored. A survey of chemotherapy-treated patients at an outpatient oncology clinic in Israel showed that, while patients felt that involving their PCP during their care was important, less than one third of patients thought their PCP was trained to or was willing to treat medical problems arising during chemotherapy treatment. As such, only 9% stated that they would consult their family physician for an urgent problem during their chemotherapy treatment [54]. Along these lines, a recent CanIMPACT qualitative study found that primary care and specialty care providers felt that primary care providers' main roles during overall cancer care were not to manage chemotherapy-related side effects, but instead to coordinate cancer care, manage comorbidities, and provide psychosocial care [8]. Furthermore, a study of breast cancer survivors in the United States looking at the role of primary care during survivorship found that most patients preferred that their primary care providers, as opposed to oncologists, manage comorbidities during their survivorship period. This preference was affected by race, education level, insurance type, number of comorbidities, surgery type, chemotherapy receipt, primary care continuity level, worry about recurrence, and time since diagnosis, but not by age, radiation or endocrine therapy receipt, or study site [55]. Although these studies did not look specifically at the adjuvant breast cancer treatment period, they suggest that more complex patients, i.e. those needing more care for comorbidities and/or psychosocial issues, may present more frequently to their primary care providers during their breast cancer care, and that this effect may be modified by demographic and treatment-related factors.

2.2.4. Comorbidity burden and mental health diagnoses during breast cancer care and chemotherapy

Comorbidity and mental health history are prevalent among women with breast cancer, both before and during treatment. In Ontario, the most common comorbidities present in breast cancer patients from 2011-2015 were diabetes without complications, a cancer diagnosis other than breast cancer, chronic obstructive pulmonary disease (COPD), congestive heart failure (CHF) and diabetes with complications [36]. A Canadian study from British Columbia found that the most prevalent baseline comorbidities in breast cancer patients were cardiovascular conditions, followed by pain/pain-inflammation. In this study, women with breast cancer were more likely to develop ischemic heart disease, heart failure, depression, diabetes, osteoporosis and hypothyroidism than women without cancer [56]. A study from Singapore found that at 1 year post-chemotherapy, 46.7% of breast cancer patients had non-cancer comorbidities, of which hypertension was the most prevalent, followed by hyperlipidemia and diabetes. The mean number of chronic disease medication classes prescribed to patients increased in the 1 year post-chemotherapy [57]. A study in the US determined that nearly 25% of female Medicare beneficiaries had a prevalent mental health diagnosis prior to being diagnosed with invasive breast cancer. The most prevalent mental health diagnoses were unipolar depression, anxiety, non-schizophrenia psychosis and dementias [58]. The prevalence of these mental health conditions, as well as service utilization for mental health problems, increased among those with breast cancer [59-61]. It is possible, then, that increased primary care services during adjuvant breast cancer chemotherapy may be well-explained by the role of primary care in managing increased mental health concerns and worsening chronic conditions that are observed when a patient undergoes treatment for breast cancer. The association between primary care visits during breast cancer chemotherapy and patient comorbidity or mental health history has not yet been explored in the literature.

In addition to undergoing chemotherapy, there are several other factors that contribute to increased patient morbidity and poor mental health. Many chronic diseases such as cancer, cardiovascular disease, Alzheimer disease, arthritis, diabetes and obesity are associated with increased age [62]. A study assessing health-related quality of life found that advanced age was associated with decreased physical function and increased comorbidity, but better mental health [63]. In Canada, multimorbidity has been linked to being female, older, living in the lowest income quintile and having not completed high school [64]. A study of US veterans determined that veterans living in rural areas had significantly more physical health comorbidities, but fewer

mental health comorbidities than those living in suburban and urban areas [65]. A study from Spain identified that immigration was associated with a decreased risk for multimorbidity, but the risk of multimorbidity increased with the length of residence in the host country [66]. A Canadian study found that economic class immigrants had fewer mental health visits to primary care compared to long-term residents, whereas government-sponsored refugees had higher mental health visits in primary care [31]. In Italy, higher continuity of care has been associated with a lower Charlson comorbidity score [67]. Patients with varying comorbidity levels also seek care from differing primary care models. Patients with more severe mental illness and chronic health conditions and higher comorbidity than the general Ontario population are more likely to be seen in CHC primary care clinics. Patients with higher comorbidity are more likely to be enrolled in a FHN, FHO or FHT than the general Ontario population. Patients who are not rostered or enrolled in any primary care model in Ontario are more likely to have fewer comorbidities [24]. Therefore, increased comorbidity has been linked to older age, female sex, lower income quintile, lower education, rurality and seeking primary care from a CHC, FHN, FHO or FHT. Lower comorbidity has been linked to recent immigration, higher continuity of care and not being enrolled in a primary care model. Better mental health has been associated with older age, rurality and being an economic class immigrant, whereas worse mental health has been associated with being a government-sponsored refugee and seeking primary care from a CHC. Developing depression in breast cancer patients specifically has been associated with younger age at the time of diagnosis, greater functional impairment, poorer social and family well-being, anxiety, comorbid arthritis and fears about treatment side effects [68].

2.2.5. Summary

Primary care plays an important role in the care of breast cancer patients. While PCPs are recognized for their work in managing comorbidity and mental health concerns and coordinating care for their breast cancer patients, patients and providers seem to agree that PCPs generally should not be responsible for management of breast cancer chemotherapy and its side effects, which falls more under the domain of oncology specialists. However, patients tend to visit their PCPs more often during chemotherapy.

We seek to explore why patients are being seen more often during breast cancer chemotherapy and to determine whether a higher comorbidity burden or more mental health concerns at baseline are driving the increase in PCP visits due to the need for management of these conditions.

2.3. The impact of primary care on wait times to receiving adjuvant chemotherapy

2.3.1. Time intervals along the breast cancer care pathway

Delays in starting adjuvant chemotherapy can occur at various points during the breast cancer care pathway. Studies looking at wait times to cancer diagnosis and treatment use a wide range of time points and intervals along the care pathway, which makes it difficult to draw conclusions or compare between studies [69]. The International Cancer Benchmarking Partnership (ICBP) is a collaboration of clinicians, researchers and policymakers from Australia, Canada, Denmark, Norway, Sweden and the United Kingdom that aims to explore international variation in cancer survival [70]. The International Cancer Benchmarking Partnership uses the Aarhus Statement [71] to define various time intervals that can characterize wait times from first cancer symptom until start of treatment [72]. The Aarhus statement was developed to promote greater consistency and transparency in the measurement of intervals and/or mapping along the cancer patient journey. According to the Aarhus statement, the patient interval occurs between first symptom and first contact with the PCP. The primary care interval occurs between first contact with the PCP and referral to secondary care and can be divided into a doctor and system interval. The primary care doctor interval occurs between the first contact with the PCP and the first investigation of cancer-related symptoms. The primary care system interval occurs between initiation of investigations and referral to secondary care. The diagnostic interval starts from initial presentation and ends at diagnosis. The treatment interval occurs between diagnosis and initiation of treatment (Figure 2-2) [71]. Intervals beyond the start of treatment are not explored in the Aarhus statement. These additional intervals may include time from neoadjuvant treatment (e.g. chemotherapy or radiation therapy) to surgery, or time from surgery to adjuvant treatment (e.g. chemotherapy, radiation therapy, hormonal treatment, or targeted therapy).

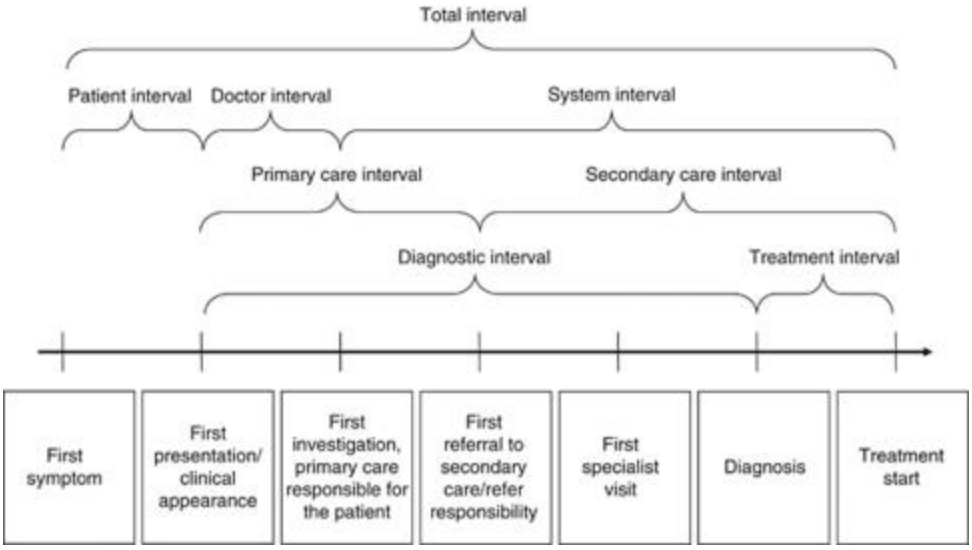

Figure 2-2. An illustration of the overall milestones and time intervals defined in the Aarhus statement describing the route from first symptom until start of treatment. Copied with permission from Weller et al. (2012) (Weller et al., 2012)

Ontario has established target wait times for some intervals along the breast cancer treatment pathway: the time from referral to first cancer surgical appointment, the time from decision to have surgery to having the cancer surgery, the time from referral to medical oncology consult and the time from medical oncology consult to chemotherapy start. The target wait time for all patients from referral to first cancer surgical appointment is 21 days, 35 days if intermediate suspicion of cancer and 10 days if high suspicion of cancer. The target time from surgical decision to having cancer surgery is 28 days, 84 days if intermediate suspicion of cancer and 14 days if high suspicion of cancer. The target time for both intervals is <24 hours if a life or limb-threatening condition is present [73]. From January to March 2019, 91% of breast cancer patients in Ontario were seen by the surgeon within the target time and 92% had surgery within the target time [74]. A report looking at Ontario breast cancer cases diagnosed in 2011 found that there was no significant difference in 5-year survival among women with breast cancer based on the wait time to receiving surgical treatment after being prioritized for surgery [75]. The recommended time from referral to medical oncology consult is 14 days. The recommended time from medical oncology consult to chemotherapy start is 28 days. In August 2017, approximately 80% of breast cancer patients were seen by a medical oncologist or received chemotherapy within the target time [76].

2.3.2. The effect of wait times along the breast cancer care pathway

Wait times to receiving treatment affect morbidity, mortality and well-being among cancer patients. Timeliness of care has been shown to be an important component to cancer patient satisfaction with wait times from symptoms to treatment [77]. While many breast cancer studies look at the time to diagnosis, or the time from surgery to start of adjuvant chemotherapy, few recent studies look at the effects of increasing wait times along the longer pathway to breast cancer chemotherapy: from when a patient first presents to the healthcare system with symptoms or a positive screening test to the start of adjuvant chemotherapy.

Increased time to diagnosis, but also very short time to diagnosis has been linked with negative outcomes among cancer patients. Longer diagnostic intervals are thought to result in a later stage at diagnosis corresponding with worse outcomes. A systematic review of 209 studies found that shorter times to diagnosis resulted in more favorable stage at diagnosis and survival outcomes for breast, colorectal, head and neck, testicular and melanoma patients [69]. A Libyan study of 200 breast cancer patients found that a delay from symptoms to histological breast cancer diagnosis of >3 months was associated with bigger tumour size, positive lymph nodes, late clinical stages, and metastatic disease (median time to diagnosis was 7.5 months in the entire study cohort) [78]. A Chinese cohort study of 1,431 breast cancer patients diagnosed between 1998 and 2005 found that a >30-day delay from initial symptoms to diagnosis was associated with larger tumour size, positive lymph nodes and later stage at diagnosis. There was no association between delay and distant metastases at diagnosis [79]. A Danish prospective, population-based study of 1128 colorectal, lung, melanoma skin, breast, and prostate cancer patients found that a longer time from first presentation of symptoms in primary care, as reported by the PCP based on the patient's medical record, to the date of diagnosis was associated with increased mortality for patients presenting to primary care with symptoms suggestive of cancer. Those who presented with vague symptoms did not have a longer diagnostic interval associated with mortality. They also found, however, that very short intervals were also associated with increased mortality, which they suggest was likely due to patients with more severe illness being investigated more promptly [80]. This is known as the "waiting time paradox" [81]. This concept is supported by a study of breast, lung, colorectal and prostate cancer patients that found that those presenting with what they termed "non-alert symptoms" had longer diagnostic intervals than patients who first presented with "alert symptoms". In this study, the majority of non-screen detected breast cancers presented with a breast lump, which was considered an "alert symptom" (median diagnostic interval 14 days, interquartile range (IQR) 9-

28) [82]. Similarly, in an ICBP study containing 1,012 breast cancer patients from 10 jurisdictions in the UK, Scandinavia, Canada and Australia, secondary care intervals (from referral to diagnosis) of >30 days, but also <30 days were associated with increased odds of later stage at breast cancer diagnosis, whereas the primary care interval (from presentation to referral) was not associated with stage at diagnosis [83]. Therefore, very long, but also very short diagnostic intervals tend to be associated with increased progression of breast cancer and more severe disease at the time of diagnosis.

The time to start of adjuvant chemotherapy also impacts breast cancer patient outcomes. A recent meta-analysis of eight studies found that a 4-week increase in wait time from breast cancer surgery to adjuvant chemotherapy was associated with a significant increase in risk of death (relative risk 1.04, 95% confidence interval (CI) 1.01-1.08) [84]. Another meta-analysis of twelve studies, some of which overlap with the previously cited meta-analysis, found that a 4-week increase in wait time from surgery to adjuvant chemotherapy was associated with significantly worse overall survival (hazard ratio (HR) for mortality 1.13, 95% CI 1.08-1.19) and disease free survival (HR 1.14, 95% CI 1.05-1.24). They additionally found that a wait of >30 days between surgery to adjuvant chemotherapy was associated with worse overall survival among patients with triple-negative breast cancer, but this effect was not seen for those with hormone receptor-positive disease [85]. Therefore, the surgery to adjuvant chemotherapy interval has a clear impact on overall survival for breast cancer patients.

While the effects of longer time to diagnosis and longer surgery to adjuvant chemotherapy intervals on breast cancer outcomes have been relatively well described in the literature, the effect of the longer interval, from when a patient first makes contact with the healthcare system with symptoms or a positive screening to when they begin adjuvant chemotherapy, has been less studied in recent years. A few studies looking at other intervals including the time from abnormal mammogram to diagnosis, as well as the time from diagnosis to surgical or systemic treatment, found no effect of increased wait time on survival of breast cancer patients [86-88]. A population-based US study of approximately 1.37 million breast cancer patients found that increased time from diagnosis to initial treatment was associated with worse survival for stage I and II breast cancer [89]. A study of stage I to III breast cancer patients diagnosed from 2010 to 2014 found that a wait time of >120 days between diagnosis and start of adjuvant chemotherapy was associated with worse overall survival (HR for mortality 1.29, $p<0.001$) [90]. But again, these studies examined only portions of the period from first contact with the healthcare system to start of adjuvant chemotherapy. A meta-analysis of 87 studies

published from 1907 to 1996 found that wait times of 3 months or more from initial onset of symptoms to start of treatment was associated with a 12% lower 5-year survival than those with shorter wait times (odds ratio (OR) for death 1.47, 95% CI 1.42-1.53) [91]. This meta-analysis also found that longer wait time was not associated with shorter survival in studies where breast cancer stage was taken into account. In this meta-analysis, no separate analysis was reported looking at the effect of delay from first oncology consultation to treatment on survival.

2.3.3. Factors associated with wait times to receiving treatment

There are several factors that can influence wait times to receiving adjuvant chemotherapy in breast cancer patients. A revised version of the Andersen model of Total Patient Delay by Walter et al. proposed that patient factors (e.g. demographic, comorbidities, psychological, social, cultural, previous experience), healthcare provider and system factors (e.g. access, healthcare policy and delivery), and disease factors (e.g. site, size, growth rate) are important contributors to wait times to diagnosis and treatment [92]. The relationship between these factors and wait times to receiving breast cancer treatments has been variably studied.

Several studies have explored the relationship between patient factors and wait times to breast cancer treatment. In a population-based study of stage I-III breast cancer patients diagnosed between 2005-2010, a >90-day wait time from surgery to start of adjuvant chemotherapy was associated with increasing age, low SES, Hispanic ethnicity or non-Hispanic black race [93]. A meta-analysis of twelve studies found that a >8-week wait time from surgery to start of chemotherapy was associated with black race, rural residence and being single (versus married). Age and comorbidity status were not shown to increase the odds of delay [94]. One Malaysian study found that a >1 month delay from diagnosis to start of treatment was associated with Malay race (compared to Chinese) [87]. A Brazilian study found that brown or black skin colour (compared to white skin colour) and lower years of schooling were associated with wait times >91 days from diagnosis to treatment [95]. A Chinese study found that a longer interval from positive screening to treatment occurred in women who were older, lived in rural areas and had lower education. A longer detection to treatment interval was not shown to be associated with breast cancer family history, comorbid conditions, menopausal status or marital status [96]. A study from Nova Scotia, Canada found that women with breast cancer who lived at greater distances from a cancer centre experienced an increase in wait times from detection to first adjuvant treatment, although the interval from detection to referral was shorter [97]. Another Canadian study found that higher income quintile was associated with longer wait time from

diagnosis to surgery, with no effect on wait times from final surgery to chemotherapy. They also found that age at diagnosis was not associated with increased wait times to receiving treatment [98]. A population-based US study of approximately 1.37 million breast cancer patients found that increased time from diagnosis to initial treatment was associated with non-white race, lower education, higher income, urban residence, prior history of cancer, higher number of comorbidities and lower age [89]. A systematic review from 1999 looking at sociodemographic, clinical, and psychosocial risk factors associated with increased wait times from onset of symptoms to start of treatment found that there was strong evidence that older age was associated with longer patient delay (between onset of symptoms and first medical consultation), and that marital status was not associated with patient delay. This same systematic review found that there was strong evidence that younger age was associated with provider delay (between first medical consultation and start of treatment) [99]. As such, patient factors including race, rural residence and lower education level have been consistently associated with longer wait times to receiving breast cancer treatment. Higher age and comorbidity were mostly found to be associated with longer wait times, although some studies did not find an association.

The relationship between disease factors and wait times to receiving breast cancer treatment has also been studied. Greater delays to receiving initial and adjuvant breast cancer treatment have been linked to stage I disease and hormone-receptor positive tumors [89,93,97]. A meta-analysis of twelve studies found that a >8-week delay from surgery to start of chemotherapy was not associated with histological grade, lymphatic/vascular invasion, cancer stage (comparing stage I+II versus III), nodal involvement, tumor size or hormone receptor status [94]. Another Canadian study found that stage III disease (compared to stage I) was associated with decreased wait time from diagnosis to surgery, but had no effect on the surgery to chemotherapy interval [98]. A systematic review from 1999 found that there was strong evidence that presentation with a breast symptom other than a lump was associated with provider delay (between first medical consultation and start of treatment) [99]. While there are inconsistent results as to whether most disease factors such as histological grade, hormone receptor status or nodal involvement affect wait times from surgery to adjuvant chemotherapy, these studies mostly suggest that patients with stage I breast cancer experience increased wait times to start treatment.

Other factors, including healthcare provider, healthcare system and treatment factors, have also been studied in their relation to wait times to receiving breast cancer treatment. An

Ontario study found that breast cancer patients treated in South Eastern Ontario experienced longer wait times from diagnosis to surgery and from surgery to chemotherapy than those treated in South Central Ontario. Patients treated in South Western and Northern Ontario experienced longer wait times from diagnosis to surgery, but not from surgery to chemotherapy. They also found that detection method (screened versus symptomatic) was not associated with increased wait times to receiving treatment [98]. Another Ontario study found that postmenopausal women with screen-detected breast cancers found through Breast Assessment Centres, which aim to provide organized breast assessment, were significantly less likely to have wait times in the longest quartile from abnormal mammogram to definitive surgery, from final surgery to radiotherapy and from final chemotherapy to radiotherapy compared to usual care. However, women assessed through the Breast Assessment Centre were more likely to experience wait times in the longest quartile from final surgery to chemotherapy [100]. Similarly, a study from British Columbia reported shorter time to surgical consultation and time from presentation to surgery for patients with a new breast problem seen in a Rapid Access Breast Clinic, which involved triple evaluation (physical examination, mammography, fine needle aspiration cytology) for all patients and navigation between clinicians and radiologists [101]. In the US, mastectomy and non-private insurance have been associated with a greater delay from diagnosis to surgery and surgery to start of adjuvant chemotherapy, with greater delay seen in those receiving mastectomy with breast reconstruction [90,93]. A meta-analysis of twelve studies found that a >8-week delay from surgery to start of chemotherapy was associated with having received a mastectomy [94]. Similarly, a study from Nova Scotia found that those undergoing a modified radical mastectomy experienced an additional 6 day wait from detection to first adjuvant therapy compared to patients undergoing breast conservation surgery [97]. Unplanned postoperative readmissions and the presence of positive margins have also been associated with increased time to receiving chemotherapy [102]. A Brazilian study found that treatment through the public (compared to private) system was associated with wait times >91 days from diagnosis to treatment [95]. A US population-based study found that increased time from diagnosis to initial treatment was associated with care at an academic center, transfer of facility, lack of insurance and living a greater distance from a treatment facility [89]. Additionally, OncotypeDx® testing, which is a gene expression profiling (GEP) test used to guide treatment decisions after surgery, has been shown to lead to increased wait times to receiving chemotherapy [103]. Decreased wait times to receiving breast cancer treatment appear to be related to the region of treatment in Ontario, assessment through a dedicated breast assessment centre, coverage through private insurance (for studies outside of Canada) and

breast conservation surgery. Mastectomy with reconstruction and OncotypeDx® testing are associated with increased wait times to receiving breast cancer treatment.

Wait times, not to treatment, but to other points along the breast cancer care pathway have also been associated with various patient, disease, healthcare provider and system factors. A cross-sectional survey of Canadian family physicians regarding cancer diagnostic interventions found that family physicians with the majority of their patients living >40km from the nearest cancer centre reported longer wait times for ultrasound scans once ordered, shorter wait times for computed tomography (CT) once ordered and decreased access to magnetic resonance imaging (MRI), with no difference in access to blood tests, endoscopy, x-ray scans or advice from specialists. There were no differences in the wait times for results once tests were completed [104]. A study of breast cancer patients diagnosed in Ontario between 2007 and 2015 found that the median diagnostic interval decreased with increasing stage at diagnosis and if 'other cancer' was the initial encounter diagnosis. The median interval was increased for encounters with cyst aspiration or drainage as the initial procedure [105]. A study of breast cancer patients from West Yorkshire found that South Asians had a significantly longer patient delay (initial symptoms to presentation to PCP >60 days) and a slightly longer provider delay (PCP referral to 1st hospital visit, or 1st hospital visit to treatment >14 days) than the general population of West Yorkshire [106]. A Danish study reported a median diagnostic interval (from first presentation in primary care to diagnosis) of 22 days for breast cancer patients (IQR 13-36) with serious symptoms, and 64 days (IQR 41-102) for those with vague symptoms (total median 25 days, IQR 15-44) [80]. A Libyan study interviewing 200 women and linking to health records found that median time from first symptoms to histological diagnosis of breast cancer was 7.5 months with only 30% diagnosed within 3 months. They found a number of factors associated with delay: symptoms not considered serious, alternative therapy applied, fear and shame preventing visit to the doctor, inappropriate reassurance that the lump was benign, initial breast symptom that did not include a lump, no monthly self-examination, older age, illiteracy, history of benign fibrocystic disease and oral contraceptive pill (OCP) use of greater than 5 years [78]. A UK study of 30 patients from 1988-1997 found that a delay of 3 months or more between first breast clinic visit and definitive diagnosis was associated with false-negative or inadequate fine needle aspiration (FNA), failure to follow-up, clinical signs that did not impress, no FNA, false-negative mammogram, failure of needle localization, and patient not accepting clinical advice [107]. A US study of 435 breast cancer patients from 2002 found that delay (ending an episode of care with no physician diagnosis when there was a sign) was related to patients being

inappropriately reassured that a lump was benign without biopsy, misread mammograms, misread pathologic finding, poorly performed FNA, benign mammography report, woman finding their own mass and current hormone replacement therapy (HRT) [108]. A South African study found that increased patient interval (until a patient first presents to care) was associated with older age, initial symptom denial and waiting for a lump to increase in size before seeking care. Longer diagnostic interval was associated with comorbidities and longer pre-treatment interval (between diagnosis and start of treatment) was associated with late stage disease at presentation [109]. Therefore, wait times from symptoms to first presentation to healthcare or until diagnosis appear to be related to distance from nearest cancer treatment centre, race, stage, misinterpreted or false negative initial results and presence of vague symptoms upon presentation.

In summary, longer wait times to receiving breast cancer treatment are seen with various patient factors such as race, rural residence and lower education, disease factors such as stage I breast cancer and healthcare factors such as region of treatment in Ontario, mastectomy with reconstruction, OncotypeDx® testing and coverage through public insurance. Shorter wait times to receiving breast cancer treatment are associated with assessment through dedicated breast assessment centres. Longer wait times to first healthcare presentation or to breast cancer diagnosis are associated with race, stage I breast cancer, misinterpreted or false negative initial results and vague symptoms at presentation.

2.3.4. Breast cancer wait times in the Ontario immigrant population

Immigrants make up a large proportion of the Ontario and Canadian population. In 2011, Canada had a foreign-born population of just under 6.8 million people, which represented 20.6% of the total population. At that time, over 3.6 million or 53.3% of Canada's foreign-born population settled in Ontario, making up 28.5% of Ontario's total population. Between 2006 and 2011, approximately 1.16 million foreign-born people immigrated to Canada, the largest source being Asia (including the Middle East). During this time, 43.1% of new immigrants to Canada, just over 501,000 people, settled in Ontario [110].

Immigrants to Canada and Ontario are younger and tend to settle in more urban areas. Of the immigrants arriving to Canada from 2006 to 2011, 58.6% were in the core working age group between 25 and 54 years, 33.7% less than 25 years and 7.7% were 55 years or older. Of

the 6.8 million Canadian immigrants in 2011, 91.0% settled in one of Canada's 33 census metropolitan areas (CMAs), compared with 63.3% of those who were born in Canada [110].

Immigrants have been shown to have different rates of cancer screening and different wait times to diagnosis. A Canadian CanIMPACT study found that immigrants, despite similar primary care access, were less likely to have breast cancer that was screen-detected and had longer diagnostic intervals than long-term residents [9]. Among Ontario immigrants, lower breast cancer screening rates were associated with immigration from South Asia, living in low-income neighbourhoods, having refugee status, being a new immigrant, not having regular physical examinations, not being enrolled in a primary care patient enrollment model, having a male physician and having an internationally trained physician [111]. An Ontario study found that immigrants were more likely to be diagnosed with a more advanced stage of breast cancer than Canadian-born women and were younger at diagnosis, although the reasons for this were not explored [112]. Diagnosis at an earlier stage has been linked to origins from East Asia and the Pacific and diagnosis at later stages has been linked to origins from Latin America and the Caribbean and South Asia [9,112]. Therefore, although primary care remains accessible to immigrants, Canadian immigrant women have lower rates of breast cancer screening, have longer wait times to diagnosis and are more likely to be diagnosed with more advanced disease at younger ages than Canadian-born women. These differences vary according to the immigrant class, years since arrival and region of origin.

2.3.5. How primary care may affect wait times to receiving care

Primary care involvement prior to and during the early stages of a cancer diagnosis improves cancer outcomes. Increased PCP visits during 24 months prior to breast cancer diagnosis has been associated with greater use of mammography, reduced odds of late-stage diagnosis, and lower breast cancer specific and overall mortality in women using Medicare insurance in the US [113]. A US study of male veterans with lung cancer found that primary care utilization in the early phase of lung cancer treatment (first 6 months after diagnosis) had a marked effect in reducing mortality risk, with a dose-response relationship observed (i.e. an increased number of primary care visits resulted in increased median survival time and reduced hazards of death) even when controlling for stage and comorbidity. The authors hypothesized that increased primary care utilization was likely associated with better care for comorbidities, increased use of preventive care services such as vaccination and potential for increased promotion of treatment adherence [114]. A population-based case-control study of colorectal

cancer (CRC) patients in the US found that higher primary care visits in the 4- to 27-month period before CRC diagnosis in cases and in a comparable interval in controls was associated with decreased CRC incidence and mortality and lower all-cause mortality. This association was increased in patients with late-stage CRC diagnosis and attenuated with ever receipt of CRC screening [115]. Taken together, these findings suggest that primary care involvement and utilization increases cancer screening rates, reduces late-stage diagnosis and increases survival time for a variety of cancers including breast cancer.

Various aspects of primary care may affect the timeliness of investigations and/or referrals for further care once a patient presents with symptoms, which may in turn influence outcomes. In a qualitative study of 60 breast, prostate, lung and colorectal cancer patients, patients felt that their family doctors' responsiveness to the patients' symptoms was an important factor for receiving timely care and improving wait times from symptoms to treatment [77]. A cross-sectional questionnaire sent to 438 breast, lung and colorectal cancer patients in Quebec, Canada found that 47% of those who presented with symptoms used their usual source of primary care to start investigations. Greater comprehensiveness of care (addressing the scope of a patient's health needs) was associated with using this source to start investigations as well as with shorter times between first symptoms and investigation. Greater accessibility (ease of using services) was associated with shorter times between investigation and diagnosis [116]. Therefore the PCP's responsiveness to patient symptoms, the comprehensiveness of care and accessibility of care are likely associated with decreased wait times to diagnosis and treatment. Higher PCP continuity, which has been linked to female patient-reported gender, older patient age, lower independence in activities of daily living and lower Charlson comorbidity score [67], has been associated with positive outcomes such as higher rates of breast cancer screening [117] and lower use of avoidable hospital or ED services [18]. However, a qualitative ICBP study from Wales found that "doctor-patient familiarity" can sometimes be reported by patients as a barrier to timely diagnosis and treatment, although the authors note that this relationship is commonly seen as a facilitator to diagnosis. The authors discuss that while good primary care continuity is an important and positive aspect of primary care, a "fresh pair of eyes" may expedite the diagnostic process [118]. The quantitative association between primary care continuity and wait times to receiving cancer therapy has not been studied.

2.3.6. Summary

Longer wait times to receiving breast cancer chemotherapy result in poorer outcomes and are associated with patient, healthcare provider, healthcare system and disease-related factors. Specifically, diagnostic and surgery to chemotherapy intervals >30 days have been shown to be associated with later stage at diagnosis and worse overall survival, respectively. Diagnosis to adjuvant chemotherapy intervals of >120 days and initial symptom to first treatment intervals of >3 months have also been associated with worse overall survival. While primary care involvement early in the cancer care pathway improves screening rates for non-immigrants and survival outcomes, the role of primary care continuity on wait times to receiving care has not been quantified. While high relational primary care continuity is commonly appreciated as a facilitator to good quality care, some qualitative work suggests that higher relational continuity may, in fact, be a barrier to timely diagnosis. Since immigrant women experience lower breast cancer screening rates and longer wait times to diagnosis despite similar primary care access, the effect of primary care continuity on wait times may need to be examined separately in this population.

2.4. Overall Summary

PCPs are often involved with initiating investigations and referrals to specialists during the early portion of a patient's breast cancer journey. PCPs are also involved with coordinating care and managing comorbidities throughout. However, during breast cancer chemotherapy, the role of the PCP becomes less clear since management of chemotherapy and its side effects is thought to be more appropriately addressed by oncology specialists. It is therefore important to clarify the characteristics of breast cancer patients that use PCP services during adjuvant chemotherapy and to identify the reasons for these visits. This is essential for helping prepare PCPs in understanding the needs of these patients and in planning the allocation of appropriate resources during this time. It is possible that patients with higher levels of comorbidity or mental health concerns at baseline need to visit their PCPs more after starting chemotherapy due to the added physical and mental stress of chemotherapy on top of their chronic concerns. However, this has not been previously studied. Similarly, understanding the impact of PCP continuity on wait times can help clinicians and policymakers in appreciating the role of relational continuity on timely access to care.

The information in this literature review was obtained through an informal review process.

Chapter 3: Objectives and hypotheses

3.1. Objectives

3.1.1. Overall objective

To better understand the role and impact of primary care before and during adjuvant breast cancer chemotherapy.

3.1.2. Specific objectives

To determine 1) how physical and/or mental comorbidity affect PCP use during adjuvant breast cancer chemotherapy and 2) how primary care continuity affects time to chemotherapy.

3.2. Research Questions

1. Does patient comorbidity burden and/or mental health history affect the number of PCP visits during adjuvant breast cancer chemotherapy after accounting for the patient's age at diagnosis, immigration status, income quintile, urban versus rural residence, Local Health Integration Network, continuity of primary care and primary care practice type?
    a. What are the most common reasons for patient PCP visits during adjuvant breast cancer chemotherapy?
2. Does continuity of primary care affect the time from the index contact date (date of initial signs/symptoms of breast cancer presentation in primary care) to start of adjuvant chemotherapy after accounting for the patient's age at diagnosis, immigration status, income quintile, urban versus rural residence, comorbidity burden, mental health history, Local Health Integration Network and primary care practice type?
    a. Does continuity of primary care affect the time from index contact date to initial consultation with an oncologist or breast cancer surgeon?
    b. Does continuity of primary care affect the time from surgery to start of adjuvant chemotherapy?

3.3. Hypotheses

1. We hypothesized that both increasing comorbidity burden and/or a history of mental health visits in primary care at baseline are associated with a greater increase in the number of PCP visits during adjuvant breast cancer chemotherapy.
    a. We hypothesized that visits to PCPs during adjuvant breast cancer chemotherapy will be mostly due to common primary care presentations, rather than breast cancer- or chemotherapy-related presentations.
2. We hypothesized that higher primary care continuity is associated with a decrease in time from index contact date to start of adjuvant chemotherapy. We predict this result since higher primary care continuity may indicate a better ability to coordinate care for patients, which in turn could help decrease wait times.
    a. We similarly hypothesized that higher primary care continuity will be associated with a decrease in time from index contact date to first consultation with an oncologist or breast surgeon,
    b. but will not have an effect on the time from surgery to start of adjuvant chemotherapy, since primary care is likely not as involved in this subinterval.

Chapter 4: Methodology

4.1. ICES

ICES is a not-for-profit research institute composed of a community of researchers, data and clinical experts who have access to an extensive and secure collection of Ontario's demographic and health-related data. In order to link databases at the individual level in a deterministic fashion, an ICES key number, the IKN, is created, which is based on the individual's health card number and/or last name, first name, date of birth, sex and postal code. Each individual is assigned his/her own IKN. Once the IKN is assigned to a record in a data set, directly identifying information is deleted from the file and the data are incorporated into the ICES data inventory, with records being linkable across health services databases using the IKN [119].

4.2. Research Design

This study uses a population-based, retrospective cohort study design using linked provincial-level administrative health databases housed at ICES, including the Ontario Cancer Registry. The DCP in appendix B lists the processes and codes used to create the study dataset and variables.

4.3. Population and Sampling

The CanIMPACT quantitative subgroup collected cohort data from five Canadian provinces along various stages of their breast cancer care (i.e. diagnosis, treatment and survivorship). The CanIMPACT Ontario treatment period cohort, which we used in this thesis, consists of women in Ontario diagnosed with stage I to III breast cancer between January 1, 2007 and Dec 31, 2011 who underwent potentially curative breast surgery (i.e. lumpectomy or mastectomy) within 9 months of their diagnosis date and who received adjuvant chemotherapy within 4 months of their initial surgery date. The CanIMPACT cohorts included women who were diagnosed between 2007 and 2011 in order to ensure that women had at least 5 years of follow up after diagnosis, which was explored in other CanIMPACT work investigating the survivorship period [120,121]. We feel that including only patients who have received chemotherapy within 4 months of surgery did not exclude potentially informative patients, since several studies exploring this time interval found that no patients exceeded 3 months between surgery and

chemotherapy in their cohorts [122-124], with other studies stating that only 3.5-6.4% of their cohort waited more than 10 weeks (~2.5 months) between surgery and chemotherapy [125], 0.92-4.32% waited more than 12 weeks (~3 months) [126,127] and 2.45% waited more than 90 days (3 months) between surgery and chemotherapy [128].

Patients were excluded if they were male, were less than 18 years old, were not a resident of Ontario or did not have a valid health card number at the time of diagnosis, had no record of having received potentially curative breast surgery, did not have their cancer histologically confirmed, had stage IV disease at diagnosis, had a previous history of any cancer (except non-melanoma skin cancer), in situ breast cancer or non-solid breast tumor, or had a new cancer diagnosis within 14 months of breast cancer diagnosis. We also excluded patients who had received neoadjuvant chemotherapy or radiation therapy prior to adjuvant chemotherapy since, due to the nature of the treatment regimens, the time to receive adjuvant chemotherapy in these patients would be naturally increased compared to the rest of our study population.

4.4. Data Sources

Provincial-level administrative data were obtained from several databases held at ICES (table 4-1). Databases were deterministically linked at the individual patient level using the patients' IKNs and the study dataset was compiled by an ICES analyst as per ICES procedures.

Table 4-1. Data sources used to obtain or create each variable of interest

Data Source	Variables Obtained
Ontario Cancer Registry (OCR)	Date of breast cancer diagnosis, age at diagnosis, sex, other cancer diagnoses, cancer stage, histologic grade, hormone receptor status (from Collaborative Staging data)*
Ontario Drug Benefit Claims (ODB) & New Drug Funding Program (NDFP) databases	Hormone and HER2 receptor status (inferred from drug identification numbers)*
Registered Persons Database (RPDB)	Postal code at time of diagnosis, date of death, Local Health Integration Network
2006 Statistics Canada Census with Postal code conversion file plus, version 5C	Urban/rural residence, Neighborhood income quintile
Immigration Refugee and Citizenship Canada (IRCC) database	Immigration status, country of birth, immigrant category, years since arrival
Ontario Breast Screening Program (OBSP)	Cancer detection method (mammograms and results)*, index contact date (date of mammograms and results)*
Ontario Health Insurance Plan (OHIP)	Number of PCP/other specialist visits (billed encounters)*, reasons for visits, Usual Provider of Care index (PCP visits)*, comorbidity burden (diagnosis codes)*, history of mental health visits, cancer detection method (billed breast testing/procedures/breast surgeon consultation)*, index contact date (dates of first tests, referring physician, date of physician encounters and dates of breast-related encounters from billings)*, date of first oncology consultation (encounter dates, diagnostic codes)*, chemotherapy receipt, start of adjuvant chemotherapy
ICES Physician Database	Number of PCP visits (physician specialty)*, Usual Provider of Care index (confirm physician specialty)*, date of first oncology consultation (confirm physician specialty)*
Client Agency Program Enrollment database (CAPE) & Corporate Provider Database	Primary care practice type (enrollment program type)*
Canadian Institute for Health Information: Discharge Abstract Database (DAD) & Same Day Surgery (SDS) database	Cancer detection method (information on breast testing and procedures)*, comorbidity burden (diagnosis codes from DAD)*, index contact date (date of in-hospital/SDS testing/procedures)*, surgery type, surgery date
Canadian Institute for Health Information: National Ambulatory Care Reporting System (NACRS)	Cancer detection method (breast testing/ procedures)*, index contact date (date of outpatient/ED testing/procedures)*
Cancer Activity Level Reporting (ALR) database	Radiotherapy receipt, PCP cancer clinic visits potentially carried out by GPOs

* Variable calculated or created using one or more datasets (relevant data that was extracted included in parentheses)

Ontario Cancer Registry (OCR)

The OCR is a database of all Ontario residents with newly diagnosed (incident) cancer or cancer-related death. All new cancer cases are registered in the OCR except for non-melanoma skin cancers. The OCR passively gathers information from pathology reports mentioning cancer, regional cancer centre/treatment-level reports, out of province reports, CIHI DAD/SDS/NACRS summaries which include a cancer diagnosis and death certificates with cancer as recorded cause of death. The OCR uses a combination of deterministic linkage by health card number and probabilistic linkage to aggregate a person's source record [129].

The OCR contains information on incident cancer cases (with earliest diagnosis dates available from 1964), patient demographics, cancer diagnosis details and death information. Staging data are available from 2007 onward. We used the OCR with collaborative staging data to identify the included cohort and to obtain information on the date of diagnosis, as well as disease characteristics such as cancer stage, histologic grade, and receptor status.

Ontario Drug Benefit (ODB) Claims

The ODB database contains information for prescription drugs claimed under the ODB program from 1990 onward. The ODB program covers adults ≥65 years old or residents of LTC facilities, people receiving services under the Home Care Program, Trillium Drug Program recipients, people receiving social assistance (Ontario Works, Ontario Disability Support Program) and people eligible for the Special Drugs Program. The ODB also includes records of children and youth ≤24 years covered under the OHIP+ program starting from January 1, 2018. The ODB covers drugs listed on the ODB formulary, some nutritional products and some diabetic testing products.

We used the ODB database to identify specific therapies associated with cancer receptor status, which helped us ascertain a patient's cancer receptor status if this information was missing in the OCR.

New Drug Funding Program (NDFP)

The NDFP, administered by Cancer Care Ontario, is one of four publicly funded drug programs under the Ontario Public Drug Programs. The NDFP funds new cancer drugs. The NDFP database is available from 1995 onward and captures information on treatment regimen, treatment intent and date of administration. From 2007 to 2011, deterministic linkage with other

databases held at ICES based on the IKN was achieved in 98.8% to 99.4% of NDFP records with no missing values for drug name in any of the NDFP records. Interestingly, among those patients identified in the NDFP as receiving drugs for breast cancer, approximately 6% were not captured in breast cancer diagnosis in the OCR [130]. Since our cohort was identified from OCR data, this signifies that there may be a small number of patients diagnosed with breast cancer in Ontario from 2007 to 2011 who were not included in our cohort.

We used the NDFP database to identify trastuzumab use, which helped us to infer a patient's HER2 receptor status if this information was missing in the OCR database.

Registered Persons Database (RPDB)

The RPDB contains basic demographic information about anyone who has ever received an Ontario health card number and is available from 1991 onward. Information is obtained from the Ontario Ministry of Health and is supplemented with geographic and death information datasets housed at ICES. The RPDB is deterministically linked with other datasets using the IKN.

We used the RPDB to obtain a patient's age at diagnosis, postal code at diagnosis and date of death.

2006 Statistics Canada Census with Postal code conversion file plus, version 5C

The 2006 census was distributed to 13.1 million households in Canada between May 1 and May 13, 2006. The short form of the census contained 8 questions and was sent to and completed by 80% of households. The long form of the census contained 53 additional questions and was sent to and completed by 20% of the population. Therefore, information on age, sex, and marital status was collected for 100% of the responding population, whereas information on occupation, education, ethnic origin, income, etc. was collected for 20% of the responding population. The response rate for the long form of the 2006 census was 94.3% in Ontario [131].

Geography data from the 2006 census was used along with data from Canada Post to create the Postal Code Conversion File Plus (PCCF+) [132]. The PCCF+ was used to link a patient's postal code at diagnosis to the associated census Dissemination Area (DA), which was used to assess neighbourhood income quintiles, LHIN and urban or rural residence in our study.

Immigration Refugee and Citizenship Canada (IRCC) database

The federal government's IRCC database contains information on Canadian immigrants who arrived from 1985 onward. We were therefore able to obtain data on these immigrants and compare them to "long-term residents", i.e. Canadian-born citizens and immigrants arriving to Canada prior to 1985. The IRCC database includes demographic information such as country of birth, date of achieving permanent residency status and immigrant class. At ICES, IRCC records are assigned an IKN once they are linked to the RPDB. IRCC data are linked deterministically to the RPDB if there are exact matches between surname, first name, date of birth, sex, and sometimes second name or second name initial. Data are further linked probabilistically using varying combinations of last and given name variants, date of birth and sex. In this manner, the IRCC database has demonstrated 86% linkage with the RPDB, with 68% of linkages attributable to deterministic linkage and 18% attributable to probabilistic linkage. Lower linkage rates at 78% were observed for people born in East Asia. Further details on the IRCC to RPDB linkage process can be found elsewhere [133].

Ontario Breast Screening Program

The OBSP is a provincial cancer screening program that was established in 1990. The OBSP database is available from 1999 onward and provides data on screening test dates, referring physicians and final results. We used the OBSP database to identify the screen-detected breast cancers that were associated with the OBSP.

Ontario Health Insurance Plan (OHIP)

OHIP is the provincial health care plan through which most health services in Ontario are covered. The OHIP database is available from 1991 onward and contains information on physicians, locations, diagnostic codes and fee codes associated with any given physician encounter. OHIP uses International Classification of Diseases, ninth revision (ICD-9) codes for diagnoses, procedures, treatments and tests.

Corporate Provider Database (CPDB)

The CPDB is available from 1965 onward and provides information on addresses, registration, specialty training, certification and program eligibility information including primary care group contracts about individual health care providers. We used this database to ascertain FHT association among PCPs.

ICES Physician Database (IPDB)

The IPDB is available from 1992 onward. The IPDB takes information from the CPDB and combines it with the Ontario Physician Human Resource Data Centre database that is verified through periodic telephone interviews with physicians practicing in Ontario. The IPDB provides information useful for physician profiling that can be linked deterministically to other ICES databases using an encoded billing number, which is valid in 99.84% of IPDB entries. We used this database to identify physician specialty (e.g. GP/FP, medical oncology, radiation oncology, etc.), which is identified in 100% of IPDB entries.

Client Agency Program Enrollment (CAPE) Tables

The CAPE tables indicate the enrollment of an individual in a primary care enrollment model with a specific practitioner and group over time. A new record is created when a Registered Person who is eligible for OHIP enrolls in a primary care model. Enrollment status is available for 100% of records in the CAPE tables. Information on specific primary care enrollment models are available for 99.5% of records in the CAPE tables. Patients attending CHCs are not included in the CAPE database. In 2014/15-2015/16, out of around 13.7 million Ontario residents, approximately 114,000 patients (<1%) were clients of a CHC [134]. These patients are not captured in the CAPE database. A separate file from the CPDB provided by the Ontario MOHLTC identifies physicians that are associated with a FHT.

Canadian Institute for Health Information (CIHI): Discharge Abstract Database (DAD)

The DAD is available from 1988 and captures administrative, clinical and demographic information from hospital discharge records. This includes information on deaths, sign-outs and transfers. The DAD uses ICD-10-enhanced Canadian version (CA) with the Canadian Classification of Health Interventions (CCI) to code diagnoses and investigations. The ICD-10 system was introduced in Ontario in 2002. A re-abstraction study from 2002/03 and 2003/04 found that demographic data and procedures were coded with high sensitivity and near-perfect specificity, while admission and discharge dates were nearly exact; however, diagnostic coding was much more variable [135]. We used the DAD to obtain information on diagnoses, tests, procedures and surgeries performed during hospital admissions.

CIHI: Same Day Surgery (SDS) Database

The SDS database is available from 1991 and contains administrative, clinical and demographic information from day surgeries. Similarly to the DAD, the SDS database uses the ICD-10-CA/CCI system to code diagnoses, investigations and procedures. As of April 2003, SDS data are derived from the National Ambulatory Care Reporting System (NACRS) database. We used the SDS database to obtain information on diagnoses, tests, procedures and surgeries performed during day surgeries.

CIHI: National Ambulatory Care Reporting System (NACRS) database

The NACRS database is available from 2000 onward and contains information on hospital-based and community-based ambulatory care. This includes information from ED visits, day procedures, medical day/night care and high-cost ambulatory clinics including dialysis, cardiac catheterization and oncology (including all regional cancer centres). The NACRS database provides data on acuity, diagnoses, interventions and demographics. Similarly to the DAD, the NACRS databases uses the ICD-10-CA/CCI system to code diagnoses, investigations and procedures. We used the NACRS database to obtain information on diagnoses, tests and procedures performed in day surgery facilities, outpatient clinics or EDs.

Cancer Activity Level Reporting (ALR) Database

The ALR database is available from 2005 onward and contains data on patient-level activity focused on radiation and systemic therapy services as well as outpatient oncology clinic visits. Over 99.9% of ALR are deterministically linked to other datasets using the IKN. The ALR data set is used to produce quality, cost and performance indicators for Ontario's cancer system. We used the ALR database to identify patients that received radiotherapy and to identify PCP visits by GPOs that took place in cancer clinics.

4.5. Operational definitions of time points and intervals

Specific dates that were looked at in this study include the index contact date, the date of the first test, the date of the first consultation, the date of diagnosis, the date of surgery and the start date of adjuvant chemotherapy (Table 4-2). These dates are analogous to the date of first presentation, date of first investigation, date of first specialist visit, date of diagnosis, and date of treatment start as seen in the Aarhus statement as used by the ICBP (Figure 2-2). The

time points and other variables in this dataset were defined by the CanIMPACT quantitative subgroup led by Patti Groome to be comparable across provinces (see appendix B for variable coding and definitions). These time points and their associated intervals have not been validated with another data source. While Groome et al. attempted to validate a slightly different method of obtaining the diagnostic interval in oral cavity cancers, they found that the treating medical charts they were using for validation were incomplete for that purpose [105].

Table 4-2. Time points used in this thesis (see appendix B for variable coding and definitions)

Time points	**Operational definition**
Index contact date	*If breast cancer was screen-detected*: the date of screening. *If breast cancer was symptom-detected*: either the earliest date of breast-related encounters within 6 months prior to the diagnosis date as determined from OHIP and CIHI-DAD diagnostic codes, or the ordering date of the first diagnostic test, whichever was earlier. If the ordering date was not available, we used the encounter prior to the first diagnostic test (with the referring physician, or the PCP if the referring physician information was not available). If there was no referring physician or PCP information available, we used the date of the first diagnostic test.
Date of the first test	The earliest date within 6 months prior to the diagnosis date in which one of the following tests was performed as determined by billings data: mammogram, breast ultrasound, breast magnetic resonance imaging (MRI), breast biopsy, or breast surgeon consultation.
Date of the first consultation	The date of first consultation with a medical oncologist, radiation oncologist, or breast surgeon.
Date of diagnosis	Date of breast cancer diagnosis as taken from the Ontario Cancer Registry (OCR) database. The OCR lists the diagnosis date as the earliest of the following records associated with the case: pathology specimen taken date, DAD admission date, NACRS registration date, regional cancer centre diagnosis/registration date, other provincial cancer registry diagnosis date, or death date [129].
Date of surgery	The earliest lumpectomy or mastectomy procedure date.
Start of adjuvant chemotherapy	The date of first chemotherapy received within 4 months after surgery as determined from OHIP billing data.

The intervals we examined in this study include a baseline period, a treatment period, a diagnostic interval, a primary care interval, a surgery to chemotherapy interval and a contact to chemotherapy interval (Figure 4-1). All intervals were defined in number of days. The **baseline period** is defined as the 6 to 30 months (i.e. a 24-month period) prior to the date of diagnosis. The **treatment period** is the 6 months from the start of adjuvant chemotherapy. The **contact to**

chemotherapy interval is the time from the index contact date to the start of adjuvant chemotherapy. This interval is subdivided into the primary care interval and the surgery to chemotherapy interval. The **primary care interval** is the time from index contact date to the date of first oncology consultation. The **surgery to chemotherapy interval** is the time from the last surgical procedure date within 6 months after breast cancer diagnosis to start of adjuvant chemotherapy. In sensitivity analyses, we also examined the **diagnostic interval**, which was defined as the time from index contact date to the date of diagnosis.

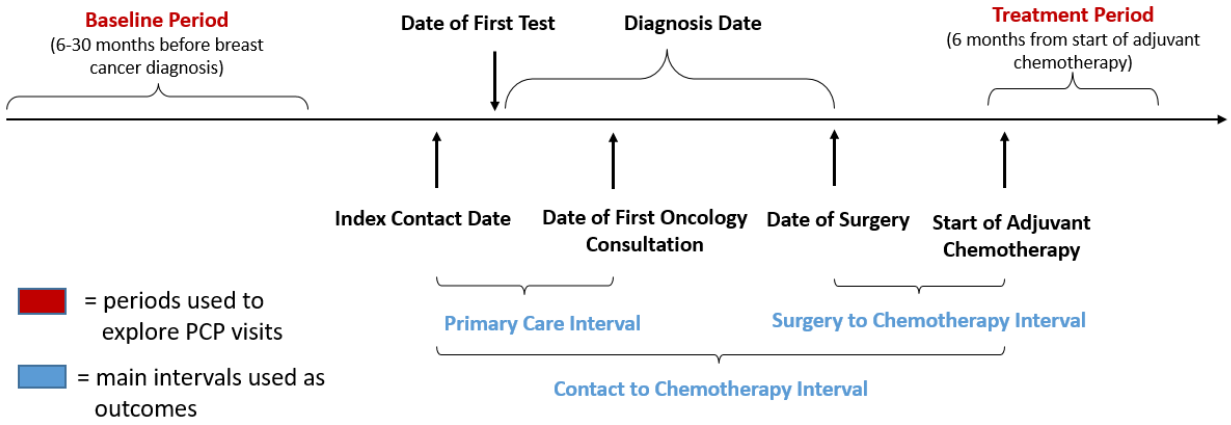

Figure 4-1. Time points and intervals of breast cancer care used in this thesis
PCP=primary care physician

The diagnostic and primary care intervals are similar to those seen in the Aarhus statement used by the ICBP in order to ensure comparability of findings (Figure 2-2); however, we have included additional intervals in this study in order to include time periods prior to the first clinical appearance (the baseline period) and beyond the start of treatment (treatment period). We have also expanded the ICBP's "treatment start" date to include a date of surgery, as well as a date of adjuvant chemotherapy initiation, in addition to the interval in between.

4.6. Operational definitions of variables of interest

4.6.1. Patient-level factors

Age at diagnosis

The patient's age at the date of diagnosis was taken from the Ontario Cancer Registry.

Comorbidity burden

Comorbidity burden was assessed using the Johns Hopkins Adjusted Clinical Groups (ACG)® System Version 11[136-138]. We specifically looked at the ACG® System Aggregated Diagnosis Groups (ADGs). The ACG® System groups International Classification of Disease (ICD) codes (-9 version, -9-CM version, or -10 version) into one of 32 diagnosis clusters known as Aggregated Diagnosis Groups (ADG). Individual ICD codes are categorized into a single ADG based on the condition's duration, severity, diagnostic certainty, etiology, and specialty care involvement [138]. The ADG and ACG systems have been shown to be useful in predicting physician utilization [139], patient costs in primary care [137], as well as mortality [138]. While there are several measures of comorbidity burden that are used in health research to predict mortality and other outcomes such as the Charlson comorbidity index and Elixhauser coding scheme, we chose to use the Johns Hopkins ACG system since the Charlson and Elixhauser scores were originally developed for use with inpatient data, whereas the ACG system was developed for use with ambulatory as well as inpatient health administrative data as is used in our study [140].

Comorbidity burden was defined as the total number of ADGs, excluding the major psychosocial ADGs (ADG 23 psychosocial: time limited, minor; ADG 24 psychosocial: recurrent/persistent, stable; ADG 25 psychosocial: recurrent or persistent, unstable). The major psychosocial ADGs were excluded from the total number of ADGs in order to prevent any overlap with our other mental health variable (see "History of mental health visits" below). This approach to define previous medical morbidity has been used in a previously published study on perinatal suicides [141]. The ADGs were calculated using healthcare data collected during the baseline interval (the 24-month period corresponding to the 6 to 30 months prior to diagnosis) since we were interested in the patient's comorbidity burden prior to their cancer diagnosis and prior to any potential adverse events related to cancer diagnosis and treatment.

History of mental health visits

Patients were considered to have a history of mental health (MH) visits if they had any PCP visits during the baseline interval with associated MH diagnostic codes (see appendix B for specific codes used). A validation study showed that using these primary care ambulatory claims had an 81% sensitivity and a 97% specificity for detecting MH visits to PCPs [142].

While psychosocial ADGs could be used to measure a history of mental health concerns, this method has not been previously validated. When comparing presence of

psychosocial ADGs with our chosen MH variable as described in the paragraph above, we achieved a near perfect agreement (kappa=0.98) with 119 more patients identified as having a MH history when using psychosocial ADGs compared to the method described above. As such, these methods are comparable. Due to the previous validation work, we chose to use the method developed by Steele et al. described above.

Immigration status

Immigration status was assigned using the Immigration Refugee and Citizenship Canada (IRCC) database.

Region of origin

Immigrant region of origin was classified into the following regions based on the patient's country of birth: East Asia & Pacific, Eastern Europe & Central Asia, South Asia, Sub-Saharan Africa, USA/New Zealand/Australia and Western Europe. This classification has been used and published in another CanIMPACT study [9].

Years since arrival

Years since arrival was calculated as the number of years from the latest landing date found in the IRCC database to the breast cancer diagnosis date.

Immigration class

Immigrants are classified into the following classes upon admission to the country: economic, family, refugee and other. The economic class refers to immigrants selected based on their ability to become economically established in Canada. The family class refers to immigrants sponsored by a family member. The refugee class refers to immigrants fleeing their countries due to fear of persecution. The other class refers to immigrants who do not fit into the previous categories and include immigrants in the deferred removal order class, express entry immigrants and immigration based on humanitarian and compassionate grounds.

Income quintile

Income, along with education and occupation, is one dimension of socio-economic status [143]. Income quintile, where Q1 (quintile 1) is the poorest and Q5 is the wealthiest, was measured as an approximated household income based on community of residence and

adjusted for household size. Postal codes at date of diagnosis were linked to a Census Dissemination Area (DA) level, which was further linked to neighbourhood income based on 2006 census data. DAs, which cover the entire territory of Canada, are the smallest standard geographic area for which census data are disseminated. DAs are composed of one or more neighbouring dissemination blocks and contain a target of 400 to 700 individuals [144].

Urban versus rural residence

Census Metropolitan Areas (CMA) with populations over 100,000 and at least 50,000 living within the core, and Census Agglomerations (CA) with populations over 10,000 based on 2006 census data were considered urban areas. Metropolitan Influenced Zones (MIZ), which refer to municipalities not in a CMA or CA, were used to classify rural areas. Strong, moderate, and weak MIZ have ≥30%, 5-30%, and 0-5% of its resident employed labour force commuting to work in any CMA or CA, respectively. “No MIZ” have no resident employed labour force commuting to work in any CMA or CA, or have fewer than 40 individuals in their resident employed labour force [145].

The patient’s residence was determined using their postal code at the date of diagnosis. Residence was classified as urban (CMA or CA, i.e. population over 10,000), rural (Non-CMA/CA, strong MIZ), rural-remote (Non-CMA/CA, moderate MIZ), rural-very remote (Non-CMA/CA, weak/no MIZ or territories), rural-unknown (Non-CMA/CA, unknown MIZ), or unknown (unknown if CMA/CA or not).

4.6.2. Healthcare provider and system-level factors

Local Health Integration Network (LHIN)

LHINs are regional healthcare agencies established by the Ontario government since 2006. They are responsible for planning, coordinating, integrating and funding health services within their jurisdictions, which includes the management of hospitals, community health centres, LTC homes, mental health and addiction agencies and community support service agencies. There are 14 LHINs in Ontario that encompass the entire province: Central, Central East, Central West, Champlain, Erie St. Clair, Hamilton Niagara Haldimand Brant, Mississauga Halton, North Simcoe Muskoka, North East, North West, South East, South West, Toronto Central, and Waterloo Wellington (Figure 2-1).

Patients were assigned to a LHIN based on their postal code at date of diagnosis.

Continuity of primary care

Continuity of care has been defined as a patient's experience of coherent and linked care over time. Continuity of care can be seen as having three elements: informational, relational and management continuity. Informational continuity is reflected in the flow of information used to give care appropriate to the patient's current circumstance. Relational continuity refers to the ongoing relationship between patients and providers that can help support knowledge of the patient over time and bridge discontinuous events. Management continuity means that care from different providers is connected in a coherent manner [17].

In this study, we focused on relational continuity of primary care, which was measured using the Usual Provider of Care (UPC) index [146]. The UPC index is one of the most commonly used measures of care continuity in healthcare research [17] and has been shown to be associated with physician-patient interaction quality [147]. The UPC index was calculated as the proportion of visits to the most-often-visited PCP during the 2-year baseline interval and was only calculated for patients with at least 3 visits to any PCP during that interval. As such, continuity of primary care was divided into the following categories: 0 PCP visits, 1-2 PCP visits, low continuity (UPC ≤0.75) and high continuity (UPC >0.75).

Primary care practice type

Patient enrollment in a primary care practice model is available using the CAPE database. Patient enrollment status was determined at the time of breast cancer diagnosis. Patients can be enrolled in one of several models: family health teams (FHT), family health groups (FHG), comprehensive care models (CCM), family health organizations (FHO), family health networks (FHN), community health groups (CHG), community sponsored agreements (CSA), group health centers (GHC), health services organizations (HSO), primary care groups (PCG), primary care networks (PCN), rural and northern groups (RAN), south eastern area medical organizations (SEAMO), and St. Joseph's Health Centre. Community Health Centres (CHC) were not considered in this analysis, since information on CHC enrollment was not readily available. However, the number of patient visits that occur in a CHC is small compared to other models. For example, in 2014/15-2015/16, out of around 13.7 million Ontario residents, approximately 114,000 patients (<1%) were clients of a CHC, whereas approximately 3.47 million patients visited a FHT in Ontario [134]. Further information on primary care practice models in Ontario can be found in Chapter 2: Literature Review of this thesis.

When assessing primary care payment models, patients assigned to FHTs were considered to have primary care services paid through ‘team-based capitation’, patients assigned to FHGs and CCMs were considered to have primary care services paid through ‘enhanced fee-for-service (FFS)’, patients assigned to FHOs and FHNs were considered to have primary care services paid through ‘capitation’, patients assigned to the other primary care models were considered to have primary care services paid through ‘other’, and unenrolled patients were considered to have primary care services paid through ‘straight FFS’.

Breast cancer detection method

Patients were assessed for whether their breast cancer was screen-detected or symptom-detected using a stepwise process. If there was documentation of a screening mammogram as the initial test within 6 months prior to diagnosis, the patient was classified as having been screen-detected. Additionally, if the earliest test was identified as a bilateral mammogram, and an additional mammogram and/or breast ultrasound was ordered by a radiologist that same day, or if the next breast testing on a different day was a mammogram or breast ultrasound with no other tests that day, the patient was classified as having been screen-detected. Otherwise, the patient was classified as symptom-detected. This method was developed by the CanIMPACT quantitative subgroup and was used in other CanIMPACT studies [9], but has not been validated against any other data sources.

Breast cancer surgery type

Patients were classified as having received a lumpectomy and/or mastectomy procedure if the CIHI DAD or SDS databases contained any of the associated procedure codes from 2 weeks before diagnosis date to 9 months after diagnosis date.

Receipt of neoadjuvant chemotherapy

Patients were deemed to have received neoadjuvant chemotherapy if they had OHIP chemotherapy billing codes documented between the diagnosis date and the date of first surgery.

Receipt of radiation therapy

Patients were deemed to have received radiation therapy if they had recorded non-palliative radiotherapy treatment to the breast, chest wall, supraclavicular nodes or axilla within 9 months of the date of diagnosis in the ALR database.

4.6.3. Disease-level factors

Stage

Breast cancer stage at diagnosis was taken from the Ontario Cancer Registry (OCR) and was classified using the tumor-node-metastasis (TNM) staging system 6th edition, which takes into account the tumour size, number of positive lymph nodes and involvement of specific tissues or adjacent structures [148]. The elements used to derive the TNM staging system are known as Collaborative Staging (CS) data. The OCR combines the CS data with histology records as well as age, grade, and tumour behaviour to create a stage group. Briefly, stage I disease is considered localized to the breast, stage II disease consists of larger tumours that involve the axillary lymph nodes and stage III disease consists of tumours that have clearly invaded tissues around the breast. Stage IV disease represents breast cancer that has metastasized throughout the body; patients with stage IV disease at diagnosis were excluded from this study.

Grade

Histologic breast cancer grade was ascertained from the OCR using International Classification of Diseases for Oncology (ICD-O) codes. The ICD-O coding system uses topography, histology and behaviour information to assign a code. Breast cancers are divided into the following groups: “well-differentiated”, “moderately differentiated” and “poorly differentiated”. Well-differentiated tumours are considered low grade – these tumours tend to grow and spread slowly. Moderately differentiated tumours are considered intermediate grade. Poorly differentiated tumours are considered high grade tumours that tend to grow and spread more rapidly than tumours of lower grades.

Receptor status

Breast cancers are categorized based on the presence or absence of estrogen receptors (ER) and/or progesterone receptors (PR), as well as the presence or absence of human

epidermal growth factor receptor 2 (HER2/neu receptors) as coded in the OCR. If ER or PR status was missing in the OCR, ER/PR positive status was assigned if the patient was 65+ years at diagnosis and had a record of taking tamoxifen or an aromatase inhibitor in the year post-diagnosis according to the ODB database. Similarly, HER2 status was also assigned to be positive if there was a record of the patient having received trastuzumab in the NDFP data within one year of diagnosis.

4.6.4. Main outcome variables

Number of PCP visits during the treatment period

We looked at the total number of outpatient PCP visits during the treatment period (6 months from the start of adjuvant chemotherapy). The treatment period was set at a 6 month interval in order to capture the time when most patients would be undergoing chemotherapy and potentially experiencing chemotherapy-related side effects or complications. Most adjuvant breast cancer chemotherapy regimens are administered over a 16-week to 6-month period depending on the regimen used [149]. All office, phone, home or LTC facility visits where the physician's main specialty was listed as "general practice/family practice" or "family practice/emergency medicine" were included. Any visits that took place in ED, inpatient, or unknown locations were excluded. Visits to the same physician on the same day were counted as one visit.

Number of PCP visits in cancer clinics

In order to get an estimate of which PCP visits might actually have been with GPOs, we recorded the number of PCP visits during the treatment period that were carried out in cancer clinics. For all OHIP-identified PCP visits that occurred during the treatment period, we looked at the institution number that described where the visit took place. We then looked at the ALR clinic visit records during the treatment period and found the hospital institution numbers associated with the ALR records. If the OHIP-identified PCP visit institution number matched any of the institution numbers associated with ALR-identified clinic visits, then the visit was deemed to have taken place in a cancer clinic. Since this method has not been previously validated or used in other studies, we only used this information in sensitivity analyses.

Reasons for PCP visits during the treatment period

We examined the diagnostic codes and visit fee codes for each PCP visit during the treatment period as taken from the OHIP billings data. Visits were considered cancer-related if

the diagnostic code was listed as “female breast neoplasm”, “male breast neoplasm”, “other malignant neoplasms”, “CIS [Carcinoma in situ] – Breast [and genito-urinary system]” or “Adverse Effects – of drugs and medications – including allergy, overdose, reactions”.

Number of oncology and other specialist visits during the treatment period

We tallied the visits and examined the diagnostic codes and visit fee codes for office, phone, home or LTC facility visits during the treatment period where the physician’s main specialty was not “general practice/family practice” or “family practice/emergency medicine”. Oncology specialists included medical oncologists, radiation oncologists, and surgical oncologists.

Contact to chemotherapy interval

The contact to chemotherapy interval is defined in our study as the number of days from the index contact date to the start date of adjuvant chemotherapy. This interval comprises the initial testing and investigations, referrals, specialist visits, diagnosis and surgical treatment that a breast cancer patient undergoes.

Primary care interval

The primary care interval is defined in our study as the number of days from the index contact date to the date of the first consultation with an oncologist (medical, radiation, or surgical oncologist). This interval reflects the period in which the PCP is likely to be the most responsible physician involved in the patient’s cancer care: from when a patient first presents with symptoms or positive screening, through any initial tests, investigations and referrals, to the date of first cancer specialist visit, at which point care is likely to transition to the specialist.

Surgery to chemotherapy interval

The surgery to chemotherapy interval is defined in our study as the number of days from date of last surgical procedure within 6 months after breast cancer diagnosis to start date of adjuvant chemotherapy. This interval reflects a period after potentially curative breast surgery when patients are consulting with their specialists on the best course of treatment. During this period, specialists have access to the breast cancer surgical sample that, through specialized testing, can help determine which therapies are best to pursue. With this information, specialists can determine the best course of treatment and proceed to arrange the appropriate therapies.

4.7. Ethics

Ethics approval was obtained for the overarching CanIMPACT project on May 5, 2014 from Queen's University Health Sciences & Affiliated Teaching Hospitals Research Ethics Board (file number 6012581). Further ethics approval for this study was obtained from the University of Toronto Health Sciences Research Ethics Board (appendix C).

Chapter 5: Statistical Analyses

5.1 Data access and cleaning

Databases were linked at the individual patient level and compiled by an ICES analyst. The ICES analyst then removed identifying information from the data. All analyses were performed at ICES Central in Toronto, Ontario using SAS software, version 9.4 [150]. Copyright © 2013 SAS Institute Inc. SAS and all other SAS Institute Inc. product or service names are registered trademarks or trademarks of SAS Institute Inc., Cary, NC, USA. A p-value <0.05 was considered statistically significant.

The original cohort included all women diagnosed with breast cancer between Jan 1, 2007 and Dec 31, 2011 who received curative surgery and adjuvant chemotherapy in Ontario. We excluded patients who had received neoadjuvant chemotherapy and patients who received radiation therapy prior to adjuvant chemotherapy. We excluded the few patients who resided in a LTC facility, since the nature and pattern of PCP visits in this setting are likely different from ambulatory clinic visits. We further checked the data for implausible values and dealt with them on a case-by-case basis. The few (n<6) patients with implausible interval lengths (i.e. date of death prior to chemotherapy start date) were treated as having missing interval lengths.

5.2. Descriptive statistics

We used descriptive statistics to evaluate the characteristics of the patient population according to comorbidity burden level, mental health (MH) history and continuity of care at baseline. The characteristics we examined included age at diagnosis, immigration status (and if patient was an immigrant, region of origin, years since immigration, immigrant class), income quintile, urban versus rural residence, comorbidity burden, history of MH visits, LHIN, primary care continuity, primary care practice type, cancer stage, grade, receptor status, detection method, surgery type and receipt of radiation. We used chi-squared tests to compare distributions of categorical variables across groups. We also evaluated mean PCP visit rates during the treatment and baseline periods and mean differences between these rates across the different characteristics. We used Wilcoxon rank sum tests to compare mean rates across binary characteristics and one-way Kruskall-Wallis analysis of variance (ANOVA) to compare means across characteristics with more than 2 categories. Lastly, we compared median and 90th percentile intervals (contact to chemotherapy interval, primary care interval and surgery to

chemotherapy interval) across the same characteristics. We stratified these comparisons by detection method (screened versus symptomatic). We used Wilcoxon rank sum tests to compare medians across binary characteristics and Kruskall-Wallis ANOVA to compare medians across potential confounders with multiple categories. The Wilcoxon rank sum and Kruskall-Wallis ANOVA tests are nonparametric tests that were used due to the non-normal distributions of PCP visits and interval lengths.

We tallied the number of visits to primary care, medical oncology, radiation oncology, surgical oncology and other physicians during the treatment period. We listed the 10 most frequently used diagnostic codes for primary care and oncology visits during the treatment period. Women who received neoadjuvant chemotherapy or received radiation therapy prior to adjuvant chemotherapy (n=726) were included in these tallies.

5.3. Regression Analyses

5.3.1. Selecting covariates and potential confounders

A confounder is a factor that is a common cause of both the exposure and outcome of interest. Failing to account for confounders may bias any causal inferences that are made about the relationship between the selected exposure and outcome. In this thesis, due to the retrospective and observational nature of our data, we accounted for confounding using statistical methods and included potential confounders in multivariable regression models. While difference-in-difference (DID) methodology used to answer our first research question theoretically eliminates confounding since subjects serve as their own controls, we wanted to account for any residual confounding by including potential confounders in our multivariable models.

We pre-specified potential confounders of interest when building our models according to clinical insight and relevance (table 5-1). All potential confounders deemed to be appropriate for our models were included.

Table 5-1. Potential confounders included in our statistical models

Objective	Exposure of interest	Outcome of interest	Potential confounders
1	Patient comorbidity burden & MH history	Increase in number of PCP visits during adjuvant breast cancer chemotherapy from baseline	Demographics: age at diagnosis, immigration status, income quintile, urban versus rural residence System and treatment factors: LHIN, continuity of primary care, primary care practice type
2	Continuity of primary care	Length of contact to chemotherapy interval in days	Demographics: age at diagnosis, immigration status, income quintile, urban versus rural residence, comorbidity burden, history of MH visits System and treatment factors: LHIN, primary care practice type

5.3.2. Testing for multicollinearity

All potential confounders were tested for multicollinearity using a variance inflation factor (VIF) cutoff of >2.5. Variables found to be multicollinear were examined and dealt with on a case-by-case basis.

5.3.3. Primary care visits during chemotherapy

We used difference-in-difference (DID) analysis to compare changes in PCP visit rates from baseline to treatment periods between comorbidity and MH history groups. Subtracting changes in PCP visits from the baseline to treatment periods between groups effectively removes background secular trends in PCP visit rates. Additionally, each subject serves as her own control, removing confounding by known and unknown individual factors associated with PCP visit rates [151]. Poisson and negative binomial regression modeling takes the log of the expected count and relates it to the predictor variables using a linear function. For the Poisson distribution to be the correct specification for the data, the mean and variance of the data need to be equal. When the data are overdispersed and the variance is greater than the mean, as was the case in our data, the Poisson distribution is inappropriate and a negative binomial model, which incorporates a dispersion component to the variance, should be used instead. We therefore used a negative binomial distribution for our model. Additionally, since the PCP visit rates for a given subject are assumed to be correlated, we needed to account for repeated measures. We therefore used generalized estimating equations with our negative binomial model in order to account for repeated measures using unstructured covariance. We included

an interaction term between the PCP visit rate and the time period (baseline versus treatment), which allowed us to estimate the DID score, which, in a negative binomial model, translates to a ratio of ratios (RoR): the ratio between comorbidity or MH groups of the ratios of PCP visit rates between baseline and treatment periods. Although most patients had PCP visits measured over the full 6 month treatment period and 24 month baseline period, some (n=72) patients died less than 6 months from the start of their adjuvant chemotherapy and others (n=319) were not OHIP eligible during the full 24 month baseline period. As such, we included an offset term in the negative binomial model to account for differences in the exposure time of the baseline and treatment periods.

5.3.3.1. Verifying Assumptions

In order to examine whether the estimates from our negative binomial model were biased, we examined several assumptions. To ensure a proper fit of the model to the data, we looked at the overdispersion factor (ODF). Since the ODF was greater than 1, meaning that the variance of our model was greater than the mean, we could not use a Poisson distribution and had to use the negative binomial distribution instead. A negative binomial model provided a more adequate fit for our data, since negative binomial models incorporate a dispersion component to the variance. We checked for influential observations using Cook's D values. Due to the large sample size of our population, over-specification was not an issue in our model. We dealt with the correlation of our repeated measures (i.e. number of PCP visits during baseline and treatment periods) by incorporating generalized estimating equations in our model. Generalized estimating equations assume data are missing completely at random (i.e. that missing values are neither due to any covariates (missing at random) nor to the outcome (missing not at random)). Since there were n=41 missing values in our multivariable model due to missing income quintile values, we performed a best-case worst-case sensitivity analysis where we repeated our analysis with all missing values having been assigned to the first income quintile and again with all missing values being assigned to the fifth income quintile. Difference-in-difference analyses rely on a common trends assumption, which means that the time series of outcomes, which in this study were PCP visit rates, in each group should differ by a fixed amount in every period and exhibit a common set of period-specific changes [152]. We checked for the common trends assumption by examining the trends in mean monthly PCP visit rates graphically in the 30 to 6 months prior to diagnosis and the 6 months after onset of chemotherapy to ensure that the trends were parallel between groups.

5.3.4. Continuity of care and wait times to chemotherapy

For our unadjusted model, we compared the median contact to chemotherapy interval, as well as the median subintervals (primary care interval and surgery to chemotherapy interval) across continuity of care groups using Kruskall-Wallis ANOVA. We also reported the 90th percentile intervals. The contact to chemotherapy and primary care intervals were stratified by detection method (screening versus symptom-detected). The surgery to chemotherapy interval was not stratified by detection method, since detection of breast cancer does not occur during this interval.

For our multivariable analysis, we performed quantile regressions looking at the effects of primary care continuity of care at baseline on the contact to chemotherapy interval after adjusting for potential confounders listed in table 5-1. Quantile regression models estimate differences in quantiles instead of differences in means. It was used in this study since the distribution of the contact to chemotherapy interval was skewed and not normal. We performed quantile regression at the median and 90th percentile values of the contact to chemotherapy interval, since those with average wait times and those with long wait times were of particular interest. We repeated the quantile regression analyses at the median and 90th percentiles for the primary care interval and the surgery to chemotherapy interval.

5.3.4.1. Verifying assumptions

A benefit of using quantile regression models is that the statistics are distribution-free and there is no assumption that the residuals are normally distributed and homoscedastic. Observations were assumed to be independent.

5.4. Loss to follow-up

Loss to follow-up was not a major issue in our project since we used health administrative data that captures the vast majority of patient health encounters in Ontario. Administrative loss could have occurred if a patient moved provinces or emigrated from Canada after starting their breast cancer chemotherapy. While the number of patients estimated to have moved out of province during the 6 month treatment period is small, persons moving out of province are not required to alert the MOHLTC and it is difficult to track this data in the health administrative databases.

5.5. Sensitivity Analyses

5.5.1. Primary care visits during chemotherapy

We completed several sensitivity analyses of our DID model looking at the ratio of PCP visit rates from treatment to baseline across comorbidity and MH groups:

1) We explored best-case, worst-case scenarios for missing income quintile values (n=41).
2) We included significant interaction terms between time period and potential confounders in the model. This allowed us to estimate effects of other confounders on the change in PCP visit rate from baseline to treatment.
3) We used total number of ADGs (including both physical and psychosocial ADGs) as main risk factor of interest instead of separating into physical ADGs and MH history.
4) We excluded PCP visits during the treatment period that were deemed to have taken place in cancer clinics.
5) We conducted an analysis restricted to the immigrant population.

5.5.2. Continuity of care and wait times to chemotherapy

We performed several sensitivity analyses of our quantile regression analyses looking at the effect of baseline primary care continuity:

1) We explored best-case, worst-case scenarios for missing income quintile values (n=41).
2) We input missing index contact date values (n=271) as the date of diagnosis. We took this approach since the index contact date values were likely to be missing if the date of the first test was after the date of diagnosis.
3) We included only patients with 3 or more PCP visits at baseline. This analysis was done since the UPC index could only be calculated in this population.
4) We conducted an analysis restricted to the immigrant population in order to assess for any differences in the effect of primary care continuity on wait times to receiving chemotherapy in the immigrant population.
5) We conducted a quantile regression analysis to assess the impact of immigrant region or origin, years since immigration and immigration class on the contact to chemotherapy interval, the primary care interval and the surgery to

chemotherapy interval. This model included age at diagnosis, income quintile, physical comorbidities and MH history as potential confounders between immigration characteristics and contact to chemotherapy interval.

5.6. Summary

In order to determine the differences in PCP visit rate changes during the treatment period compared to baseline between comorbidity and/or MH groups, we performed a difference-in-difference analysis using negative binomial modelling with generalized estimating equations to account for repeated measures using the length of the baseline and treatment intervals as an offset term. In order to determine the effect of continuity of primary care at baseline on the varying intervals along the treatment pathway, we used quantile regression analysis done at the median and 90^{th} percentile levels. We used multivariable analyses to account for a pre-determined set of potential confounders.

Chapter 6: Results

6.1. Participants

The original CanIMPACT treatment cohort included 13,508 women diagnosed with breast cancer between Jan 1, 2007 and Dec 31, 2011 who received curative surgery and adjuvant chemotherapy in Ontario. We excluded 653-657 patients who had received neoadjuvant chemotherapy and a further 69 patients who received radiation therapy prior to adjuvant chemotherapy (figure 6-1). A small number of patients who resided in a LTC facility were excluded (n<6). This resulted in a final cohort size of 12,781 patients.

There were 271 (2.12%) patients with missing values for the index contact date. The index contact date would likely have been missing in these patients if they did not receive any testing (e.g. mammography, ultrasounds, biopsy or breast surgeon consultation) or have any breast-cancer related encounters prior to diagnosis. In simple descriptive analyses, these 271 patients were more likely to have no primary care visits at baseline, poor continuity of care at baseline and not be rostered to a primary care enrollment model, as well as being more likely to be diagnosed with later stage disease, more likely to receive mastectomy and less likely to receive radiation therapy (data not shown). These missing values were imputed in a sensitivity analysis (see description in section 5.5.2.).

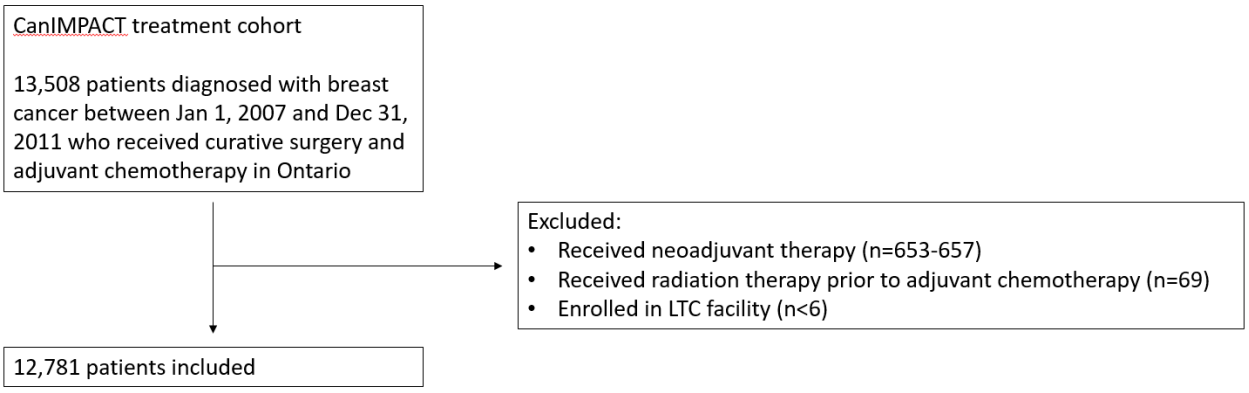

Figure 6-1. Flow sheet of patients included in cohort study

6.2. Descriptive Statistics

In our cohort, 64.2% of women were diagnosed with breast cancer after the age of 50 years, 87.5% lived in urban areas and 13.3% were immigrants (table 6-1). The majority of immigrants arrived as economic immigrants. Most patients (81.7%) visited a PCP at least 3

times during the 24 month baseline. Of these, 62.5% were considered to have high baseline continuity of care with their PCP (UPC >0.75). Only 6.3% of patients did not visit a PCP during the baseline period. Most patients were rostered in a primary care enrollment model, with almost half of patients being enrolled in an enhanced FFS model (FHG or CCM). The majority of patients (57.01%) had 5 or fewer ADGs reflecting low comorbidity burden and 32.2% of patients had a history of MH visits in primary care during the 24-month baseline period (6 to 30 months prior to diagnosis). Less than a quarter of patients had their breast cancer diagnosed through screening. Most patients were diagnosed with stage II disease, received lumpectomy and received radiation. Over half of patients had missing values for histological grade and receptor status.

6.2.1. Characteristics of comorbidity and mental health groups

Characteristics between comorbidity and MH groups are listed in table 6-1. Those in the lower comorbidity group were more likely to be younger, live rurally, be non-immigrants, have fewer than 3 PCP visits during the baseline period, not be rostered in a primary care enrollment model, live in South West, Waterloo Wellington, Hamilton Niagara Haldimand Brant or North Simcoe Muskoka LHINs, have no MH visits at baseline or have received radiation therapy. Those in the higher comorbidity group were more likely to be older, live in urban areas, have low continuity of care, be rostered in a primary care model, particularly the enhanced FFS model, be from Central West, Mississauga Halton, Toronto Central, Central and Central East LHINs and have a MH history. Those with a MH history were more likely to be younger, live in urban areas, be non-immigrants, be enrolled in an enhanced FFS primary care model, be from Erie St. Clair, Central East or Champlain LHINs and have a higher number of comorbidities. Those with no MH history were more likely to be older, be immigrants, have fewer than 3 PCP visits at baseline, live in Waterloo Wellington, Mississauga Halton or South East LHINs, have a lower number of comorbidities and have received radiation therapy. There was no association between comorbidity or MH groups and neighbourhood income quintile, cancer detection method, cancer stage, histological grade or surgery type.

In the immigrant population, those in the lower comorbidity groups were more likely to be from East Asia & Pacific or Eastern Europe & Central Asia or have arrived less than 10 years prior to diagnosis. Immigrants in the higher comorbidity groups were more likely to be from Latin America & Caribbean, South Asia or Western Europe, were more likely to have arrived 10 or more years prior to diagnosis and were more likely to be refugees. Immigrants with no MH

history were more likely to be from East Asia & Pacific and South Asia, were more likely to have arrived less than 10 years prior to diagnosis and be economic class immigrants.

Table 6-1. Baseline characteristics according to levels of comorbidity and history of mental health visits

	Total N= 12,781	**Co-morbidity Level**			P value	**Mental Health History**		P value
		0-5 ADGs (low) N= 7,287	**6-9 ADGs (medium)** N= 4,425	**10+ ADGs (high)** N= 1,069		**Yes** N=4,127	**No** N=8,654	
Age (Categorical)								
<40	1,102 (8.6%)	639 (8.8%)	374 (8.5%)	89 (8.3%)	<0.001	349 (8.5%)	753 (8.7%)	0.008
40-49	3,481 (27.2%)	2,177 (29.9%)	1,092 (24.7%)	212 (19.8%)		1,134 (27.5%)	2,347 (27.1%)	
50-59	4,225 (33.1%)	2,500 (34.3%)	1,417 (32.0%)	308 (28.8%)		1,404 (34.0%)	2,821 (32.6%)	
60-69	3,045 (23.8%)	1,581 (21.7%)	1,155 (26.1%)	309 (28.9%)		985 (23.9%)	2,060 (23.8%)	
70-74	607 (4.7%)	262 (3.6%)	239 (5.4%)	106 (9.9%)		180 (4.4%)	427 (4.9%)	
>74	321 (2.5%)	128 (1.8%)	148 (3.3%)	45 (4.2%)		75 (1.8%)	246 (2.8%)	
Urban/rural Residence								
Urban	11,189 (87.5%)	6,254 (85.8%)	3,957 (89.4%)	978 (91.5%)	<0.001	3,677 (89.1%)	7,512 (86.8%)	0.06
Rural	699 (5.5%)	450 (6.2%)	213 (4.8%)	36 (3.4%)		199 (4.8%)	500 (5.8%)	
Rural-remote	596 (4.7%)	392 (5.4%)	168 (3.8%)	36 (3.4%)		170 (4.1%)	426 (4.9%)	
Rural-very remote	292-297 (2.3%)	187-192 (2.6%)	85-90 (1.9-2.0%)	15-20 (1.4-1.9%)		80-85 (1.9-2.1%)	210-215 (2.4-2.5%)	
Rural-unknown	<=5	<=5	<=5	<=5		<=5	<=5	
Unknown	<=5	<=5	<=5	<=5		<=5	<=5	
Immigration Status								
Long-term residents*	11,075 (86.7%)	6,384 (87.6%)	3,775 (85.3%)	916 (85.7%)	0.001	3,636 (88.1%)	7,439 (86.0%)	<0.001
Immigrants	1,706 (13.3%)	903 (12.4%)	650 (14.7%)	153 (14.3%)		491 (11.9%)	1,215 (14.0%)	
Immigrant Characteristics**								
Region of Origin					<0.001			0.007
East Asia & Pacific	544 (4.3%)	280 (3.8%)	218 (4.9%)	46 (4.3%)		142 (3.4%)	402 (4.6%)	
Eastern Europe & Central Asia	286 (2.2%)	183 (2.5%)	90 (2.0%)	13 (1.2%)		91 (2.2%)	195 (2.3%)	
Latin America & Caribbean	239 (1.9%)	113 (1.6%)	99 (2.2%)	27 (2.5%)		70 (1.7%)	169 (2.0%)	
Middle East & North Africa	145 (1.1%)	71 (1.0%)	62 (1.4%)	12 (1.1%)		53 (1.3%)	92 (1.1%)	
South Asia	270 (2.1%)	125 (1.7%)	108 (2.4%)	37 (3.5%)		71 (1.7%)	199 (2.3%)	
Sub-Saharan Africa	87 (0.7%)	43 (0.6%)	38 (0.9%)	6 (0.6%)		27 (0.7%)	60 (0.7%)	
USA/New Zealand/Australia	37 (0.3%)	25 (0.3%)	12 (0.3%)	0 (0.0%)		7 (0.2%)	30 (0.3%)	
Western Europe	98 (0.8%)	63 (0.9%)	23 (0.5%)	12 (1.1%)		30 (0.7%)	68 (0.8%)	
Years since Arrival								
<10y	618 (4.8%)	370 (5.1%)	211 (4.8%)	37 (3.5%)	<0.001	149 (3.6%)	469 (5.4%)	<0.001
>=10y	1,088 (8.5%)	533 (7.3%)	439 (9.9%)	116 (10.9%)		342 (8.3%)	746 (8.6%)	
Immigrant Class					<0.001			<0.001
Economic	885 (6.9%)	460 (6.3%)	354 (8.0%)	71 (6.6%)		244 (5.9%)	641 (7.4%)	
Family	571 (4.5%)	311 (4.3%)	210 (4.7%)	50 (4.7%)		166 (4.0%)	405 (4.7%)	
Refugee	218 (1.7%)	111 (1.5%)	71-76 (1.6-1.7%)	30-35 (2.8-3.3%)		76-81 (1.8-2.0%)	136-141 (1.6%)	
Other	32 (0.3%)	21 (0.3%)	6-11 (0.1-0.2%)	<=5		<=5	27-32 (0.3-0.4%)	

	Total N= 12,781	**Co-morbidity Level**			P value	**Mental Health History**		P value
		0-5 ADGs (low) N= 7,287	**6-9 ADGs (medium)** N= 4,425	**10+ ADGs (high)** N= 1,069		**Yes** N=4,127	**No** N=8,654	
Neighbourhood Income Quintile					0.073			0.09
1 (lowest)	2,020 (15.8%)	1,121 (15.4%)	705 (15.9%)	194 (18.1%)		685 (16.6%)	1,335 (15.4%)	
2	2,384 (18.7%)	1,376 (18.9%)	792 (17.9%)	216 (20.2%)		786 (19.0%)	1,598 (18.5%)	
3	2,523 (19.7%)	1,433 (19.7%)	879-883 (20.0%)	207-211 (19.4-19.7%)		839 (20.3%)	1,684 (19.5%)	
4	2,819 (22.1%)	1,598 (21.9%)	980 (22.1%)	241 (22.5%)		867 (21.0%)	1,952 (22.6%)	
5 (highest)	2,994 (23.4%)	1,733 (23.8%)	1,051 (23.8%)	210 (19.6%)		934 (22.6%)	2,060 (23.8%)	
Unknown	41 (0.3%)	26 (0.4%)	10-15 (0.2-0.3%)	<=5		16 (0.4%)	25 (0.3%)	
Cancer Detection Method								
Screening	2,916 (22.8%)	1,626 (22.3%)	1,054 (23.8%)	236 (22.1%)	0.142	918 (22.2%)	1,998 (23.1%)	0.288
Symptomatic	9,865 (77.2%)	5,661 (77.7%)	3,371 (76.2%)	833 (77.9%)		3,209 (77.8%)	6,656 (76.9%)	
Stage								
Stage I	2,839 (22.2%)	1,564 (21.5%)	1,041 (23.5%)	234 (21.9%)	0.064	941 (22.8%)	1,898 (21.9%)	0.399
Stage II	7,311 (57.2%)	4,191 (57.5%)	2,516 (56.9%)	604 (56.5%)		2,359 (57.2%)	4,952 (57.2%)	
Stage III	2,631 (20.6%)	1,532 (21.0%)	868 (19.6%)	231 (21.6%)		827 (20.0%)	1,804 (20.8%)	
Histological grade								
Well-differentiated	528 (4.1%)	321 (4.4%)	174 (3.9%)	33 (3.1%)	0.334	161 (3.9%)	367 (4.2%)	0.164
Moderately-differentiated	2,468 (19.3%)	1,407 (19.3%)	856 (19.3%)	205 (19.2%)		773 (18.7%)	1,695 (19.6%)	
Poorly-differentiated	3,196 (25.0%)	1,818 (24.9%)	1,124 (25.4%)	254 (23.8%)		1,007 (24.4%)	2,189 (25.3%)	
Unknown	6,589 (51.6%)	3,741 (51.3%)	2,271 (51.3%)	577 (54.0%)		2,186 (53.0%)	4,403 (50.9%)	
Receptor Status					0.063			<0.001
ER+ or PR+ and Her2-	2,930 (22.9%)	1,715 (23.5%)	1,007 (22.8%)	208 (19.5%)		886 (21.5%)	2,044 (23.6%)	
ER+ or PR+ and HER2+	1,107 (8.7%)	626 (8.6%)	396 (8.9%)	85 (8.0%)		317 (7.7%)	790 (9.1%)	
ER- and PR- and Her2+	519 (4.1%)	294 (4.0%)	172 (3.9%)	53 (5.0%)		163 (3.9%)	356 (4.1%)	
ER- and PR- and Her2-	859 (6.7%)	465 (6.4%)	315 (7.1%)	79 (7.4%)		317 (7.7%)	542 (6.3%)	
Unknown	7,366 (57.6%)	4,187 (57.5%)	2,535 (57.3%)	644 (60.2%)		2,444 (59.2%)	4,922 (56.9%)	
Surgery Type								
Lumpectomy	7,645 (59.8%)	4,365 (59.9%)	2,665 (60.2%)	615 (57.5%)	0.407	2,448 (59.3%)	5,197 (60.1%)	0.639
Mastectomy	3,896 (30.5%)	2,234 (30.7%)	1,322 (29.9%)	340 (31.8%)		1,281 (31.0%)	2,615 (30.2%)	
Lumpectomy +Mastectomy	1,240 (9.7%)	688 (9.4%)	438 (9.9%)	114 (10.7%)		398 (9.6%)	842 (9.7%)	
Receipt of Radiation								
Yes	8,652 (67.7%)	5,086 (69.8%)	2,903 (65.6%)	663 (62.0%)	<0.001	2,695 (65.3%)	5,957 (68.8%)	<0.001
Baseline Continuity of Care								
0 visit	800 (6.3%)	788 (10.8%)	7-12 (0.2-0.3%)	<=5	<0.001	18 (0.4%)	782 (9.0%)	<0.001

	Total N= 12,781	**Co-morbidity Level**			P value	**Mental Health History**		P value
		0-5 ADGs (low) N= 7,287	**6-9 ADGs (medium)** N= 4,425	**10+ ADGs (high)** N= 1,069		**Yes** N=4,127	**No** N=8,654	
1-2 visits	1,536 (12.0%)	1,472 (20.2%)	59-64 (1.3-1.4%)	<=5		149 (3.6%)	1,387 (16.0%)	
UPC<=0.75 (low)	3,914 (30.6%)	1,773 (24.3%)	1,661 (37.5%)	480 (44.9%)		1,486 (36.0%)	2,428 (28.1%)	
UPC>0.75 (high)	6,531 (51.1%)	3,254 (44.7%)	2,695 (60.9%)	582 (54.4%)		2,474 (59.9%)	4,057 (46.9%)	
Primary Care Practice Model								
Straight FFS	1,887 (14.8%)	1,193 (16.4%)	568 (12.8%)	126 (11.8%)	<0.001	562 (13.6%)	1,325 (15.3%)	<0.001
Enhanced FFS	6,281 (49.1%)	3,212 (44.1%)	2,394 (54.1%)	675 (63.1%)		2,213 (53.6%)	4,068 (47.0%)	
Capitation	2,235 (17.5%)	1,326 (18.2%)	763 (17.2%)	146 (13.7%)		714 (17.3%)	1,521 (17.6%)	
Team-based capitation	2,206 (17.3%)	1,434 (19.7%)	658 (14.9%)	114 (10.7%)		608 (14.7%)	1,598 (18.5%)	
Other	172 (1.3%)	122 (1.7%)	42 (0.9%)	8 (0.7%)		30 (0.7%)	142 (1.6%)	
Primary Care Enrollment Status								
Rostered	10,900 (85.3%)	6,094 (83.6%)	3,863 (87.3%)	943 (88.2%)	<0.001	3,566 (86.4%)	7,334 (84.7%)	0.013
Not rostered	1,881 (14.7%)	1,193 (16.4%)	562 (12.7%)	126 (11.8%)		561 (13.6%)	1,320 (15.3%)	
LHIN					<0.001			<0.001
1 Erie St. Clair	713 (5.6%)	396 (5.4%)	256 (5.8%)	61 (5.7%)		259 (6.3%)	454 (5.2%)	
2 South West	992 (7.8%)	623 (8.5%)	302 (6.8%)	67 (6.3%)		312 (7.6%)	680 (7.9%)	
3 Waterloo Wellington	654 (5.1%)	436 (6.0%)	188 (4.2%)	30 (2.8%)		180 (4.4%)	474 (5.5%)	
4 Hamilton Niagara Haldimand Brant	1,468 (11.5%)	906 (12.4%)	471 (10.6%)	91 (8.5%)		454 (11.0%)	1,014 (11.7%)	
5 Central West	543 (4.2%)	248 (3.4%)	226 (5.1%)	69 (6.5%)		180 (4.4%)	363 (4.2%)	
6 Mississauga Halton	750 (5.9%)	393 (5.4%)	273 (6.2%)	84 (7.9%)		226 (5.5%)	524 (6.1%)	
7 Toronto Central	1,061 (8.3%)	554 (7.6%)	405 (9.2%)	102 (9.5%)		398 (9.6%)	663 (7.7%)	
8 Central	1,784 (14.0%)	886 (12.2%)	712 (16.1%)	186 (17.4%)		550 (13.3%)	1,234 (14.3%)	
9 Central East	1,710 (13.4%)	923 (12.7%)	615 (13.9%)	172 (16.1%)		570 (13.8%)	1,140 (13.2%)	
10 South East	520 (4.1%)	349 (4.8%)	137 (3.1%)	34 (3.2%)		139 (3.4%)	381 (4.4%)	
11 Champlain	1,335 (10.4%)	784 (10.8%)	453 (10.2%)	98 (9.2%)		460 (11.1%)	875 (10.1%)	
12 North Simcoe Muskoka	518-522 (4.1%)	325-329 (4.5%)	170-174 (3.8-3.9%)	14-18 (1.3-1.7%)		177-181 (4.3-4.4%)	338-342 (3.9-4.0%)	
13 North East	478 (3.7%)	301 (4.1%)	146 (3.3%)	31 (2.9%)		157 (3.8%)	321 (3.7%)	
14 North West	252 (2.0%)	157 (2.2%)	69 (1.6%)	26 (2.4%)		62 (1.5%)	190 (2.2%)	
Unknown	<=5	<=5	<=5	<=5		<=5	<=5	
History of mental health visits at baseline	4,127 (32.3%)	1,730 (23.7%)	1,810 (40.9%)	587 (54.9%)	<0.001			
Physical ADGs								
0-5	7,287 (57.01%)					1,730 (41.9%)	5,557 (64.2%)	<0.001
6-9	4,425 (34.62%)					1,810 (43.9%)	2,615 (30.2%)	
10+	1,069 (8.36%)					587 (14.2%)	482 (5.6%)	

*Long-term residents: Canadian-born citizens and immigrants arriving to Canada prior to 1985.

**Proportions of immigrant characteristics taken from entire cohort (n=12,781).

6.2.2. Mean number of PCP visits by cohort characteristics

The mean number of PCP visits per month is displayed in figure 6-2. The mean number of PCP visits during the baseline period was 0.39 visits per month (2.34 visits per 6 month period), which remained fairly consistent throughout the entire baseline period. The mean number of PCP visits per month started to increase in the 3 months prior to diagnosis with most patients having at least one PCP visit in the month prior to diagnosis (mean 1.04 visits per month in month prior to diagnosis). This pattern was similar in those who were diagnosed by screening versus by symptoms with the exception that those whose breast cancer was detected through screening had slightly fewer, although still increased, PCP visits during the one month prior to diagnosis (mean 0.82 visits per month if screen-detected and 1.1 visits per month if symptom-detected). Between the diagnosis date and the start of adjuvant chemotherapy (median interval length 91 days), patients visited their PCPs an average of 0.85 times per month. During the treatment period, patients visited their PCPs an average of 0.56 times per month (3.36 visits per 6 month period), which was elevated compared to their baseline rate.

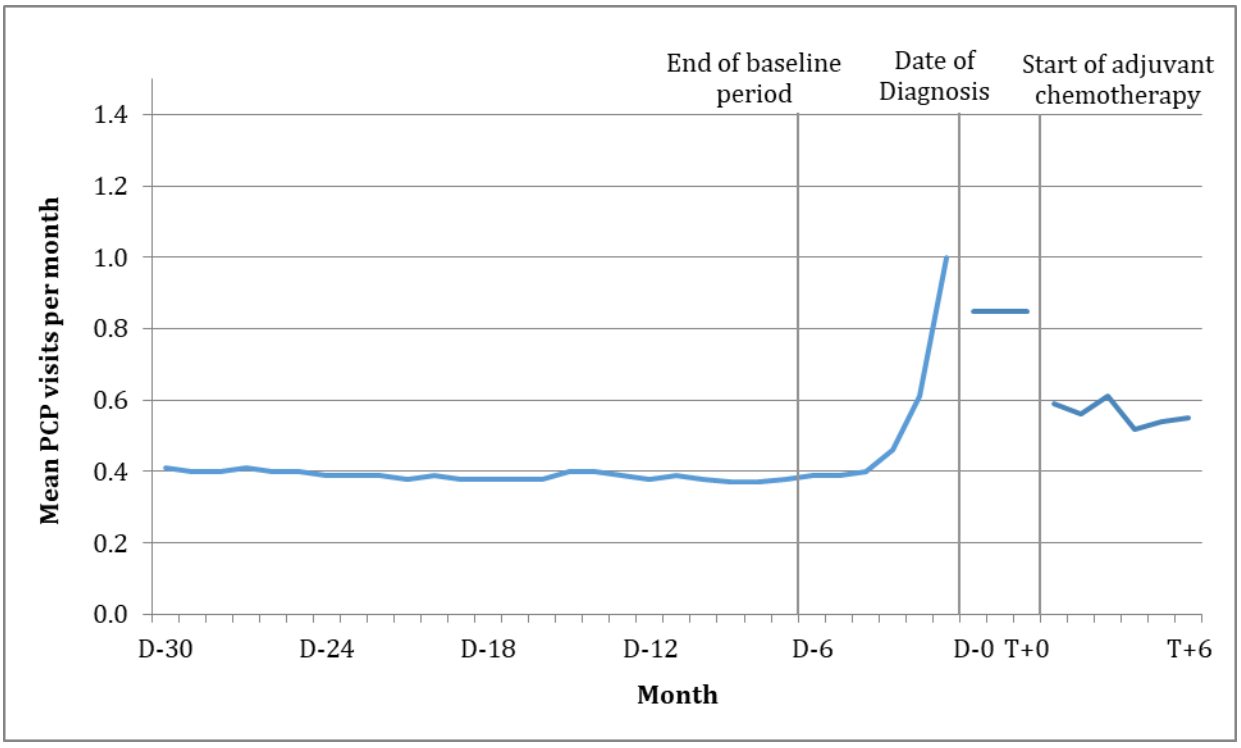

Figure 6-2. Mean PCP visits per month prior to diagnosis and during adjuvant chemotherapy
D[n]=number of months prior to diagnosis date
T[n]=number of months from start of adjuvant chemotherapy
Median number of days between date of diagnosis and start of adjuvant chemotherapy=91 days.

The PCP visit rates over 6 months during the baseline and treatment periods as well as the change in rates are shown in table 6-2. PCP visits increased from baseline to treatment periods across all groups of baseline characteristics (mean increase of 1 PCP visit over 6 months in whole cohort) except for the few (<5) patients with unknown LHIN (increase of -0.1 PCP visits per 6 months). There were 247 patients who had no PCP visits in either the baseline or treatment periods. The greatest increases in PCP visit rates from baseline to treatment occurred in those with <3 PCP visits at baseline, those living in remote or very remote rural locations and those in the South West, Champlain and North West LHINs (mean increase of 1.8-2.5 PCP visits per 6 months). The lowest increases in PCP visit rates from baseline to treatment occurred in those from Central West, Mississauga Halton and Toronto Central LHINs as well as immigrants from South Asia (mean increase of 0.21-0.47 PCP visits over 6 months). Patients over 70 years old had more PCP visits during both baseline and treatment periods (mean 3.0-3.1 visits over 6 months at baseline and 4.2-4.4 visits over 6 month during treatment) compared to other age groups; however there were no age differences in the change of rates from baseline to treatment. Patients not enrolled in primary care models had fewer PCP visits during the baseline and treatment periods (mean 2.1 and 3.2 visits per 6 months, respectively), but showed no difference in change in rates. Patients enrolled in enhanced FFS primary care models had the greatest number of visits during the baseline and treatment periods (mean 2.7 and 3.6 visits per 6 months, respectively), but the largest increase in rates was seen in patients enrolled in team-base capitation models (mean increase of 1.5 visits per 6 months). Among the surgery types, those who received mastectomies had the greatest number of PCP visits during the treatment period (mean 3.6 visits over 6 months) and had the greatest increase in number of PCP visits (mean increase of 1.2 visits over 6 months). PCP rates and change in rates did not differ by cancer detection method nor by stage.

Table 6-2. Baseline characteristics according to PCP visits (per 6 month period)

	Total N= 12,781	**Mean (SD)/4 baseline PCP visits**	**P value**	**Mean (SD) treatment PCP visits**	**P value**	**Difference (treatment – baseline) Mean (SD)**	**P value**
Total		2.3 (2.5)		3.4 (3.4)		1 (3.3)	
Age (Categorical)			<0.0001		<0.0001		0.3662
<40	1,102 (8.6%)	2.2 (2.2)		3 (3.7)		0.87 (3.6)	
40-49	3,481 (27.2%)	2.1 (2.3)		3.1 (3.1)		1 (3.1)	
50-59	4,225 (33.1%)	2.3 (2.6)		3.3 (3.1)		1 (3.2)	
60-69	3,045 (23.8%)	2.5 (2.5)		3.6 (3.4)		1 (3.4)	
70-74	607 (4.7%)	3.1 (2.6)		4.2 (3.8)		1 (3.3)	
>74	321 (2.5%)	3 (2.7)		4.4 (4.9)		1.3 (4.8)	
Urban/rural Residence			<0.0001		<0.0001		<0.0001
Urban	11,189 (87.5%)	2.4 (2.5)		3.3 (3.3)		0.89 (3.2)	
Rural	699 (5.5%)	2 (2.2)		3.5 (3.6)		1.5 (3.7)	

	Total N= 12,781	**Mean (SD)/4 baseline PCP visits**	**P value**	**Mean (SD) treatment PCP visits**	**P value**	**Difference (treatment – baseline) Mean (SD)**	**P value**
Rural-remote	596 (4.7%)	1.7 (1.7)		3.5 (3.8)		1.8 (3.8)	
Rural-very remote	292-297 (2.3%)	1.7 (1.9)		4.7 (4.2)		2.9 (4.3)	
Rural-unknown	<=5	*		*		*	
Unknown	<=5	*		*		*	
Immigration Status			0.0439		0.2578		0.0079
Long-term residents	11,075 (86.7%)	2.3 (2.5)		3.4 (3.4)		1 (3.3)	
Immigrants	1,706 (13.3%)	2.5 (2.2)		3.3 (3.1)		0.82 (3.1)	
Immigrant Characteristics							
Region of Origin			<0.0001		0.0531		0.0290
East Asia & Pacific	544 (4.3%)	2.5 (2.3)		3.2 (3.1)		0.73 (3.2)	
Eastern Europe & Central Asia	286 (2.2%)	1.8 (1.9)		2.9 (3.2)		1.1 (3)	
Latin America & Caribbean	239 (1.9%)	2.6 (2.1)		3.4 (3.2)		0.76 (3.2)	
Middle East & North Africa	145 (1.1%)	2.6 (2)		3.7 (3.2)		1.2 (3.1)	
South Asia	270 (2.1%)	3.1 (2.2)		3.4 (3.1)		0.34 (3.1)	
Sub-Saharan Africa	87 (0.7%)	2.3 (1.9)		3.8 (2.9)		1.5 (2.8)	
USA/New Zealand/Australia	37 (0.3%)	1.3 (0.85)		2.4 (2.5)		1.1 (2.7)	
Western Europe	98 (0.8%)	2.3 (2.2)		3.1 (2.8)		0.8 (2.9)	
Years since Arrival			<0.0001		0.3055		0.0020
<10y	618 (4.8%)	2 (1.9)		3.2 (3.1)		1.1 (3.1)	
>=10y	1,088 (8.5%)	2.7 (2.3)		3.3 (3.1)		0.65 (3.1)	
Immigrant Class			0.1216		0.7962		0.1225
Economic	885 (6.9%)	2.4 (2)		3.3 (3.3)		0.89 (3.1)	
Family	571 (4.5%)	2.5 (2.4)		3.2 (3.1)		0.77 (3.2)	
Refugee	218 (1.7%)	2.6 (2.3)		3.1 (2.6)		0.51 (2.6)	
Other	32 (0.3%)	1.6 (1.6)		3.4 (3.4)		1.8 (3.1)	
Neighbourhood Income Quintile			0.0028		<0.0001		0.2246
1 (lowest)	2,020 (15.8%)	2.4 (2.3)		3.5 (3.6)		1.1 (3.5)	
2	2,384 (18.7%)	2.3 (2.4)		3.5 (3.4)		1.1 (3.3)	
3	2,523 (19.7%)	2.4 (2.5)		3.5 (3.3)		1 (3.2)	
4	2,819 (22.1%)	2.3 (2.4)		3.4 (3.3)		1 (3.3)	
5 (highest)	2,994 (23.4%)	2.2 (2.7)		3.1 (3.3)		0.91 (3.3)	
Unknown	41 (0.3%)	2.2 (1.5)		3.9 (3.5)		1.7 (3.2)	
Cancer Detection Method			0.5976		0.4014		0.6489
Screening	2,916 (22.8%)	2.3 (2.4)		3.3 (3.1)		0.99 (3.1)	
Symptomatic	9,865 (77.2%)	2.3 (2.5)		3.4 (3.4)		1 (3.4)	
Stage			0.7891		0.8486		0.5796
Stage I	2,839 (22.2%)	2.3 (2.2)		3.4 (3.2)		1.1 (3.2)	
Stage II	7,311 (57.2%)	2.4 (2.4)		3.3 (3.3)		0.99 (3.2)	
Stage III	2,631 (20.6%)	2.3 (2.9)		3.4 (3.7)		1 (3.7)	
Histological grade			0.0054		<0.0001		<0.0001
Well-differentiated	528 (4.1%)	2 (2)		3.3 (3.1)		1.2 (2.7)	
Moderately-differentiated	2,468 (19.3%)	2.3 (2.3)		3.1 (3)		0.85 (2.9)	
Poorly-differentiated	3,196 (25.0%)	2.3 (2.5)		3.2 (3.3)		0.85 (3.4)	
Unknown	6,589 (51.6%)	2.4 (2.6)		3.5 (3.5)		1.1 (3.5)	
Receptor Status			0.0219		0.8880		0.1251
ER+ or PR+ and Her2-	2,930 (22.9%)	2.2 (2.4)		3.1 (3.1)		0.92 (3.1)	
ER+ or PR+ and HER2+	1,107 (8.7%)	2.3 (2.2)		3.2 (3.3)		0.95 (3.2)	
ER- and PR- and Her2+	519 (4.1%)	2.5 (2.7)		3.1 (3.3)		0.63 (3.3)	
ER- and PR- and Her2-	859 (6.7%)	2.4 (2)		3.1 (3.2)		0.76 (3.1)	
Unknown	7,366 (57.6%)	2.4 (2.6)		3.5 (3.5)		1.1 (3.4)	

	Total N= 12,781	**Mean (SD)/4 baseline PCP visits**	**P value**	**Mean (SD) treatment PCP visits**	**P value**	**Difference (treatment – baseline) Mean (SD)**	**P value**
Surgery Type			0.4995		<0.0001		0.0002
Lumpectomy	7,645 (59.8%)	2.3 (2.3)		3.2 (3.3)		0.92 (3.2)	
Mastectomy	3,896 (30.5%)	2.4 (2.8)		3.6 (3.5)		1.2 (3.4)	
Lump + mastectomy	1,240 (9.7%)	2.4 (2.4)		3.5 (3.4)		1 (3.4)	
Receipt of Radiation			<0.0001		<0.0001		<0.0001
Yes	8,652 (67.7%)	2.3 (2.4)		3.2 (3.2)		0.92 (3.1)	
No	4129 (32.3%)	2.5 (2.7)		3.7 (3.7)		1.2 (3.7)	
Baseline Continuity of Care			<0.0001		<0.0001		<0.0001
0 visit	800 (6.3%)	0 (0)		2.1 (2.7)		2.1 (2.7)	
1-2 visits	1,536 (12.0%)	0.39 (0.12)		2.1 (2.4)		1.8 (2.4)	
UPC<=0.75 (low)	3,914 (30.6%)	2.8 (2.5)		3.6 (3.5)		0.74 (3.6)	
UPC>0.75 (high)	6,531 (51.1%)	2.8 (2.5)		3.7 (3.4)		0.88 (3.3)	
Primary Care Practice Model			<0.0001		<0.0001		<0.0001
Straight FFS	1,887 (14.8%)	2.1 (2.7)		3.2 (3.4)		1.1 (3.4)	
Enhanced FFS	6,281 (49.1%)	2.7 (2.7)		3.6 (3.4)		0.88 (3.3)	
Capitation	2,235 (17.5%)	2.1 (2.1)		3 (3.1)		0.85 (3.1)	
Team-based capitation	2,206 (17.3%)	1.7 (1.9)		3.2 (3.3)		1.5 (3.4)	
Other	172 (1.3%)	1.3 (1.6)		2.4 (3.2)		1.1 (3)	
Primary Care Enrollment Status			<0.0001		0.0316		0.2449
Rostered	10,900 (85.3%)	2.4 (2.4)		3.4 (3.3)		1 (3.3)	
Not rostered	1,881 (14.7%)	2.1 (2.7)		3.2 (3.4)		1.1 (3.4)	
LHIN			<0.0001		<0.0001		<0.0001
1 Erie St. Clair	713 (5.6%)	2.4 (2.5)		3.4 (3.7)		1.1 (3.5)	
2 South West	992 (7.8%)	2.1 (2)		3.8 (3.2)		1.8 (3.2)	
3 Waterloo Wellington	654 (5.1%)	1.7 (1.8)		2.7 (3)		1 (2.7)	
4 Hamilton Niagara Haldimand Brant	1,468 (11.5%)	2.1 (2.2)		3.5 (3.1)		1.4 (3)	
5 Central West	543 (4.2%)	3 (2.4)		3.5 (3.1)		0.46 (3.1)	
6 Mississauga Halton	750 (5.9%)	2.6 (2.4)		2.8 (3.1)		0.21 (3)	
7 Toronto Central	1,061 (8.3%)	2.5 (3.2)		3 (3.3)		0.47 (3.2)	
8 Central	1,784 (14.0%)	2.7 (2.7)		3.2 (3)		0.52 (3.3)	
9 Central East	1,710 (13.4%)	2.6 (2.4)		3.4 (3.5)		0.85 (3.4)	
10 South East	520 (4.1%)	2 (2.1)		3.1 (3.5)		1.2 (3.5)	
11 Champlain	1,335 (10.4%)	2.1 (2.6)		3.9 (3.3)		1.8 (2.9)	
12 North Simcoe Muskoka	518-522 (4.1%)	2.3 (2.9)		3 (2.7)		0.7 (3.5)	
13 North East	478 (3.7%)	2 (1.9)		3.1 (3.9)		1.1 (3.6)	
14 North West	252 (2.0%)	1.9 (1.8)		4.4 (5.6)		2.5 (5.6)	
Unknown	<=5	*		*		*	

*Values suppressed due to small cells

Within the immigrant population, those from USA/New Zealand/Australia had the fewest PCP visits and those from South Asia had the highest number of PCP visits at baseline (mean 1.3 and 3.1 visits per 6 months, respectively; table 6-2). Those from Sub-Saharan Africa showed the greatest increase in rates and those from South Asia showed the lowest increase in rates (mean increase of 1.5 and 0.34 visits per 6 months, respectively). Those who arrived less than 10 years prior to diagnosis had a lower number of PCP visits at baseline (mean 2.0 visits per 6 months) and showed a greater increase in rate (mean increase of 1.1 visits per 6 months).

Immigrant class was not associated with the number of PCP visits during any period nor with the change in PCP visit rate.

6.2.3. Characteristics of physician visits

Number of physician visits by specialty during the baseline and treatment intervals are listed in table 6-3. While those who visited their PCP at least one time decreased from the baseline period to the treatment period (93.74% versus 84.97%), the mean number of visits to PCPs per 6 month period increased from 2.3 visits per 6 months during the baseline period to 3.4 visits per 6 months during the treatment period. Patients visited oncologists an average of 10.5 times during the 6 month treatment period and other specialists an average of 1.1 times. During the baseline period, the most visited other specialties included obstetrics & gynecology, psychiatry, ophthalmology, general surgery and orthopedic surgery. During the treatment period, the most visited other specialties included psychiatry, obstetrics & gynecology, ophthalmology, plastic surgery and cardiology. The number of patients with at least one visit to a specialist increased during the treatment period for the following specialties: hematology, psychiatry, diagnostic radiology, anatomical pathology, gynecologic oncology, infectious diseases, medical genetics, general pathology, medical biochemistry, nuclear medicine and medical, radiation and surgical oncology.

Table 6-3. Mean number of physician visits by specialty during the baseline and treatment intervals

Physician Specialty **N=12,781**	**Number of Visits during the 24 month Baseline period*** ***Mean (SD)***	**Number of Visits during the 6 month Treatment period**** ***Mean (SD)***
Primary Care	9.36 (9.93)	3.36 (3.36)
Oncology	0.03 (0.38)	10.46 (4.59)
Medical	0.01 (0.27)	6.00 (3.73)
Radiation	0.01 (0.27)	3.39 (2.42)
Surgical	N/A	1.06 (1.56)
Other specialties	4.21 (7.20)	1.09 (2.03)
Psychiatry	0.53 (4.15)	0.17 (1.14)
Obstetrics & Gynecology	0.69 (2.59)	0.11 (0.63)
Ophthalmology	0.42 (1.73)	0.09 (0.47)
General Surgery	0.32 (1.00)	0.01 (0.15)
Orthopedic Surgery	0.29 (1.19)	0.03 (0.27)
Plastic Surgery	0.10 (0.65)	0.08 (0.56)
Cardiology	0.13 (0.75)	0.07 (0.44)

* Baseline period = the 6 to 30 months prior to diagnosis (i.e. a 24-month period)
** Treatment period = the 6 months starting from the start of adjuvant chemotherapy

Patients were seen by their PCPs during the baseline and treatment periods for a variety of reasons (table 6-4). Prior to their breast cancer diagnosis, patients most often went to their PCP for the following reasons: hypertension, anxiety, annual health examinations, upper respiratory tract infections and diabetes. During adjuvant chemotherapy, patients most often saw their PCP for breast cancer-related concerns, with other reasons remaining similar to their pre-diagnosis visits. Although males were excluded from the cohort, 1.84% of PCP visits during the treatment period had an associated diagnostic code of male breast cancer. Breast-cancer related concerns (diagnostic codes of female breast cancer, other malignant neoplasm, breast/genitourinary carcinoma in situ, adverse medication/drug effects or male breast cancer) made up 39.64% of PCP visits during the treatment period. Adding anxiety as a breast-cancer related concern increased this proportion to 45.92%.

Table 6-4. Top 10 diagnostic codes for PCPs during baseline and treatment periods

Rank	PCP Visits (Baseline period)		PCP Visits (Treatment period)	
	Dx code	**N (%)**	**Dx code**	**N (%)**
Total		119294		42748
1	Hypertension	10951 (9.18%)	Breast cancer (Female)	14097 (32.98%)
2	Anxiety	8533 (7.15%)	Anxiety	2686 (6.28%)
3	Annual health examination	5606 (4.70%)	Hypertension	1757 (4.11%)
4	Common cold	4844 (4.06%)	Other ill-defined conditions, general symptoms	1429 (3.34%)
5	Diabetes	4696 (3.94%)	Common cold	1301 (3.04%)
6	Join pain, swelling, masses; muscle pain	3804 (3.19%)	No diagnosis*	1182 (2.77%)
7	Hypercholesterolemia	3661 (3.07%)	Cancer, multiple sites, other malignant neoplasms	1006 (2.35%)
8	Other ill-defined conditions, general symptoms	3410 (2.86%)	Diabetes	978 (2.29%)
9	Abdominal pain, nausea and vomiting, general digestive symptoms	3261 (2.73%)	Breast cancer (male)	785 (1.84%)
10	Osteoarthritis	2678 (2.24%)	Abdominal pain, nausea and vomiting, general digestive symptoms	763 (1.78%)

* 90% of PCP visits with no diagnosis code during treatment were billed with monthly long-term anticoagulant supervision by telephone, completion of northern health travel grant application form, routine urinalysis and pre-operative assessment fee codes.

Figure 6-3 shows the percentage of breast cancer-related, anxiety and other PCP visits during the treatment phase by physical and mental comorbidity groups. Patients in the low physical comorbidity group had the highest proportion of breast cancer-related PCP visits during the treatment phase at 45.9% or 51.6% if anxiety-related visits are included. This proportion decreases to 28.8% among the high physical comorbidity group or 35.7% if anxiety-related visits are included. Patients with a MH history had a higher proportion of anxiety-related visits during the treatment phase and a lower proportion of breast cancer-related visits. However, if you include anxiety as a breast cancer-related concern, the percentage of visits for breast cancer-related concerns becomes similar among those with and without a MH history.

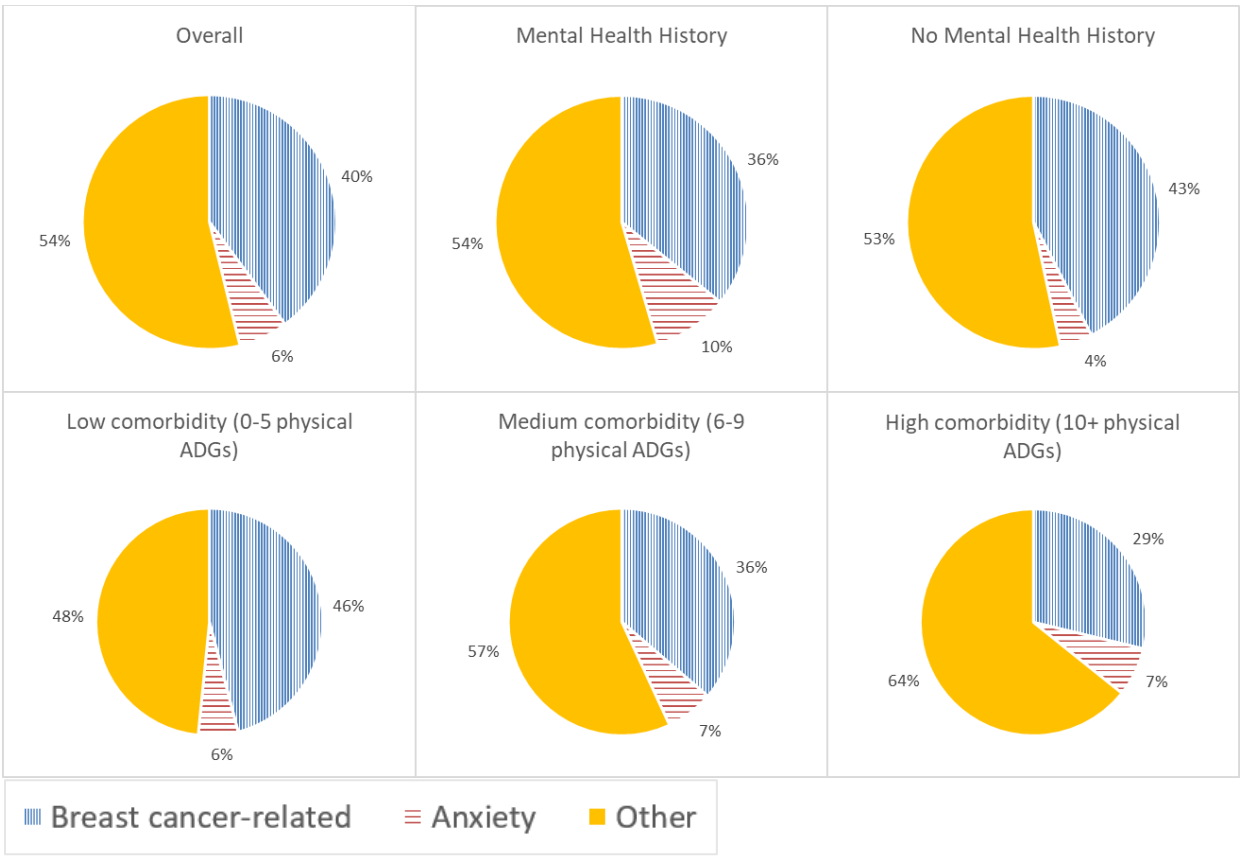

Figure 6-3. Percentage of breast cancer-related, anxiety and other PCP visits during adjuvant breast cancer chemotherapy by physical comorbidity and mental health groups

Breast-cancer related diagnostic codes include female breast cancer, other malignant neoplasm, breast/genitourinary carcinoma in situ, adverse medication/drug effects or male breast cancer.

Note: No one diagnostic code in the “other” category was associated with >5% of total PCP visits

6.2.4. Characteristics according to baseline continuity of care

The characteristics of the continuity of care groups for those with 3 or more PCP visits during the baseline period are listed in table 6-5. Since the UPC index for continuity of care could not be calculated for those with fewer than 3 PCP visits at baseline, we included the characteristics for patients with 0 or 1-2 PCP visits at baseline separately in table 6-5. Those with no visits during the baseline period were more likely to be in the 50-59 year old age group, to live in remote rural locations, to be in the lowest two income quintiles, to have lower comorbidity scores, to have no history of MH visits in primary care, to not be enrolled in a primary care enrollment model, to live in the North East LHIN, to be diagnosed with stage II or III disease and to receive mastectomy. Those with low continuity of care were more likely to be less than 40 years old, to live in urban areas, to be immigrants, to have a higher number of

comorbidities, to live in Mississauga Halton, Toronto Central or Central LHINs, to have initially presented with symptoms and to be diagnosed with ER/PR/HER2 positive cancers. High continuity of care was associated with age over 60 years, being rostered to a primary care model, screen-detected cancers and living in Central East LHIN.

In the immigrant group, those with no visits during the baseline period were more likely to be from Eastern Europe & Central Asia and Middle East & North Africa, to have arrived less than 10 years prior to diagnosis and to be family class immigrants. Immigrants with low continuity of care were more likely to be from East Asia & Pacific, Latin America & Caribbean and South Asia, to have been in Canada for greater than 10 years at the time of diagnosis and to be refugee-class immigrants.

Table 6-5. Baseline characteristics according to continuity of care at baseline

	Total N=12,781	**Baseline Continuity of Care**				P value
		0 visit	**1-2 visits**	**UPC≤0.75 (low)**	**UPC>0.75 (high)**	
Total		800 (100%)	1,536 (100%)	3,914 (100%)	6,531 (100%)	
Age (Categorical)						
<40	1,102 (8.6%)	69 (8.6%)	142 (9.2%)	457 (11.7%)	434 (6.6%)	<.001
40-49	3,481 (27.2%)	226 (28.3%)	499 (32.5%)	1,237 (31.6%)	1,519 (23.3%)	
50-59	4,225 (33.1%)	302 (37.8%)	533 (34.7%)	1,251 (32.0%)	2,139 (32.8%)	
60-69	3,045 (23.8%)	176 (22.0%)	309 (20.1%)	779 (19.9%)	1,781 (27.3%)	
70-74	607 (4.7%)	15 (1.9%)	37 (2.4%)	126 (3.2%)	429 (6.6%)	
>74	321 (2.5%)	12 (1.5%)	16 (1.0%)	64 (1.6%)	229 (3.5%)	
Urban/rural Residence						
Urban	11,189 (87.5%)	664 (83.0%)	1,283 (83.5%)	3,549 (90.7%)	5,693 (87.2%)	<.001
Rural	699 (5.5%)	45 (5.6%)	108 (7.0%)	149 (3.8%)	397 (6.1%)	
Rural-remote	596 (4.7%)	62 (7.8%)	94 (6.1%)	119 (3.0%)	321 (4.9%)	
Rural-very remote	292-297 (2.3%)	25-30 (3.1-3.8%)	50-55 (3.3-3.6%)	93-98 (2.4-2.5%)	115-120 (1.8%)	
Rural-unknown	<=5	<=5	<=5	<=5	<=5	
Unknown	<=5	<=5	<=5	<=5	<=5	
Immigration Status						
Long-term residents	11,075 (86.7%)	681 (85.1%)	1,373 (89.4%)	3,281 (83.8%)	5,740 (87.9%)	<.001
Immigrants	1,706 (13.3%)	119 (14.9%)	163 (10.6%)	633 (16.2%)	791 (12.1%)	
Immigrant Characteristics						
Region of Origin						
East Asia & Pacific	544 (4.3%)	34 (4.3%)	51 (3.3%)	191 (4.9%)	268 (4.1%)	<.001
Eastern Europe & Central Asia	286 (2.2%)	29 (3.6%)	43 (2.8%)	96 (2.5%)	118 (1.8%)	
Latin America & Caribbean	239 (1.9%)	13 (1.6%)	16 (1.0%)	94 (2.4%)	116 (1.8%)	
Middle East & North Africa	145 (1.1%)	16 (2.0%)	6 (0.4%)	55 (1.4%)	68 (1.0%)	
South Asia	270 (2.1%)	12 (1.5%)	16 (1.0%)	111 (2.8%)	131 (2.0%)	
Sub-Saharan Africa	87 (0.7%)	3-7 (0.4-0.9%)	6-10 (0.4-0.7%)	44 (1.1%)	30 (0.5%)	
USA/New Zealand/Australia	37 (0.3%)	<=5	5-9 (0.3-0.6%)	14 (0.4%)	12 (0.2%)	
Western Europe	98 (0.8%)	6 (0.8%)	16 (1.0%)	28 (0.7%)	48 (0.7%)	
Years since Arrival						
<10y	618 (4.8%)	74 (9.3%)	65 (4.2%)	242 (6.2%)	237 (3.6%)	<.001
>=10y	1,088 (8.5%)	45 (5.6%)	98 (6.4%)	391 (10.0%)	554 (8.5%)	
Immigrant Class						
Economic	885 (6.9%)	49 (6.1%)	84 (5.5%)	349 (8.9%)	403 (6.2%)	<.001
Family	571 (4.5%)	47 (5.9%)	58 (3.8%)	180 (4.6%)	286 (4.4%)	

	Total N=12,781	Baseline Continuity of Care				P value
		0 visit	**1-2 visits**	**UPC≤0.75 (low)**	**UPC>0.75 (high)**	
Refugee	218 (1.7%)	16-20 (2.0-2.5%)	12-18 (0.8-1.2%)	95 (2.4%)	89 (1.4%)	
Other	32 (0.3%)	5-10 (0.6-1.3%)	<=5	9 (0.2%)	13 (0.2%)	
Neighbourhood Income Quintile						
1 (lowest)	2,020 (15.8%)	150 (18.8%)	227 (14.8%)	597 (15.3%)	1,046 (16.0%)	<.001
2	2,384 (18.7%)	191 (23.9%)	276 (18.0%)	696 (17.8%)	1,221 (18.7%)	
3	2,523 (19.7%)	140-144 (17.5-18.0%)	274-278 (17.8-18.1%)	807 (20.6%)	1,298 (19.9%)	
4	2,819 (22.1%)	153 (19.1%)	351 (22.9%)	873 (22.3%)	1,442 (22.1%)	
5 (highest)	2,994 (23.4%)	160 (20.0%)	401 (26.1%)	928 (23.7%)	1,505 (23.0%)	
Unknown	41 (0.3%)	<=5	<=5	13 (0.3%)	19 (0.3%)	
Comorbidity Burden						
0-5 ADGs	7,287 (57.0%)	788 (98.5%)	1,472 (95.8%)	1,773 (45.3%)	3,254 (49.8%)	<.001
6-9 ADGs	4,425 (34.6%)	10-14 (1.3-1.8%)	55-59 (3.6-3.8%)	1,661 (42.4%)	2,695 (41.3%)	
10+ ADGs	1,069 (8.4%)	<=5	<=5	480 (12.3%)	582 (8.9%)	
History of Mental Health Visits						
Yes	4,127 (32.3%)	18 (2.3%)	149 (9.7%)	1,486 (38.0%)	2,474 (37.9%)	<.001
Cancer Detection Method						
Screening	2,916 (22.8%)	164 (20.5%)	328 (21.4%)	776 (19.8%)	1,648 (25.2%)	<.001
Symptomatic	9,865 (77.2%)	636 (79.5%)	1,208 (78.6%)	3,138 (80.2%)	4,883 (74.8%)	
Stage						
Stage I	2,839 (22.2%)	140 (17.5%)	328 (21.4%)	886 (22.6%)	1,485 (22.7%)	0.017
Stage II	7,311 (57.2%)	470 (58.8%)	889 (57.9%)	2,251 (57.5%)	3,701 (56.7%)	
Stage III	2,631 (20.6%)	190 (23.8%)	319 (20.8%)	777 (19.9%)	1,345 (20.6%)	
Histological grade						
Well-differentiated	528 (4.1%)	42 (5.3%)	82 (5.3%)	152 (3.9%)	252 (3.9%)	0.025
Moderately-differentiated	2,468 (19.3%)	155 (19.4%)	293 (19.1%)	763 (19.5%)	1,257 (19.2%)	
Poorly-differentiated	3,196 (25.0%)	203 (25.4%)	376 (24.5%)	1,038 (26.5%)	1,579 (24.2%)	
Unknown	6,589 (51.6%)	400 (50.0%)	785 (51.1%)	1,961 (50.1%)	3,443 (52.7%)	
Receptor Status						
ER+ or PR+ and Her2-	2,930 (22.9%)	194 (24.3%)	383 (24.9%)	920 (23.5%)	1,433 (21.9%)	0.037
ER+ or PR+ and HER2+	1,107 (8.7%)	69 (8.6%)	125 (8.1%)	362 (9.2%)	551 (8.4%)	
ER- and PR- and Her2+	519 (4.1%)	32 (4.0%)	52 (3.4%)	176 (4.5%)	259 (4.0%)	
ER- and PR- and Her2-	859 (6.7%)	42 (5.3%)	97 (6.3%)	282 (7.2%)	438 (6.7%)	
Unknown	7,366 (57.6%)	463 (57.9%)	879 (57.2%)	2,174 (55.5%)	3,850 (58.9%)	
Surgery Type						
Lumpectomy	7,645 (59.8%)	447 (55.9%)	921 (60.0%)	2,382 (60.9%)	3,895 (59.6%)	0.032
Mastectomy	3,896 (30.5%)	283 (35.4%)	458 (29.8%)	1,179 (30.1%)	1,976 (30.3%)	
Lumpectomy + Mastectomy	1,240 (9.7%)	70 (8.8%)	157 (10.2%)	353 (9.0%)	660 (10.1%)	
Receipt of Radiation						
Yes	8,652 (67.7%)	549 (68.6%)	1,095 (71.3%)	2,621 (67.0%)	4,387 (67.2%)	0.011
No						
Primary Care Practice Model						
Straight FFS	1,887 (14.8%)	301 (37.6%)	277 (18.0%)	542 (13.8%)	767 (11.7%)	<.001
Enhanced FFS	6,281 (49.1%)	228 (28.5%)	553 (36.0%)	2,036 (52.0%)	3,464 (53.0%)	
Capitation	2,235 (17.5%)	110 (13.8%)	303 (19.7%)	654 (16.7%)	1,168 (17.9%)	
Team-based capitation	2,206 (17.3%)	123 (15.4%)	369 (24.0%)	642 (16.4%)	1,072 (16.4%)	
Other	172 (1.3%)	38 (4.8%)	34 (2.2%)	40 (1.0%)	60 (0.9%)	
Primary Care Enrollment Status						
Rostered	10,900 (85.3%)	499 (62.4%)	1,259 (82.0%)	3,373 (86.2%)	5,769 (88.3%)	<.001
Not rostered	1,881 (14.7%)	301 (37.6%)	277 (18.0%)	541 (13.8%)	762 (11.7%)	
LHIN						
1 Erie St. Clair	713 (5.6%)	47 (5.9%)	88 (5.7%)	221 (5.6%)	357 (5.5%)	<.001
2 South West	992 (7.8%)	55 (6.9%)	145 (9.4%)	242 (6.2%)	550 (8.4%)	
3 Waterloo Wellington	654 (5.1%)	59 (7.4%)	125 (8.1%)	140 (3.6%)	330 (5.1%)	

	Total N=12,781	Baseline Continuity of Care				P value
		0 visit	**1-2 visits**	**UPC≤0.75 (low)**	**UPC>0.75 (high)**	
4 Hamilton Niagara Haldimand Brant	1,468 (11.5%)	101 (12.6%)	198 (12.9%)	413 (10.6%)	756 (11.6%)	
5 Central West	543 (4.2%)	25 (3.1%)	30 (2.0%)	197 (5.0%)	291 (4.5%)	
6 Mississauga Halton	750 (5.9%)	47 (5.9%)	67 (4.4%)	280 (7.2%)	356 (5.5%)	
7 Toronto Central	1,061 (8.3%)	65 (8.1%)	121 (7.9%)	357 (9.1%)	518 (7.9%)	
8 Central	1,784 (14.0%)	72 (9.0%)	152 (9.9%)	626 (16.0%)	934 (14.3%)	
9 Central East	1,710 (13.4%)	90 (11.3%)	177 (11.5%)	495 (12.6%)	948 (14.5%)	
10 South East	520 (4.1%)	49 (6.1%)	81 (5.3%)	125 (3.2%)	265 (4.1%)	
11 Champlain	1,335 (10.4%)	108 (13.5%)	183 (11.9%)	444 (11.3%)	600 (9.2%)	
12 North Simcoe Muskoka	518-522 (4.1%)	12-16 (1.5-2.0%)	70-74 (4.6-4.8%)	165-169 (4.2-4.3%)	266-270 (4.1%)	
13 North East	478 (3.7%)	44 (5.5%)	64 (4.2%)	129 (3.3%)	241 (3.7%)	
14 North West	252 (2.0%)	24 (3.0%)	34 (2.2%)	78 (2.0%)	116 (1.8%)	
Unknown	<=5	<=5	<=5	<=5	<=5	

6.2.5. Characteristics according to various intervals along the breast cancer care pathway

The median overall interval from index contact date to start of adjuvant chemotherapy was 125 days in the screened group and 127 in the symptomatic group (table 6-6). This median interval was longer in those over 74 years by 7-12 days and shorter in those less than 40 years old by 12-18 days. This median interval was shortened in those with stage III disease by 6-8 days. Among those who presented with symptoms, women who were diagnosed with stage I disease had a longer interval by 9 days. Those who received both lumpectomy and mastectomy had an increased median interval by 13-20 days from the overall median, those who did not receive radiation after chemotherapy had an increased median interval by 19-20 days and those in the Champlain LHIN had an increased median interval by 19-21 days. Those in the Waterloo Wellington LHIN had shorter wait times by 6-15 days. Those enrolled in team-based capitation primary care models had shorter median intervals by 4-5 days. Those in the Central east LHIN had shorter wait times in the screened group by 11 days compared to the overall median. Within the screened group, longer intervals were also seen in rural areas, with those in very remote rural neighbourhoods experiencing a 30 day increase in interval compared to those living in urban neighbourhoods. Within the symptomatic group, longer wait times were seen in the immigrant population by 7 days compared to non-immigrants, those with higher comorbidity burden by 12 days compared to those with lower comorbidity burden and those with a MH history in primary care by 7 days compared to those without that history. Among immigrants who presented with breast cancer symptoms, those from Latin America & Caribbean experienced the longest contact to chemotherapy interval at 141 days, which was 30 days longer than immigrants from Western Europe.

Table 6-6. Baseline characteristics according to median contact to adjuvant chemotherapy interval (in days) stratified by screened versus symptomatic detection

	Total N= 12,781	**Contact to adjuvant chemotherapy interval in days**					
		Screened N=2,916 (22.8%)			**Symptomatic N=9,865 (77.2%)**		
		Median (IQR)	**90th percentile**	**P value***	**Median (IQR)**	**90th percentile**	**P value***
Total		125 (103, 154)	185		127 (99, 171)	228	
Age (Categorical)				<0.0001			<0.0001
<40	1,102 (8.6%)	107 (85, 124)	189		115 (90, 155)	205	
40-49	3,481 (27.2%)	115 (93, 147)	178		126 (99, 170)	228	
50-59	4,225 (33.1%)	124 (103, 154)	187		128 (101, 175)	233	
60-69	3,045 (23.8%)	126 (105, 155)	184		132 (103, 176)	231	
70-74	607 (4.7%)	125 (104, 158)	185		138 (108, 179)	224	
>74	321 (2.5%)	137 (118, 162)	187		134 (104, 175)	221	
Urban/rural Residence				<0.0001			0.4999
Urban	11,189 (87.5%)	123 (102, 153)	182		127 (99, 170)	227	
Rural	699 (5.5%)	127 (110, 159)	189		125 (102, 175)	223	
Rural-remote	596 (4.7%)	134 (110, 164)	194		127 (98, 173)	225	
Rural-very remote	292-297 (2.3%)	153 (122, 184)	231		132 (104, 182)	259	
Rural-unknown	<=5	**	**		**	**	
Unknown	<=5	**	**		**	**	
Immigration Status				0.1425			0.0008
Long-term residents	11,075 (86.7%)	125 (103, 154)	184		126 (99, 170)	227	
Immigrants	1,706 (13.3%)	129 (104, 161)	194		133 (104, 175)	231	
Immigrant Characteristics							
Region of Origin				0.9288			0.0085
East Asia & Pacific	544 (4.3%)	135 (106, 161)	191		138 (104, 175)	231	
Eastern Europe & Central Asia	286 (2.2%)	135 (102, 167)	191		127 (100, 173)	230	
Latin America & Caribbean	239 (1.9%)	129 (116, 154)	258		141 (108, 179)	241	
Middle East & North Africa	145 (1.1%)	124 (104, 147)	191		134 (108, 181)	218	
South Asia	270 (2.1%)	126 (98, 160)	194		134 (109, 169)	217	
Sub-Saharan Africa	87 (0.7%)	137 (103, 155)	163		139 (106, 180)	225	
USA/New Zealand/Australia	37 (0.3%)	119 (103, 148)	162		119 (100, 178)	231	
Western Europe	98 (0.8%)	123 (105, 176)	203		111 (94, 144)	231	
Years since Arrival				0.6553			0.3281
<10y	618 (4.8%)	128 (103, 162)	170		132 (103, 174)	224	
>=10y	1,088 (8.5%)	129 (104, 161)	194		134 (105, 175)	236	
Immigrant Class				0.2277			0.3383
Economic	885 (6.9%)	124 (101, 153)	187		133 (104, 175)	238	
Family	571 (4.5%)	133 (104, 167)	220		129 (104, 174)	219	
Refugee	218 (1.7%)	126 (112, 158)	203		137 (111, 179)	234	
Other	32 (0.3%)	153 (136, 167)	201		133 (108, 174)	236	
Neighbourhood Income Quintile				0.1196			0.1620
1 (lowest)	2,020 (15.8%)	128 (106, 160)	188		130 (100, 175)	226	
2	2,384 (18.7%)	125 (104, 155)	181		128 (100, 170)	231	
3	2,523 (19.7%)	125 (104, 155)	183		127 (101, 174)	225	
4	2,819 (22.1%)	127 (103, 153)	186		126 (99, 168)	226	
5 (highest)	2,994 (23.4%)	122 (100, 151)	184		125 (98, 170)	231	
Unknown	41 (0.3%)	170 (119, 226)	247		143 (102, 182)	234	
Comorbidity Burden				0.7763			<0.0001
0-5 ADGs	7,287 (57.0%)	124 (104, 153)	183		123 (98, 166)	219	
6-9 ADGs	4,425 (34.6%)	126 (103, 155)	189		133 (103, 178)	238	
10+ ADGs	1,069 (8.4%)	126 (104, 158)	182		135 (104, 183)	245	

		Contact to adjuvant chemotherapy interval in days					
		Screened N=2,916 (22.8%)			Symptomatic N=9,865 (77.2%)		
		Median (IQR)	90th percentile	P value*	Median (IQR)	90th percentile	P value*
History of Mental Health Visits				0.9609			<0.0001
Yes	4,127 (32.3%)	124 (102, 155)	191		132 (103, 176)	233	
No	8654 (67.7%)	126 (104, 154)	183		125 (98, 169)	225	
Stage				0.0010			<0.0001
Stage I	2,839 (22.2%)	128 (105, 158)	188		136 (105, 185)	242	
Stage II	7,311 (57.2%)	125 (103, 154)	184		127 (100, 169)	225	
Stage III	2,631 (20.6%)	119 (100, 146)	182		119 (93, 162)	219	
Histological grade				<0.0001			<0.0001
Well-differentiated	528 (4.1%)	128 (108, 155)	189		141 (114, 184)	246	
Moderately-differentiated	2,468 (19.3%)	129 (106, 160)	189		133 (104, 178)	232	
Poorly-differentiated	3,196 (25.0%)	120 (98, 146)	179		119 (95, 161)	218	
Unknown	6,589 (51.6%)	126 (104, 155)	188		127 (100, 173)	231	
Receptor Status				0.0063			0.0225
ER+ or PR+ and Her2-	2,930 (22.9%)	124 (104, 155)	181		127 (101, 171)	226	
ER+ or PR+ and HER2+	1,107 (8.7%)	133 (103, 164)	195		125 (99, 166)	223	
ER- and PR- and Her2+	519 (4.1%)	122 (106, 154)	177		123 (95, 171)	224	
ER- and PR- and Her2-	859 (6.7%)	118 (95, 144)	182		120 (97, 162)	211	
Unknown	7,366 (57.6%)	126 (104, 154)	188		127 (100, 173)	231	
Surgery Type				<0.0001			<0.0001
Lumpectomy	7,645 (59.8%)	123 (102, 154)	182		126 (100, 169)	226	
Mastectomy	3,896 (30.5%)	124 (104, 152)	184		124 (97, 167)	223	
Lumpectomy + Mastectomy	1,240 (9.7%)	138 (113, 172)	217		147 (109, 196)	259	
Receipt of Radiation				<0.0001			<0.0001
Yes	8,652 (67.7%)	118 (99, 143)	170		120 (97, 160)	215	
No	4,129 (32.3%)	145 (114, 176)	213		146 (110, 191)	252	
Primary Care Model				0.0373			0.0012
Straight FFS	1,887 (14.8%)	127 (104, 152)	182		126 (100, 169)	221	
Enhanced FFS	6,281 (49.1%)	127 (104, 159)	190		128 (100, 172)	230	
Capitation	2,235 (17.5%)	121 (102, 153)	180		127 (100, 175)	233	
Team-based capitation	2,206 (17.3%)	121 (101, 149)	182		122 (97, 166)	228	
Other	172 (1.3%)	126 (108, 157)	190		117 (91, 155)	203	
Primary Care Enrollment Status				0.7247			0.6580
Rostered	10,900 (85.3%)	125 (103, 155)	185		127 (99, 171)	230	
Not rostered	1,881 (14.7%)	127 (104, 152)	183		127 (100, 169)	221	
LHIN				<0.0001			<0.0001
1 Erie St. Clair	713 (5.6%)	118 (99, 142)	179		120 (92, 157)	208	
2 South West	992 (7.8%)	138 (113, 167)	200		133 (103, 172)	227	
3 Waterloo Wellington	654 (5.1%)	119 (98, 141)	167		112 (91, 150)	207	
4 Hamilton Niagara Haldimand Brant	1,468 (11.5%)	118 (100, 140)	170		116 (96, 155)	213	
5 Central West	543 (4.2%)	120 (99, 150)	182		126 (99, 171)	223	
6 Mississauga Halton	750 (5.9%)	120 (96, 154)	196		124 (96, 173)	234	
7 Toronto Central	1,061 (8.3%)	126 (106, 155)	184		134 (105, 185)	247	
8 Central	1,784 (14.0%)	124 (101, 154)	188		128 (101, 174)	231	
9 Central East	1,710 (13.4%)	114 (95, 146)	179		127 (98, 171)	220	
10 South East	520 (4.1%)	126 (106, 159)	183		120 (99, 157)	217	
11 Champlain	1,335 (10.4%)	144 (121, 169)	189		148 (120, 189)	249	
12 North Simcoe Muskoka	518-522 (4.1%)	126 (103, 162)	176		122 (102, 176)	237	
13 North East	478 (3.7%)	118 (98, 147)	190		117 (88, 160)	216	
14 North West	252 (2.0%)	143 (108, 161)	198		128 (92, 173)	231	
Unknown	<=5	**	**		**	**	

*p-values calculated for median values

**values suppressed due to small cells

We looked further at two subdivisions of the contact to chemotherapy interval, the primary care interval (from index contact date to date of first oncology consultation) and the surgery to chemotherapy interval. The median primary care interval was 34 days in both the screened and symptomatic groups (appendix D). This median interval was longer in those with stage I disease by 3-5 days, with well-differentiated tumours by 4-5 days and in the Champlain LHIN by 10-12 days. This median primary care interval was decreased in the screened group for those aged <50 years by 13-14 days. This median interval was increased in the screened group for those living very remotely rural by 9 days and those in the North West LHIN by 22 days. Those in the symptomatic group had shorter median primary care intervals for those <40 years or >74 years by 5-6 days. The median surgery to adjuvant chemotherapy interval was 58 days (appendix E). This interval was longer in those >74 years old by 7 days, those living very remotely rural by 8 days, those who received lumpectomy and mastectomy by 14 days, those who did not receive radiation therapy by 7 days and those in the Champlain LHIN by 7 days. This median interval was shorter in those with stage III disease by 5 days, those with triple negative tumours by 6 days and in the Erie St. Clair LHIN by 8 days. A summary of the intervals is presented in figure 6-4.

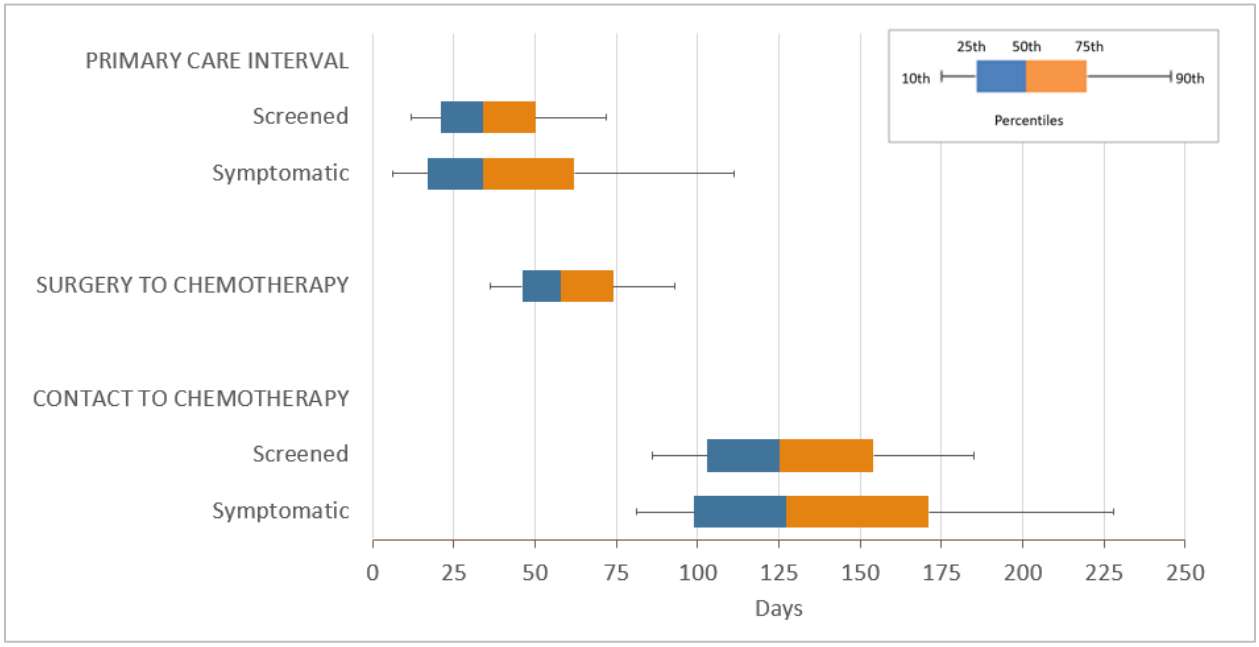

Figure 6-4. Boxplots of all intervals in days separated by method of breast cancer detection. Note: surgery to chemotherapy interval not separated by detection method since breast cancer detection not relevant during this interval.

6.3. Primary care use increases during breast cancer chemotherapy

6.3.1. Unadjusted model

The mean number of PCP visits during the baseline and treatment periods by physical comorbidities and history of MH visits are presented in table 6-7, figures 6-5 and 6-6. Those with a MH history and those with higher comorbidity level had a higher PCP visit rate during both baseline and treatment periods; however, the relative increase in PCP visit rates in these groups appears to be less than those with no MH history or low comorbidity. Parallel trends are observed during the baseline periods across the different groups.

Table 6-7. Mean number of PCP visits per 6 months by physical comorbidity groups and mental health history

	Total N= 12,781	**Mean (SD) /4 baseline PCP visits**	**Mean (SD) treatment PCP visits**	**Difference (treatment – baseline) Mean (SD)**
Total		2.3 (2.5)	3.4 (3.4)	1 (3.3)
Physical comorbidities				
0-5 physical ADGs (low)	7,287 (57.1%)	1.4 (1.7)	2.8 (3)	1.4 (3)
6-9 physical ADGs (medium)	4,425 (34.6%)	3.2 (2.3)	3.8 (3.4)	0.66 (3.4)
10+ physical ADGs (high)	1,069 (8.4%)	5.6 (3.4)	5.3 (4.2)	-0.2 (4)
Mental health history				
Yes	4,127 (32.3%)	3.5 (3.1)	4.1 (3.8)	0.58 (3.7)
No	8,654 (67.7%)	1.8 (1.9)	3 (3.1)	1.2 (3.1)

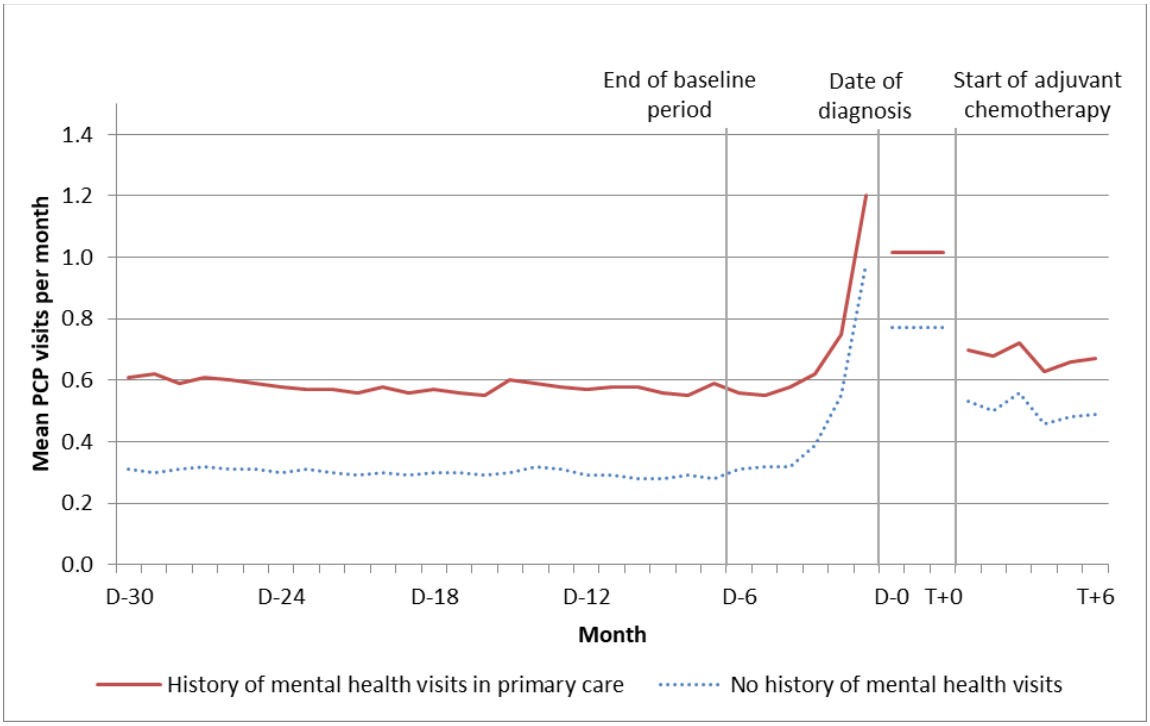

Figure 6-5. Unadjusted mean PCP visits per month by mental health history

D[n]=number of months from diagnosis date; T[n]=number of months from start of adjuvant chemotherapy
Median number of days between date of diagnosis and start of adjuvant chemotherapy in those with a history of mental health visits in primary care=92 days. In those with no history, median=90 days.

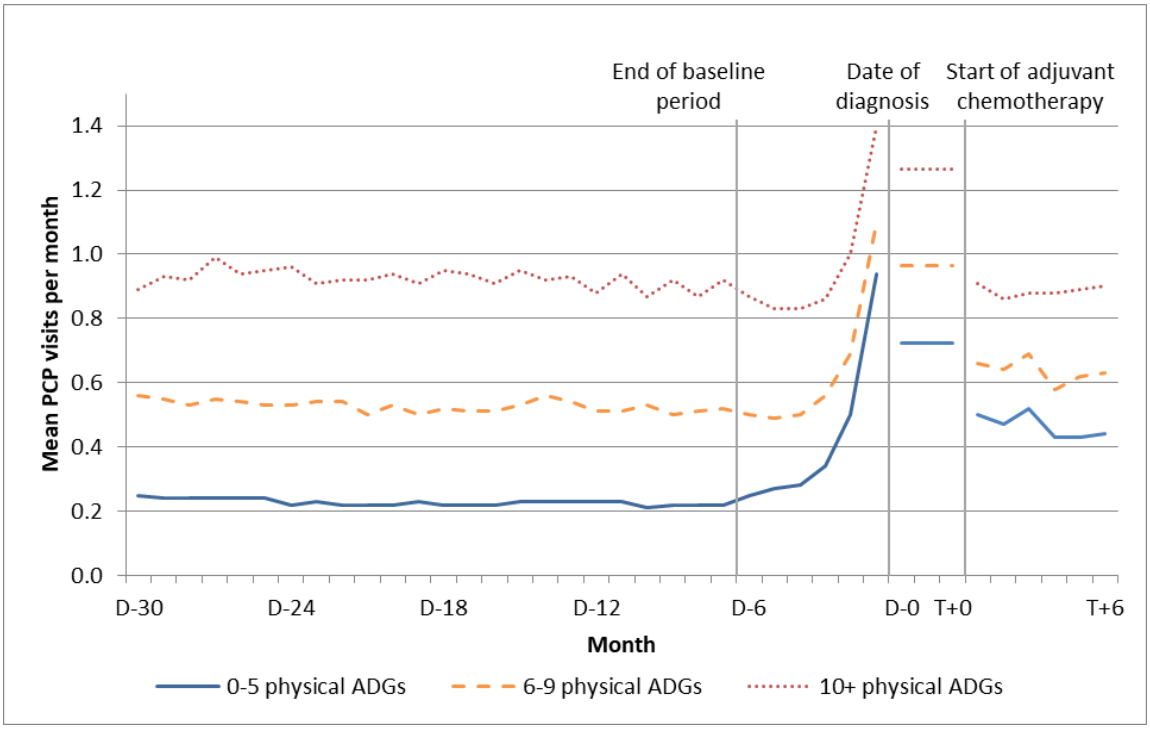

Figure 6-6. Unadjusted mean PCP visits per month by comorbidity groups

D[n]=number of months from diagnosis date; T[n]=number of months from start of adjuvant chemotherapy; ADG=Aggregated Diagnosis Group
Median number of days between date of diagnosis and start of adjuvant chemotherapy in those with 0-5, 6-9, and 10+ ADGs = 90, 92, and 93 days, respectively.

Our unadjusted model measured how physical comorbidities and MH history affected the change in PCP visit rate over 6 months from the baseline to treatment periods (table 6-8). We found that the incidence of PCP visits over the 6 month treatment period approximately doubled compared to baseline visit rates in those with low physical and mental comorbidity (incidence rate ratio (IRR) 2.23, 95% CI 2.15-2.30). Those with a history of MH visits in primary care had an increased incidence of PCP visits during baseline compared to those with no history (IRR 1.62, 95% CI 1.56-1.68), having a MH history was associated with a lower increase in PCP visits during the treatment period (RoR 0.76, 95% CI 0.73-0.79) compared to those with no MH history. Similarly, while those with 10+ physical ADGs, i.e. high physical comorbidity, had a higher incidence of PCP visits during baseline (IRR 3.54, 95% CI 3.37-3.73), this group demonstrated a lower increase in PCP visits than the lowest comorbidity group (RoR 0.51, 95% CI 0.48-0.54). The 6-9 ADG comorbidity group displayed a similar, but attenuated trend (RoR 0.62, 95% CI 0.60-0.65).

Table 6-8. Change in PCP visits rates between treatment and baseline periods by physical comorbidity and mental health groups - unadjusted difference-in-difference model estimates

	Exponentiated estimate (95% CI)	Estimate	Standard Error	95% CI	p-value
Intercept	0.01 (0.01-0.01)	-5.0202	0.0136	-5.05, -4.99	<.0001
Treatment period	2.23 (2.15-2.30)	0.8008	0.0173	0.77, 0.83	<.0001
Mental Health History	1.62 (1.56-1.68)	0.4803	0.019	0.44, 0.52	<.0001
Period*Mental Health History	0.76 (0.73-0.79)	-0.2766	0.0212	-0.32, -0.23	<.0001
6-9 ADGs	2.13 (2.06-2.21)	0.7577	0.0176	0.72, 0.79	<.0001
10+ ADGs	3.54 (3.37-3.73)	1.2649	0.0257	1.21, 1.32	<.0001
Period*(6-9 ADGs)	0.62 (0.60-0.65)	-0.4713	0.0218	-0.51, -0.43	<.0001
Period*(10+ ADGs)	0.51 (0.48-0.54)	-0.6754	0.0287	-0.73, -0.62	<.0001

6.3.2. Adjusted model

Our adjusted multivariable model measured how physical comorbidities and MH history affect the change in PCP visit rate over 6 months from the baseline to treatment periods after accounting for age at diagnosis, immigration status, neighbourhood income quintile, rurality, LHIN, continuity of primary care at baseline and primary care enrollment model (table 6-9). We did not include primary care model enrollment status in our model, since this was found to be collinear with primary care enrollment model variable. Similar to our unadjusted model, we found that the incidence of PCP visits over the 6 month treatment period approximately doubled compared to baseline visit rates in the low physical and mental comorbidity group after accounting for potential confounders (IRR 2.52, 95% CI 2.43-2.61). While those with 10+

physical ADGs, i.e. high physical comorbidity, had a higher number of PCP visits during baseline (IRR 2.97, 95% CI 2.83-3.12), this group demonstrated a lower increase in PCP visits than the lowest comorbidity group (RoR 0.46, 95% CI 0.44-0.49). The 6-9 ADG comorbidity group displayed a similar, but attenuated trend (RoR 0.57, 95% CI 0.54-0.59). Similarly, while those with a MH history had an increased number of PCP visits during baseline compared to those with no history (IRR 1.49, 95% CI 1.44-1.54), having a history of MH visits in primary care was associated with a lower increase in PCP visits during the treatment period (RoR 0.72, 95% CI 0.69-0.75) compared to those with no history of MH visits.

Table 6-9. Change in PCP visits rates between treatment and baseline periods by physical comorbidity and mental health groups – adjusted difference-in-difference model estimates

	Exponentiated estimate (95% CI)	**Estimate**	**SE**	**95% CI**	**p-value**
Intercept	0.01 (0.01-0.01)	-4.8086	0.0424	-4.89, -4.73	<.0001
Treatment period	2.52 (2.43-2.61)	0.9239	0.0184	0.89, 0.96	<.0001
Mental Health History	1.49 (1.44-1.54)	0.3991	0.0174	0.36, 0.43	<.0001
No Mental Health History	reference				
Period*Mental Health History	0.72 (0.69-0.75)	-0.3271	0.0213	-0.37, -0.29	<.0001
0-5 ADGs	reference				
6-9 ADGs	1.82 (1.76-1.88)	0.5986	0.0178	0.56, 0.63	<.0001
10+ ADGs	2.97 (2.83-3.12)	1.0887	0.0255	1.04, 1.14	<.0001
Period*(6-9 ADGs)	0.57 (0.54-0.59)	-0.5707	0.0222	-0.61, -0.53	<.0001
Period*(10+ ADGs)	0.46 (0.44-0.49)	-0.7661	0.0292	-0.82, -0.71	<.0001
Age <40 years	0.94 (0.90-0.99)	-0.061	0.0249	-0.11, -0.01	0.0145
Age 40-49 years	0.94 (0.91-0.98)	-0.0576	0.0166	-0.09, -0.03	0.0005
Age 50-59 years	Reference				
Age 60-69 years	1.04 (1.01-1.08)	0.0434	0.0172	0.01, 0.08	0.0115
Age 70-74 years	1.13 (1.07-1.18)	0.1192	0.0249	0.07, 0.17	<.0001
Age >74 years	1.20 (1.11-1.29)	0.1793	0.0394	0.10, 0.26	<.0001
Non-immigrant	Reference				
Immigrant	1.03 (1.00-1.07)	0.0326	0.0165	0.00, 0.06	0.0479
Income quintile 1	Reference				
Income quintile 2	0.99 (0.95-1.03)	-0.0111	0.02	-0.05, 0.03	0.5801
Income quintile 3	0.99 (0.95-1.03)	-0.0117	0.0197	-0.05, 0.03	0.5523
Income quintile 4	0.97 (0.93-1.01)	-0.0313	0.0194	-0.07, 0.01	0.1063
Income quintile 5	0.93 (0.89-0.97)	-0.0728	0.022	-0.12, -0.03	0.0009
Urban	Reference				
Rural	0.99 (0.94-1.05)	-0.0086	0.028	-0.06, 0.05	0.7575
Rural-remote	0.96 (0.90-1.03)	-0.0375	0.0328	-0.10, 0.03	0.2532
Rural-very remote	1.20 (1.10-1.31)	0.1818	0.0441	0.10, 0.27	<.0001
LHIN 1 Erie St. Clair	1.06 (0.98-1.14)	0.056	0.0399	-0.02, 0.13	0.1605
LHIN 2 South West	1.11 (1.03-1.19)	0.1044	0.0366	0.03, 0.18	0.0043
LHIN 3 Waterloo Wellington	0.97 (0.90-1.05)	-0.0307	0.0395	-0.11, 0.05	0.4372
LHIN 4 Hamilton Niagara Haldimand Brant	1.09 (1.02-1.17)	0.0873	0.0356	0.02, 0.16	0.0141
LHIN 5 Central West	1.10 (1.02-1.19)	0.0973	0.0391	0.02, 0.17	0.0128
LHIN 6 Mississauga Halton	1.05 (0.97-1.13)	0.0476	0.0388	-0.03, 0.12	0.2191
LHIN 7 Toronto Central	reference				
LHIN 8 Central	1.05 (0.98-1.12)	0.0459	0.0342	-0.02, 0.11	0.1805
LHIN 9 Central East	1.06 (0.99-1.14)	0.0624	0.0345	-0.01, 0.13	0.0709

LHIN 10 South East	1.10 (1.01-1.20)	0.0974	0.044	0.01, 0.18	0.0269
LHIN 11 Champlain	1.12 (1.04-1.21)	0.115	0.038	0.04, 0.19	0.0025
LHIN 12 North Simcoe Muskoka	1.08 (0.98-1.19)	0.076	0.0512	-0.02, 0.18	0.1375
LHIN 13 North East	1.03 (0.94-1.13)	0.0275	0.048	-0.07, 0.12	0.5662
LHIN 14 North West	1.14 (1.00-1.30)	0.1352	0.0666	0.00, 0.27	0.0424
Continuity 0 visits	0.25 (0.23-0.28)	-1.3847	0.0486	-1.48, -1.29	<.0001
Continuity 1-2 visits	0.39 (0.38-0.41)	-0.9289	0.0218	-0.97, -0.89	<.0001
Continuity UPC <=0.75	0.95 (0.93-0.98)	-0.0496	0.0139	-0.08, -0.02	0.0004
Continuity UPC >0.75	Reference				
PC model capitation	0.89 (0.85-0.93)	-0.1187	0.0236	-0.17, -0.07	<.0001
PC model enhanced FFS	1.00 (0.96-1.04)	0.0024	0.0209	-0.04, 0.04	0.9096
PC model team-based capitation	0.87 (0.83-0.92)	-0.1356	0.0249	-0.18, -0.09	<.0001
PC model other	0.74 (0.65-0.83)	-0.3033	0.0616	-0.42, -0.18	<.0001
PC model straight FFS	reference				

6.3.3. Verifying Assumptions

When checking for influential observations, we found that there were 28 data points (0.2% of the sample) with Cook's D values >0.0025, a cut-off value that was determined after visually examining the influence plots (appendix F). We examined these data points individually. Since there were no improbable values associated with these few data points, we chose to ignore these points and leave them in the model. We felt that the common trends assumption was met in this sample after examining the trends in mean monthly PCP visit rates graphically in the 30 months prior to diagnosis and the 6 months after onset of chemotherapy to ensure that the trends were parallel between groups (figures 6-2 and 6-3).

6.3.4. Sensitivity Analyses

1) Our first sensitivity analysis showed minimal change in estimates after substituting the lowest and then the highest values for the missing income quintile values.
2) When we included significant interaction terms between time period and potential confounders in the model, the effect estimates for comorbidity and MH history were slightly attenuated, but the overall conclusions remained the same. The incidence of PCP visits during the treatment period increased by 42% in those with low physical and mental comorbidity (IRR 1.42, 95% 1.28-1.58). Those with high physical comorbidity had increased PCP visits during baseline (IRR 2.66, 95% CI 2.54-2.80), but a lower increase in rates from baseline to treatment (RoR 0.62, 95% CI 0.59-0.66). While those with a MH history had increased PCP visits at baseline (IRR 1.40, 95% CI 1.35-1.45), having a MH history was associated with a lower increase in PCP visit rates from baseline to treatment (RoR 0.84, 95% CI 0.81-0.88). The highest relative increase in this model was seen in those with <3 PCP visits at baseline (RoR 4.39, 95% CI 4.10-4.69).

3) When we substituted physical ADGs and MH history for a single ADG score, we again found that the incidence of PCP visits over the 6 month treatment period approximately doubled compared to baseline visit in the low comorbidity group after adjusting for potential confounders (IRR 2.29, 95% CI 2.21-2.37). While those with 10+ ADGs, i.e. high physical/mental comorbidity, had a higher number of PCP visits during baseline (IRR 3.68, 95% CI 3.52-3.84), this group demonstrated a lower increase in PCP visits than the lowest comorbidity group (RoR 0.42, 95% CI 0.40-0.44). The 6-9 ADG comorbidity group displayed a similar, but attenuated trend (RoR 0.54, 95% CI 0.52-0.57).
4) We excluded PCP visits during the treatment period that were deemed to have taken place in cancer clinics in an effort to exclude PCP visits that may have been to GPOs. Since this method to identify potential GPO visits has not been validated or used in previous studies, this method was included as a sensitivity analysis only. We found that the mean number of PCP visits during the treatment period decreased from 3.4 to 3.0 visits. The number of patients with at least one PCP visit during the treatment period decreased from 84.97% to 82.01% of the cohort. The mean increase in visits over 6 months from baseline to treatment periods then decreased from an increase in 1.0 to 0.61 visits. Similar to our original multivariable model, we found that the incidence of PCP visits over the 6 month treatment period approximately doubled compared to baseline visit rates in those with low physical and mental comorbidity after accounting for other potential confounders (IRR 1.98, 95% CI 1.91-2.06). While those with 10+ physical ADGs, i.e. high physical comorbidity, had a higher number of PCP visits during baseline (IRR 3.01, 95% CI 2.86-3.18), this group demonstrated a lower increase in PCP visits than the lowest comorbidity group (RoR 0.52, 95% CI 0.49-0.56). The 6-9 ADG comorbidity group displayed a similar, but attenuated trend (RoR 0.61, 95% CI 0.59-0.64). Similarly, while those with a MH history in primary care had an increased number of PCP visits during baseline compared to those with no history (IRR 1.50, 95% CI 1.45-1.55), having a MH history was associated with a lower increase in PCP visits during the treatment period (RoR 0.76, 95% CI 0.73-0.79) compared to those with no MH history.
5) When we included only the immigrant population we found that, similar to our whole population, immigrants with a history of MH visits in primary care had a lower increase in PCP visits during the treatment period (RoR 0.86, 95% CI 0.78-0.95) compared to immigrants with no history of MH visits. Immigrants with 10+ ADGs had a lower increase in PCP visits than the lowest comorbidity group (RoR 0.41, 95% CI 0.36-0.47). The 6-9 ADG comorbidity group displayed a similar, but attenuated trend (RoR 0.59, 95% CI 0.53-0.66).

Results for sensitivity analyses of our DID models are included in appendix G.

6.4. Continuity of care and wait times to chemotherapy

6.4.1. Unadjusted Model

The unadjusted median and 90th percentile contact to chemotherapy interval by continuity of primary care at baseline separated by method of breast cancer detection is shown in figure 6-7.

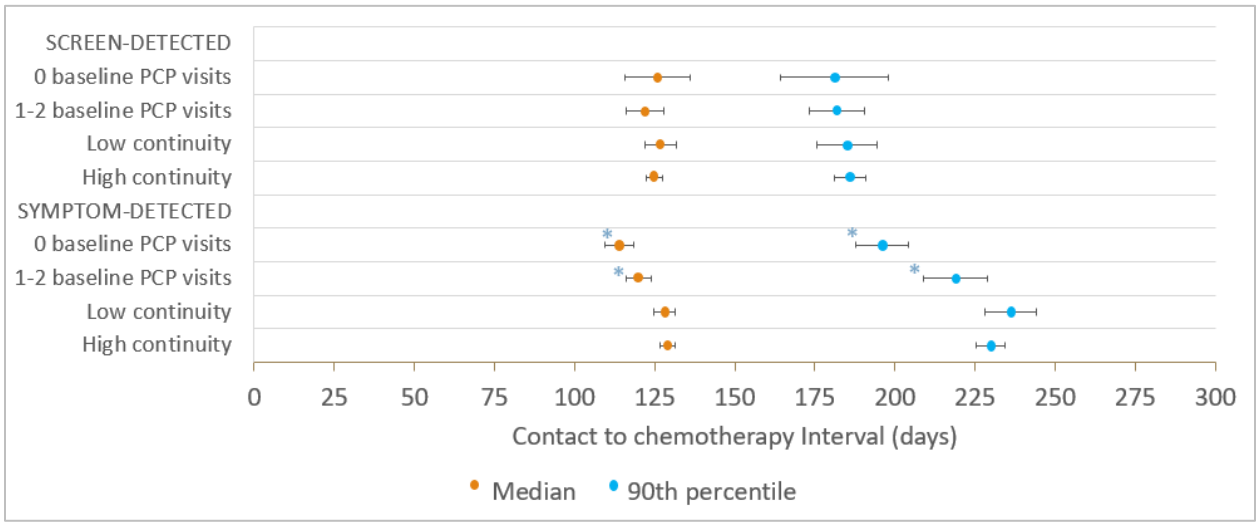

Figure 6-7. Unadjusted median and 90th percentile contact to chemotherapy intervals in days by continuity of primary care at baseline separated by method of breast cancer detection with 95% confidence intervals
PCP=primary care provider
Low continuity= usual provider of care (UPC) index ≤0.75.
High continuity= UPC index >0.75.
*Indicates statistical significance.

In our unadjusted model, baseline continuity of primary care was not found to be associated with the contact to chemotherapy interval in the screened population (table 6-10). The UPC score for continuity was not associated with the contact to chemotherapy interval in the symptomatic population. However, having no primary care visits during the baseline period was associated with a decrease in the median contact to chemotherapy interval by 15 days (95% CI -19.44, -10.56) and a decrease in the 90th percentile contact to chemotherapy interval by 34 days (95% CI -42.13, -25.87) in the symptomatic population compared to those with high continuity of care. The UPC index was also not associated with the primary care interval in screened patients. In symptomatic patients, low UPC was associated with an increase in the 90th percentile primary care interval by 9 days (95% CI 0.69, 17.31) but was not associated with

the median primary care interval. Having no PCP visits at baseline was associated with a decreased median (-9, 95% CI -11.45, -6.55) and 90th percentile (-33, 95% CI -42.56, -23.44) primary care interval in the symptomatic, but not the screened population. The UPC index was not associated with the diagnostic interval in either the screened or symptomatic patients (data not shown). Having 1-2 PCP visits versus high continuity of care during the baseline period decreased the median (-5, 95% CI -7.83, -2.16) and 90th percentile (-12, 95% CI -20.01, -3.99) diagnostic intervals in the screened population. Neither the UPC index nor having a lower number of PCP visits at baseline were associated with the surgery to chemotherapy interval.

Table 6-10. Median and 90th percentile wait times by continuity of care at baseline compared to high continuity at baseline - quantile regression unadjusted models

		Screened		Symptomatic	
Interval	Continuity group	Median (95% CI)	90th percentile (95% CI)	Median (95% CI)	90th percentile (95% CI)
Contact to chemotherapy	High	125 (122.43, 127.57)	186 (181.21, 190.79)	129 (126.73, 131.27)	230 (225.47, 234.53)
	Low	2 (-2.83, 6.83)	-1 (-10.45, 8.45)	-1 (-4.46, 2.46)	6 (-1.98, 13.98)
	1-2 visits	-3 (-9.00, 3.00)	-4 (-12.63, 4.63)	**-9 (-12.81, -5.19)**	**-11 (-21.03, -0.97)**
	0 visits	1 (-9.26, 11.26)	-5 (-21.76, 11.76)	**-15 (-19.44, -10.56)**	**-34 (-42.13, -25.87)**
Primary care (contact to first oncology consult)	High	34 (32.76, 35.24)	73 (69.32, 76.68)	35 (34.01, 35.99)	111 (106.48, 115.52)
	Low	1 (-0.98, 2.98)	-2 (-7.34, 3.34)	0 (-1.46, 1.46)	**9 (0.69, 17.31)**
	1-2 visits	0 (-4.04, 4.04)	-4 (-11.72, 3.72)	**-5 (-7.44, -2.56)**	**-16 (-29.08, -2.92)**
	0 visits	1 (-4.61, 6.61)	-2 (-21.90, 17.90)	**-9 (-11.45, -6.55)**	**-33 (-42.56, -23.44)**
Surgery to chemotherapy	High	60 (58.22, 61.78)	92 (89.72, 94.28)	57 (56.24, 57.76)	94 (91.72, 96.28)
	Low	0 (-2.83, 2.83)	5 (-1.31, 11.31)	0 (-1.11, 1.11)	-2 (-5.38, 1.38)
	1-2 visits	0 (-3.62, 3.62)	-1 (-6.72, 4.72)	0 (-1.31, 1.31)	-3 (-6.66, 0.66)
	0 visits	2 (-3.65, 7.65)	1 (-9.75, 11.75)	0 (-2.11, 2.11)	2 (-4.08, 8.08)

High continuity: UPC >0.75
Low continuity: UPC ≤0.75
Bolded values: p-value <0.05

6.4.2. Adjusted Model

Adjusted estimates for the median and 90th percentile contact to chemotherapy interval are found in figure 6-8. In our multivariable model, we found that continuity of care was not associated with a change in the median or 90th percentile contact to chemotherapy intervals for screened patients after adjusting for age, immigration status, neighbourhood income quintile, physical comorbidities, MH history, rurality, LHIN and primary care enrollment model (table 6-11). Patients who presented with symptoms and had low continuity of care had a lower median interval by 3.21 days (95% CI -5.96, -0.47) compared to those with high continuity of care. Symptomatic patients with no visits at baseline had a decreased median interval by 10.68 days

(95% CI -16.00, -5.36) compared to those with high comorbidity. At the 90th percentile, symptomatic patients with low continuity trended towards longer intervals, but this result was not statistically significant (6.13, 95% CI -1.14, 13.39). Symptomatic patients with no visits at baseline had a shorter 90th percentile interval by 25.38 days (95% CI -39.67, -11.09).

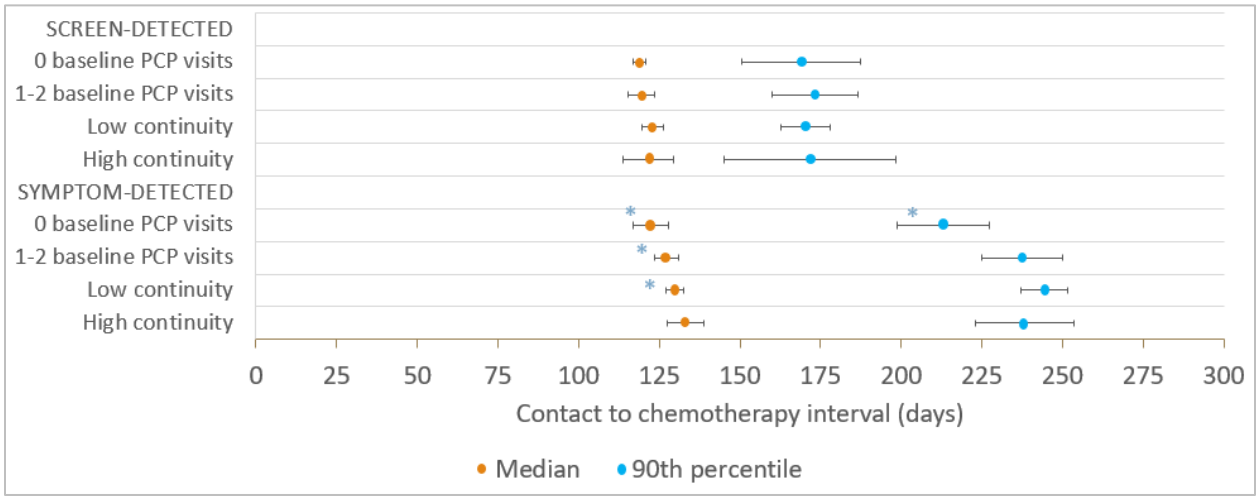

Figure 6-8. Adjusted median and 90th percentile contact to chemotherapy intervals in days by continuity of primary care at baseline separated by method of breast cancer detection with 95% confidence intervals

PCP=primary care provider; Low continuity= usual provider of care (UPC) index ≤0.75;
High continuity= UPC index >0.75.
*Indicates statistical significance.

Table 6-11. Median and 90th percentile contact to chemotherapy wait times - quantile regression multivariable adjusted models

		Screened n=2906		Symptomatic n=9565	
Parameter	**Group**	**Median**	**90th percentile**	**Median**	**90th percentile**
Intercept		121.48 (113.60, 129.37)	171.79 (145.15, 198.43)	133.06 (127.32, 138.80)	238.29 (222.91, 253.68)
Continuity	0 Visits	-2.48 (-9.76, 4.80)	-2.70 (-21.04, 15.65)	**-10.68 (-16.00, -5.36)**	**-25.38 (-39.67, -11.09)**
	1-2 Visits	-1.93 (-6.13, 2.27)	1.43 (-11.98, 14.85)	**-5.78 (-9.32, -2.24)**	-0.73 (-13.33, 11.87)
	UPC <=0.75	1.48 (-2.02, 4.99)	-1.51 (-9.25, 6.23)	**-3.21 (-5.96, -0.47)**	6.13 (-1.14, 13.39)
	UPC >0.75	Reference	Reference	Reference	Reference
Age	<40 years	**-23.78 (-46.82, -0.74)**	15.38 (-156.66, 187.42)	**-15.41 (-18.79, -12.03)**	**-29.99 (-40.90, -19.08)**
	40-49 years	**-10.96 (-21.38, -0.54)**	-0.98 (-29.92, 27.96)	**-3.75 (-6.72, -0.77)**	-1.88 (-9.90, 6.13)
	50-59 years	Reference	Reference	Reference	Reference
	60-69 years	1.63 (-1.32, 4.58)	3.23 (-4.37, 10.82)	1.25 (-2.25, 4.75)	-3.07 (-12.35, 6.21)
	70-74 years	4.00 (-2.04, 10.04)	5.38 (-14.32, 25.08)	3.47 (-2.77, 9.71)	-8.60 (-23.63, 6.43)
	>74 years	**11.70 (1.61, 21.80)**	6.75 (-6.89, 20.40)	2.39 (-6.17, 10.94)	-9.78 (-26.90, 7.35)
Immigrant	Immigrants	**7.26 (0.45, 14.07)**	12.89 (-0.85, 26.63)	**7.68 (4.36, 11.00**)	3.19 (-6.12, 12.51)
	Long-term residents	Reference	Reference	Reference	Reference
Income quintile	1 (low)	**5.56 (1.44, 9.67)**	6.53 (-5.99, 19.04)	**5.47 (1.75, 9.18)**	-4.87 (-16.03, 6.29)
	2	**6.11 (1.77, 10.46)**	-1.72 (-12.51, 9.07)	2.66 (-0.81, 6.13)	2.26 (-6.90, 11.43)
	3	**5.04 (0.75, 9.32)**	1.83 (-8.31, 11.97)	**4.47 (1.07, 7.86)**	-6.03 (-16.80, 4.75)
	4	3.33 (-0.65, 7.32)	-2.91 (-14.10, 8.29)	1.00 (-2.14, 4.14)	-5.18 (-15.77, 5.40)
	5 (high)	Reference	Reference	Reference	Reference
Physical comorbidities	0-5 ADGs	Reference	Reference	Reference	Reference
	6-9 ADGs	-1.30 (-4.67, 2.08)	1.77 (-7.30, 10.85)	**4.35 (1.44, 7.26)**	**15.53 (7.71, 23.36)**
	10+ ADGs	-1.48 (-7.88, 4.92)	-4.02 (-17.06, 9.02)	**6.72 (1.66, 11.79)**	**27.20 (14.01, 40.38)**

		Screened n=2906		Symptomatic n=9565	
Parameter	**Group**	**Median**	**90th percentile**	**Median**	**90th percentile**
History of mental health visits	Yes	0.89 (-2.28, 4.06)	**8.75 (0.37, 17.14)**	2.03 (-0.67, 4.73)	-0.82 (-7.97, 6.33)
	No	Reference	Reference	Reference	Reference
Rurality	Rural	4.48 (-2.54, 11.50)	-0.34 (-16.10, 15.42)	0.31 (-4.79, 5.42)	0.72 (-16.95, 18.38)
	Rural-remote	6.44 (-1.36, 14.25)	10.13 (-9.40, 29.66)	-2.95 (-10.70, 4.79)	13.49 (-9.30, 36.29)
	Rural-very remote	**28.15 (18.81, 37.48)**	47.34 (-0.33, 95.01)	6.33 (-3.73, 16.40)	**27.66 (7.46, 47.86)**
	Urban	Reference	Reference	Reference	Reference
LHIN	1 Erie St. Clair	**-9.70 (-17.54, -1.87)**	-1.17 (-35.03, 32.69)	**-15.07 (-20.93, -9.21)**	**-34.31 (-51.55, -17.07)**
	2 South West	6.00 (-3.06, 15.06)	14.64 (-8.13, 37.41)	-3.15 (-9.20, 2.91)	-15.97 (-32.57, 0.64)
	3 Waterloo Wellington	-3.22 (-15.16, 8.71)	-14.45 (-39.97, 11.06)	**-21.44 (-27.66, -15.23)**	**-32.62 (-49.96, -15.28)**
	4 Hamilton Niagara Haldimand Brant	**-9.81 (-16.65, -2.98)**	-15.28 (-37.66, 7.09)	**-15.11 (-19.80, -10.42)**	**-28.35 (-42.42, -14.28)**
	5 Central West	-9.00 (-18.47, 0.47)	-9.34 (-35.78, 17.10)	**-8.57 (-16.16, -0.98)**	**-18.56 (-35.76, -1.36)**
	6 Mississauga Halton	-6.63 (-16.98, 3.73)	16.36 (-15.32, 48.03)	**-11.55 (-18.59, -4.51)**	-10.22 (-30.31, 9.86)
	7 Toronto Central	Reference	Reference	Reference	Reference
	8 Central	-2.85 (-10.88, 5.18)	4.68 (-19.61, 28.97)	**-6.88 (-12.10, -1.66)**	-10.05 (-22.22, 2.12)
	9 Central East	**-14.93 (-22.18, -7.67)**	-7.21 (-29.08, 14.67)	**-7.32 (-12.84, -1.80)**	**-20.66 (-32.71, -8.61)**
	10 South East	-0.37 (-10.40, 9.66)	0.62 (-23.19, 24.44)	**-10.21 (-17.82, -2.59)**	**-25.17 (-46.33, -4.01)**
	11 Champlain	**17.30 (10.76, 23.83**)	5.40 (-16.53, 27.33)	**14.29 (8.32, 20.27)**	6.78 (-8.90, 22.45)
	12 North Simcoe Muskoka	-1.44 (-12.90, 10.01)	-3.02 (-33.22, 27.18)	-11.77 (-19.66, -3.87)	-13.32 (-33.03, 6.38)
	13 North East	**-12.33 (-20.21, -4.46)**	-15.38 (-46.92, 16.17)	**-15.04 (-23.08, -7.00)**	**-29.22 (-54.08, -4.37)**
	14 North West	4.74 (-6.36, 15.85)	9.74 (-32.40, 51.87)	-7.02 (-19.05, 5.02)	-8.43 (-30.62, 13.75)
Primary care enrollment model	Capitation	-0.89 (-6.74, 4.96)	2.23 (-11.56, 16.01)	2.36 (-1.47, 6.19)	10.68 (-0.79, 22.14)
	Enhanced FFS	3.30 (-1.65, 8.24)	11.47 (-3.51, 26.45)	-0.74 (-3.77, 2.28)	0.06 (-8.61, 8.72)
	Other	2.22 (-9.90, 14.35)	21.92 (-9.43, 53.27)	0.31 (-13.56, 14.18)	-13.57 (-44.00, 16.87)
	Team-based capitation	-3.30 (-8.96, 2.36)	2.04 (-13.94, 18.02)	-1.76 (-5.57, 2.04)	3.37 (-7.64, 14.38)
	Straight FFS	Reference	Reference	Reference	Reference

Bolded values: p-value <0.05

We found that continuity of care was not associated with a change in the median or 90th percentile primary care intervals for screened or symptomatic patients after adjusting for age, immigration status, neighbourhood income quintile, physical comorbidities, history of MH visits in primary care, rurality, LHIN and primary care enrollment model (appendix H). Screened patients with 1-2 PCP visits during the baseline period had a shorter median primary care interval by 3.67 days (95% CI -7.24, -0.09) compared to the high continuity group. Symptomatic patients with no PCP visits during the baseline period had a decreased median primary care interval by 8.04 days (95% CI -10.55, -5.52) and a decreased 90th percentile primary care interval by 28.14 days (95% CI -39.68, -16.60).

We found that neither continuity of care nor having a small number of PCP visits at baseline was associated with a change in the median or 90th percentile surgery to chemotherapy interval after adjusting for potential confounders (appendix I).

6.4.3. Sensitivity Analyses

1) Our first sensitivity analysis showed minimal change in estimates after substituting the lowest and then the highest values for the missing income quintile values.
2) Similarly, when substituting the diagnosis date for missing index contact date values, our results remained the same.
3) When including only those with 3 or more PCP visits during the baseline period, we found that symptomatic patients with low continuity of care had an increased 90th percentile contact to chemotherapy interval by 7.60 days (95% CI 0.12, 15.09) compared to those with high continuity of care, whereas the median contact to chemotherapy interval was no longer significantly shorter for symptomatic patients. Neither the median nor 90th percentile contact to chemotherapy intervals were associated with continuity of care in screened patients. The other intervals, the median and 90th percentile primary care intervals in screened and symptomatic patients and the surgery to chemotherapy interval, were not associated with continuity of care at baseline.
4) Within the immigrant population, low continuity of care was associated with an increased median and 90th percentile contact to chemotherapy interval by 17.43 days (95% CI 0.90-34.76) and 59.37 days (95% CI 4.06-114.67) in the screened population, respectively, but did not show any association with the contact to chemotherapy interval in the symptomatic population. The increased median interval in the screened population was mostly driven by the increase in median primary care interval by 15.45 days (95% CI 4.00, 26.90). In the symptomatic immigrant population, having no PCP visits at baseline was associated with a decreased median primary care interval by 14.52 days (95% CI -21.25, -7.79) and decreased 90th percentile primary care interval by 45.25 days (95% CI -68.01, -22.49). There was no association between continuity of care or primary care utilization at baseline and the surgery to chemotherapy interval in the immigrant population.
5) When looking at immigrant characteristics and interval lengths, symptom-diagnosed women from Latin America & Caribbean and East Asia & Pacific experienced a 15.5 day (95% CI 2.18, 28.82) and 10.5 day (95% CI 2.77, 18.23) longer median contact to chemotherapy interval than long-term residents, respectively. Symptom-diagnosed immigrants from Western Europe experienced a 12.5 day shorter median contact to chemotherapy interval (95% CI -22.88, -2.12) than long-term residents. Within our sub-intervals, symptom-diagnosed women from Middle East & North Africa experienced longer median and 90th percentile primary care intervals by 9.0 days (95% CI 1.19, 16.81) and 25.51 days (95% CI

1.80, 49.20), respectively and longer median surgery to chemotherapy intervals by 6.0 days (95% CI 1.51, 10.49) compared to long-term residents.

Results for our quantile regression sensitivity analyses are included in appendix J.

6.5. Summary of results

We found that the total number of PCP visits over 6 months increased during the treatment phase, with a mean increase of 1 PCP visit over 6 months during treatment. While the absolute number of PCP visits during the treatment phase remained higher in those with high physical and/or mental comorbidity, the relative increase in PCP visit rates from baseline to treatment was higher in those with low physical and/or mental comorbidity. We also found that low baseline primary care continuity was associated with a statistically significant 3.21 day decrease in the median contact to chemotherapy interval for patients diagnosed due to symptoms. However, in our sensitivity analysis including only those with >2 PCP visits at baseline, this association was not statistically significant. Further, in our sensitivity analysis containing only the immigrant population, low continuity of care was associated with an increased median and 90th percentile contact to chemotherapy interval by 17.43 days and 59.37 days in the screened population, respectively. Having no PCP visits during the baseline period was associated with a decreased median contact to chemotherapy interval by 10.68 days and a decreased 90th percentile contact to chemotherapy interval by 25.38 days in those with symptom-detected breast cancer. Continuity of primary care at baseline was not associated with the primary care or surgery to chemotherapy subintervals. Having no PCP visits at baseline was associated with a decreased median primary care interval by 8.04 days and a decreased 90th percentile primary care interval by 28.14 days. Having no PCP visits at baseline was not associated with the surgery to chemotherapy interval.

Chapter 7: Discussion

7.1. Primary care visits during chemotherapy

Similar to previous studies, we found that the absolute number of PCP visits increases during adjuvant chemotherapy compared to baseline [7]. The number of PCP visits per month was fairly constant throughout the baseline period and started to increase in the 3 months prior to diagnosis with most patients having at least one PCP visit in the month prior to diagnosis. After diagnosis, the mean number of PCP visits per month decreased until the start of adjuvant chemotherapy, where the rate remained higher than at baseline at 3.4 PCP visits in the 6 month treatment period. The number of PCP visits during the treatment period was fairly constant, showing a gradual trend towards decreasing PCP visits as one got further from chemotherapy start. This fits well with another CanIMPACT study that showed a gradual decrease in number of PCP visits with every additional year up to year 5 after breast cancer diagnosis [6].

In our multivariable DID analysis, we found that, contrary to our initial hypothesis, the relative increase in PCP visits during treatment was not due to those with high physical and/or mental comorbidity requiring extra primary care during chemotherapy. While those with high physical and/or mental comorbidity still contributed to the absolute high rate of PCP visits, their PCP visit rates increased only slightly, if at all, during treatment. We instead found that the relative increase in PCP visits during treatment was much higher in the low physical and/or mental comorbidity groups. This association remained even when excluding PCP visits that took place in cancer clinics and when combining physical and mental comorbidities into one score. Some of this could be due to a “ceiling effect” – where those with high comorbidity and/or a MH history already had a relatively saturated number of PCP visits at baseline with little room for increasing visits during the treatment period, whereas those with low comorbidity and/or no MH history had few PCP visits at baseline and greater potential for increased visits. Additionally, those with a low number of PCP visits at baseline may be more unfamiliar with the healthcare system and require more help from their PCP during treatment for care coordination and navigation. We checked for this association in one of our sensitivity analyses and indeed found that low primary care utilization at baseline, i.e. having <3 PCP visits during the baseline period, was associated with the greatest measurable increase in PCP visit rates from baseline to treatment of all included characteristics (RoR 4.39, 95% CI 4.10-4.69). However, even with low primary care utilization at baseline accounted for in our sensitivity analysis, those with low

physical and/or mental comorbidities still showed a relatively greater increase in PCP visit rates than those with high comorbidity. Several studies have shown that physical and mental comorbidities increase after breast cancer diagnosis [56,57,59-61]. Therefore, another reason for this association could be that those with low physical and/or mental comorbidity at baseline have greater potential to develop more comorbidities and/or MH issues during chemotherapy, which would require additional primary care management.

While the mean number of PCP visits per patient increased during the treatment phase, the actual percentage of patients who visited their PCP at least once during the treatment phase decreased so that over 15% of patients did not see any PCP during the treatment phase (as opposed to approximately 6% at baseline). Not surprisingly, oncologists were the most visited specialists during the treatment period, with patients visiting their medical oncologists on average once monthly, their radiation oncologist just over once every 2 months and their breast surgeon once during the 6 month period. The rates of visits to other specialists were fairly low during the treatment phase, with a mean of 1 visit to any other specialist during the 6 months.

Interestingly, almost 46% of PCP visits during the treatment period were breast cancer-related. This proportion ranged from 36% in those with high baseline physical comorbidity to 52% in those with low baseline physical comorbidity. Those with higher comorbidity likely had a lower proportion of breast-cancer related PCP visits since they would have a higher proportion of PCP visits related to their comorbidities. While the nature of the health administration data makes it difficult to ascertain the specific breast cancer-related reasons for these visits, this generally highlights the importance of PCPs in being informed and educated about issues that can arise during this period of cancer care.

7.2. Primary care utilization and primary care continuity at baseline

Lower primary care utilization at baseline (<3 visits during the 24 month baseline period) was associated with various characteristics including remote rural location, not being enrolled in a primary care enrollment model and low income; having few PCP visits at baseline may therefore be linked to poor access and low SES. Low PCP utilization was also associated with low comorbidity and no previous MH visits in primary care. This could be explained by those with low physical and/or mental comorbidity requiring less care from PCPs. It is also possible that, if a patient with high physical and/or mental comorbidity avoided going to their PCP during

baseline, comorbidities and MH issues may be underdiagnosed in this population due to a lack of visits and paucity of records in the health administrative databases. Additionally, low primary care utilization was associated with stage II or III disease and receiving a mastectomy, which suggests that low primary care utilization may result in delayed presentation to healthcare, resulting in later stage at diagnosis requiring more extensive surgery. Other studies have linked low primary care utilization with worsened survival time for lung cancer [114] and increased mortality for breast and colorectal cancer [113,115].

For those with 3 or more PCP visits during the baseline period, low continuity (UPC ≤0.75) was associated with younger age, living in urban areas, immigration and high comorbidity level. Living in urban areas is likely tied to low continuity due to the relatively high access to different PCPs, including at walk-in clinics, seen in urban areas. This could also explain why immigration, which is linked to urban living, is also associated with low continuity. Those who are younger may have lower continuity due to lower rates of chronic disease. This may result in more acute healthcare presentations, where relational continuity with a PCP may be less important. High comorbidity levels, on the other hand, may be associated with low continuity of primary care due to a higher number of issues needing to be addressed, which may be sought through different PCPs within the same primary care team, or through multiple visits to different PCPs. The association between low comorbidity scores and higher continuity of care has been seen in other studies [67]. Low continuity of care was associated with symptomatic presentation, whereas high continuity of care was associated with screen-detected cancers. This is not surprising, since higher continuity of care is known to result in better preventive care [18,19] leading to higher screening rates.

7.3. Contact to chemotherapy interval

The median interval from index contact date to start of adjuvant chemotherapy was 126 days, or just over 4 months (90th percentile 184 days (6 months) in the screened group and 228 days (7.5 months) in the symptomatic group). The median primary care sub-interval was 34 days, or just over 1 month (90th percentile 72 days (2.4 months) if screened and 111 days (3.6 months) if symptomatic) and the median surgery to chemotherapy sub-interval was 58 days, or just under 2 months (90th percentile 93 days (3 months)). Other Ontario studies have looked at different sub-intervals and are therefore difficult to compare directly. In another CanIMPACT study, Lofters et al. found a 28 to 33 day median diagnostic interval (from contact to date of diagnosis) in long-term residents diagnosed with breast cancer between 2007 and 2011 [9].

Rastpour et al. found an approximately 30 to 35 day interval between date of first test and first surgery for breast cancers diagnosed between 2007 and 2011 [153]. Plotogea et al. found median wait times of 17 days from diagnosis to surgery and 44 days from surgery to adjuvant chemotherapy for women aged 50-69 diagnosed with breast cancer between 1995 and 2003 [98].

In our descriptive analyses, the contact to chemotherapy interval varied according to several baseline characteristics. The median interval was longer in patients who received both lumpectomy and mastectomy (that took place on different days) and shorter in patients who were younger and had higher stage disease. This is consistent with the literature [89,93,97]. Receiving radiation after chemotherapy was associated with a shorter median interval; this may be due to providers scheduling chemotherapy sooner in order to allow for a course of radiation therapy, which the Canadian Cancer Society recommends occurs within 8 to 12 weeks after surgery [40]. Within the screened group, longer intervals were seen in rural areas. This may be due to difficulties in coordinating travel over long distances for workup after a positive screen. It also suggests that there may be features of the screening and subsequent diagnostic assessment processes in rural areas that could be improved upon. Those with higher physical and/or mental comorbidity had longer median intervals in the symptomatic, but not the screened groups, by 7-12 days; this is possibly due to management of pre-existing physical and MH issues resulting in delays in care among patients presenting with symptoms. Those in the Champlain LHIN had consistently longer wait times across screened and symptomatic groups (up to 26-36 days longer than the median interval in other LHINs), even among the primary care sub-interval (up to 17-19 days longer than other LHINs) and surgery to chemotherapy sub-interval (up to 15 days longer than other LHINs). The regional variations in practice that may account for this remain to be explored.

The median primary care interval was the same in both the screened and symptomatic groups. However, the 90th percentile interval was 39 days longer in the symptomatic group. This indicates a larger variability in time to first oncology consult in the symptomatic group. Patients <50 years old who were screen-detected had a shorter median primary care interval by 2 weeks. Current recommendations suggest patients <50 years old be screened only if they are higher than average risk for breast cancer. As such, patients in this age group with a positive screen are more likely to have greater access to oncology specialists through high risk breast screening programs.

The median surgery to adjuvant chemotherapy interval was 58 days, or just over 8 weeks. There is room for improvement here since an interval longer than 4 weeks has been associated with increased mortality [84,85]. While those with triple-positive disease had a shorter median interval at 52 days in our study, it has been found that a wait of >30 days between surgery and adjuvant chemotherapy in patients with triple-negative breast cancer is associated with worse overall survival [85].

Among immigrants who presented with breast cancer symptoms, those from Latin America & Caribbean experienced the longest contact to chemotherapy interval at 141 days, which was 30 days longer than immigrants from Western Europe. This is despite women from Latin America & Caribbean generally being diagnosed at later stages in Ontario [9,112], which would otherwise be associated with a shorter interval. In our multivariable sensitivity analysis looking at immigrant characteristics and interval length, symptom-diagnosed women from Latin America & Caribbean and East Asia & Pacific experienced longer median contact to chemotherapy intervals by 15.5 days (95% CI 2.18, 28.82) and 10.5 days (95% CI 2.77, 18.23), respectively, whereas symptom-diagnosed immigrants from Western Europe experienced a 12.5 day shorter median contact to chemotherapy interval (95% CI -22.88, -2.12) compared to long-term residents. This signifies an adjusted difference of 28 days between immigrants from Latin America & Caribbean and Western Europe. This points to wide disparities in wait times based on region of origin. Interestingly, within our sub-intervals, women from these regions showed no statistically significant differences in these intervals compared to long-term residents. However, symptom-diagnosed women from Middle East & North Africa experienced longer median and 90th percentile primary care intervals by 9.0 days (95% CI 1.19, 16.81) and 25.51 days (95% CI 1.80, 49.20), respectively and longer median surgery to chemotherapy intervals by 6.0 days (95% CI 1.51, 10.49) compared to long-term residents.

7.4. Continuity of primary care and time to chemotherapy initiation

Relational continuity of primary care at baseline was mostly not associated with the contact to chemotherapy interval. Neither was it associated with the primary care or surgery to chemotherapy sub-intervals in screened and symptomatic patients after adjusting for potential confounders. The one exception was a statistically significant decrease in the median contact to chemotherapy interval in symptomatic patients by 3.21 days in the low continuity group compared to the high continuity group; the clinical significance of this is likely minimal. Additionally, when we included only those with >2 baseline PCP visits, this finding became non-

statistically significant. As such, we cannot conclude that baseline primary care continuity has much impact on the contact to chemotherapy interval. These findings mostly went against our initial hypothesis that high continuity of care would be associated with decreased contact to chemotherapy and primary care intervals; it was consistent with our hypothesis that there would be no association between the surgery to chemotherapy interval and continuity of primary care at baseline.

In our sensitivity analyses where only those with 3 or more PCP visits during the baseline period were included, we found that symptomatic patients with low continuity of care had an increased 90th percentile contact to chemotherapy interval by 7.60 days (95% CI 0.12, 15.09) compared to those with high continuity of care (compared to a non-statistically significant increase of 6.13 days in the original model including those with <3 PCP visits at baseline). While this is only marginally statistically significant, this points to symptomatic patients with low continuity having a greater variation in the contact to chemotherapy interval than those with high continuity.

Interestingly, primary care utilization at baseline had more of an impact than primary care continuity on the intervals in symptomatic patients, although not in screened patients. Having no PCP visits during the baseline period led to shorter median and 90th percentile contact to chemotherapy interval by 10.7 and 25.4 days in those with symptom-detected breast cancer, respectively. Similarly, having no PCP visits during the baseline period was associated with shorter median and 90th percentile primary care intervals by 8.0 and 28.1 days, respectively, but was not associated with the surgery to chemotherapy interval. It is possible that those with no primary care utilization at baseline were more likely to present to the ED and/or present with later stage disease and more alarming symptoms, prompting earlier referral and consultation with oncology. This might result in a shorter time to chemotherapy initiation [82], but could also lead to worse outcomes as described by the “waiting time paradox” [81]. This possibility is supported by our data since those with no PCP visits at baseline were more likely to be diagnosed at a later stage in our unadjusted analyses.

Other elements of continuity of care besides relational continuity, i.e. informational and management continuity, may have an important impact on the contact to chemotherapy interval that was not assessed in this study. Informational continuity refers to the flow of information used to give care appropriate to the patient’s current circumstance. Informational continuity may better account for the processes required to ensure timely follow-up and management of breast

cancer patients that would affect wait times. However, informational continuity can be difficult to measure using health administrative data [17]. Future studies could include data record availability, completion of referral documents and/or if previously identified problems were followed up as measures of informational continuity in order to determine the effects of informational continuity on wait times to chemotherapy. Management continuity refers to a consistent approach to managing a patient's condition between different providers and is often measured by determining if care was given in the correct sequence, at the proper time and in a clinically appropriate manner [17]. By restricting our population to only those who received surgery followed by adjuvant chemotherapy, we standardized the management and sequence of treatment in our included population. As such, changes in time to chemotherapy due to differences in management continuity are unlikely to be observed in our cohort.

Within the immigrant population studied in our multivariable sensitivity analysis, low continuity of care was associated with a 17.43 day increase (95% CI 0.90-34.76) in the median and 59.37 day increase (95% CI 4.06-114.67) in the 90th percentile contact to chemotherapy interval in the screened, but not the symptomatic population. The majority of this increase, 15.5 days, was due to an increase in the primary care interval. In essence, half of Canadian immigrants with low continuity of primary care at baseline are waiting more than 2 weeks longer to be seen by an oncologist after a positive screen than immigrants with high continuity of primary care; 10% of immigrants with low primary care continuity are waiting almost 2 months longer than those with high primary care continuity. This suggests that relational continuity between the patient and their PCP seems to play more of a role in the immigrant population versus long-term Canadian residents, particularly when organizing a referral and/or further investigations after a positive screening test.

7.5. Missing Data

There were few missing data in our analyses. Specifically, income quintile had 41 missing values, and index contact date had 271 missing values. Rural/urban residence and LHIN each had ≤5 missing values. In our main analyses, these data were assumed to be missing completely at random (i.e. that missing values were neither due to any covariates (missing at random) nor to the outcome (missing not at random)). However, it is possible that the data were missing not at random (i.e. there was a relationship between whether a data point was missing and the value of the missing data point). For example, income quintile was possibly missing due to missing postal code, or having no permanent address, at diagnosis which may

signify low income. Similarly, index contact date was likely missing if the first breast-related healthcare encounter or test occurred after the date of diagnosis. This could have occurred if a patient presented with symptoms to the ED and got admitted for investigation. Initial tests and breast-related encounters used to calculate the index contact date would have occurred after the recorded ED admission date, which can be used to obtain the date of diagnosis in the OCR (table 4-2). As an aside, if investigations were initiated upon initial admission or in the ED upon initial admission, then the time from index contact date to diagnosis (the diagnostic interval) would be set at 0 days. This occurred in 391 patients (3.13%). If the data were missing not at random, our estimates could be biased. Even so, since the number of missing values was quite low, the magnitude of any bias would likely be slight.

In order to test our assumptions about the missing data, we completed sensitivity analyses. When we input the highest and then the lowest values for the missing income quintile data points into our analyses, the estimates showed minimal changes and our conclusions remained the same. Similarly, when we input the diagnosis date as the missing index contact date data points, the estimates changed very little and our conclusions remained the same. As such, even if the missing data points were missing not at random, the bias introduced by this is unlikely to change our results or conclusions.

Half of our cohort had missing values for histological grade and/or receptor status. While this was described in our descriptive analyses, these characteristics were not included in our multivariable analyses. Therefore the high number of missing values for these characteristics did not affect the main results.

7.6. Strengths and Limitations

This study design has various merits as well as some limitations. Using administrative health databases allowed us to sample from the entire population of Ontario in order to build our cohort. This resulted in a large sample size, which increased the power of our study. However, the retrospective nature of our study design means that there are some limits to what data are available from the various data sources. First, we lack information on some demographic variables such as marital status and race. Second, we were unable to determine psychiatric history from hospitalizations since psychiatric admissions in Ontario have not been captured in the CIHI database since April 1, 2006 and are now reported in a separate database. However, the proportion of psychiatric patients that could only be identified from hospitalizations is likely

small (<1%), since most patients will have visits from multiple sources such that we can still capture them in the OHIP database. Furthermore, within the outpatient setting, we only captured MH visits in the primary care setting; however, this likely did not alter our findings much since there were only 3 patients who visited a psychiatrist at baseline that did not have any primary care MH visits at baseline. Third, OHIP data do not provide us with precise clinical reasons for primary care visits and we are unable to differentiate family medicine clinic visits with walk-in clinic visits. Fourth, capitation and salaried primary care models, as opposed to fee-for-service models, often perform shadow billing, which involves submitting information about provided services for tracking purposes with only a fraction of the billing resulting in reimbursement. The accuracy of shadow billing in Ontario has not been studied and may underestimate the number of primary care visits that occurred. This is particularly important for the 34.8% of patients in our study who were enrolled in a capitation model. Fifth, our measure of relational primary care continuity, the UPC index, focuses on continuity of visits with a single PCP; it does not take into consideration continuity within a group practice. If relational continuity within a group practice has more effect than continuity with a single provider, these effects might have been obscured in our analyses as some patients with low single provider continuity might, in fact, have high continuity within a group practice. Sixth, while we used strict definitions for our time points and intervals, these methods were not previously validated. The Aarhus statement defines the date of first presentation, which we termed “index contact date” in our study, as “the time point at which, given the presenting signs, symptoms, history and other risk factors, it would be at least possible for the clinician seeing that patient to have started investigation or referral for possible important pathology, including cancer” [71] and notes that measuring this can be complex. While they suggest in-depth qualitative interviews with patients and primary care providers with calendar landmarking to reduce recall bias, such an endeavour was beyond the scope of our study. Seventh, while we examined many intervals included in the Aarhus statement, we were unable to examine the patient interval (from first symptoms to first presentation to health care) since this is difficult to capture with health administrative data. Relational continuity may have a large part to play in decreasing the patient interval; however, this was unable to be addressed in our study.

Eighth, we did not specifically identify patients who were diagnosed in the ED without primary care involvement. First breast cancer presentation in the ED is uncommon. A study of 103 breast cancer patients in Quebec, Canada found that only 3.7% had investigations initiated in the ED [116]. A study from the East of England found that only 4% of breast cancers diagnosed

in 2006-2008 were referred to a specialist or admitted to hospital through an ED prior to diagnosis [154]. Furthermore, another study from England using survey data found that of those breast cancer patients who were considered “emergency presenters”, over 65% had actually had cancer-related primary care consultations prior to their emergency presentation [155]. As such, only a small proportion of patients were likely to have no primary care involvement prior to diagnosis. Patients with no primary care involvement could potentially have shorter “primary care” intervals due to earlier involvement of specialists if referred directly from the ED. It is helpful to consider this when interpreting our findings. Patients with no primary care involvement could potentially have a shorter primary care interval due to earlier involvement of specialists if referred directly from the ED.

Ninth, the CanIMPACT cohort used in this thesis involved patients diagnosed from 2007 to 2011. Trends from more recent technologies that may influence PCP visits and/or wait times to receiving chemotherapy, such as Oncotype Dx ®, which leads to increased wait times to receiving chemotherapy [103] and only began being funded in Ontario in early 2010, would not be well-captured in our data. An Ontario study of cancer patients from 2002 to 2012 found that median time to first breast cancer treatment decreased by 1.6 days per year during the studied period. Time to first breast cancer treatment decreased over the included years if first treatment was chemotherapy or radiotherapy, but increased if first treatment was surgery [153]. Therefore, including more recent data may show some differences in median wait times, although the magnitude of these differences is likely to be small.

Tenth, when classifying the region of origin of the immigrant population, we used large groupings based on a patient’s country of birth that encompass many diverse countries and locations. While this grouping was based on that used by the World Bank and published in other studies, it does not reflect the cultural and economic variations within the grouping.

One of the limitations of using administrative health data is the potential for misclassification bias. In our study, for instance, 1.8% of PCP visits during adjuvant chemotherapy had a diagnostic code of male breast cancer, despite males being excluded from our cohort. This is likely explained by misclassification, i.e. PCPs entering the wrong diagnostic code for the visit. As another example, patients seen in CHCs were not identified in our study. Shadow billing is not required in a CHC and visits by patients in these models are likely underrepresented in our data. However, if shadow billing were performed, these patients would have been misclassified as having been seen in a straight FFS model, instead of in a salaried

model, since these patients are considered unenrolled. That being stated, in 2015, <1% of Ontarians were seen in a CHC [134], so this misclassification is likely to affect a small minority of patients. Additionally, OHIP fee codes identifying receipt of chemotherapy do not differentiate between adjuvant chemotherapy and palliative chemotherapy. We aimed to reduce the likelihood of palliative chemotherapy being misclassified as adjuvant by including only those who received chemotherapy within 4 months of surgery. That being said, since we included only patients diagnosed with stage I to III breast cancer who received surgery, the chance that the chemotherapy received was for palliation is small. Similarly, codes used to identify screening mammograms may misclassify some that are actually diagnostic mammograms for symptomatic patients. There is a possibility that some medical oncologists may have been misclassified as internal medicine specialists and would have been missed in our study. The IPDB contains self-reported main specialties taken from the Ontario Physician Human Resource Data Centre and was able to identify 231 medical oncologists in 2011 [13]. Additionally, the number of visits during the treatment period in our dataset that were attributed to internal medicine specialists was 840 visits compared to 133,654 visits with medical oncologists. Therefore, the number of medical oncology visits that may have been misclassified is likely small. New immigrants who were residing in Ontario at the time of diagnosis but originally landed in another province were not captured and would have been misclassified as long-term residents. Additionally, the IRCC database does not include immigrants that arrived prior to 1985. Therefore, immigrants arriving prior to 1985 would have been misclassified as long-term residents. Using the PCCF, which links postal codes to Statistics Canada census data, to identify geo-coded information such as area-level socioeconomic status and urban/rural residence, poses similar limitations. Postal codes used in the PCCF may contain multiple records when the postal code covers more than one block-face, dissemination block, or dissemination area. This is a particular issue in rural areas and with community mailboxes. As such, these areas may not be as precisely identified with the PCCF. The PCCF+ deals with this issue by using population-weighted random allocation for postal codes with multiple matches to ensure that the distribution of respondents more accurately reflects the underlying population. However, misclassification can still occur, particularly in rural areas and at urban fringe [132]. Additionally, we used the PCCF 2006 version, which covers the time frame from 2004-2008. We did not incorporate the PCCF 2011, which covers the time frame from 2009-2013. It is possible that some of the information in the 2006 PCCF became outdated as neighbourhoods changed. The impact of misclassification bias when using administrative health data is difficult to ascertain without full validation studies for each

variable assessed. As such, it is important to be aware of potential misclassification bias when interpreting our results.

Chapter 8: Conclusions & Future Directions

8.1. Conclusions & implications

8.1.1. Overall summary of key findings

In this thesis, we found that PCP visit rates start to increase during the 3 months prior to breast cancer diagnosis and remain elevated during the first 6 months after starting adjuvant chemotherapy. While patients with high comorbidity levels and/or a history of MH concerns have the highest absolute number of PCP visits during this treatment period (mean 5.3 ± 4.2 and 4.1 ± 3.8, respectively), these patients have a much lower relative increase in visit rate from baseline compared to those with low comorbidity or no history of MH concerns (RoR 0.48, 95% CI 0.46-0.51 and RoR 0.75, 95% CI 0.72-0.78, respectively). This could be due to a "ceiling effect" – where those with high comorbidity and/or a MH history already have a relatively saturated number of PCP visits at baseline with little room for increasing visits during the treatment period and those with low comorbidity and/or no MH history have few PCP visits at baseline and greater potential for increased visits. Approximately 40% of PCP visits made during the treatment period were for breast cancer-related concerns.

We also found that the median contact to chemotherapy interval was 126 days. Continuity of primary care at baseline was not strongly associated with the wait times to receiving chemotherapy. Low primary care utilization, on the other hand, was associated with a 10.7 day decrease in the median contact to chemotherapy interval in those with symptom-detected breast cancer. This may potentially be due to these patients presenting with advanced disease or more severe symptoms prompting more urgent referral to oncology.

In the immigrant population, continuity of primary care at baseline had a greater effect on the contact to chemotherapy interval. Specifically, among immigrants with screen-detected breast cancers, those with low primary care continuity at baseline had a 17.4 day longer median and a 59.4 day longer 90th percentile contact to chemotherapy interval compared to immigrants with high primary care continuity at baseline. This suggests that primary care continuity plays an important role when organizing referrals and/or further investigations after a positive screening test in the immigrant population. Additionally, we identified wide disparities in the contact to chemotherapy interval between immigrant groups, with immigrants from Latin America &

Caribbean experiencing an adjusted 28 day increase in this interval compared to immigrants from Western Europe.

8.1.2. Implications for primary care providers

Overall, PCPs can expect breast cancer patients to have an increase of 1 visit per 6 months from their baseline rate after starting adjuvant chemotherapy. PCPs can plan for their patients with high physical and/or mental comorbidity to continue having appointments at a high rate while they undergo chemotherapy and they can expect their patients with low physical and/or mental comorbidity to increase the frequency of their visits during chemotherapy with almost 40% of these visits being related to their breast cancer diagnosis. It is therefore important for the PCP to be aware of issues that may arise during chemotherapy and be able to provide management strategies for these issues.

PCPs can also make efforts to increase continuity of care, particularly with immigrant patients, since high continuity of care (seeing the same PCP in over 75% of visits) is associated with reduced wait times to chemotherapy and first specialist visit in immigrants with screen-detected breast cancers.

Poor informational continuity between PCPs and oncologists has been identified as a problem area in Canadian cancer care [8,156]. Since we found that PCPs are often visited while a patient is undergoing adjuvant chemotherapy, good coordination of care and informational continuity between PCPs and oncology specialists during this time is important and should be a focus for future improvement.

Interventions to improve shared care between PCPs and oncologists of cancer patients during chemotherapy have been explored. In Australia, Jefford et al. found that faxing information tailored to the patient's chemotherapy regimen to PCPs increased PCP confidence and satisfaction with shared care, with no differences seen in knowledge [157]. In February 2018, CanIMPACT launched a trial of eOncoNote, an asynchronous communication platform aimed at improving communication between PCPs and oncologists through a patient's diagnosis, treatment and survivorship [158]. More details on eOncoNote are described in section 8.2.2. Incorporating these or other interventions to improve shared care and informational continuity during chemotherapy can assist PCPs in caring for patients over the increased number of visits during this time.

8.1.3. Implications for breast cancer specialists and policymakers

We found that visits to PCPs increase during the adjuvant chemotherapy treatment period. As such, it is important for specialists to be aware of the PCPs involvement in care during this time and ideally to be open for consultation and easily accessible should the PCP have any concerns. Interventions such as the ones listed in the previous section should be considered in order to improve informational continuity between PCPs and oncologists.

The median surgery to adjuvant chemotherapy interval was 58 days, or just over 8 weeks. With previous studies showing higher mortality for intervals greater than 4 weeks, decreasing this interval may be an important target for breast cancer specialists and policymakers. It was also interesting to note that those in the Champlain LHIN had consistently longer median wait times across screened and symptomatic groups (up to 26 to 36 days longer than other LHINs), even among both the primary care and surgery to chemotherapy sub-intervals. While the association between these longer jurisdictional wait times on mortality or morbidity outcomes has not been studied, it may be important for policymakers to investigate the processes that occur in this LHIN that may be contributing to longer times to oncology consultation and receiving adjuvant chemotherapy. Similarly, we identified wide disparities in wait times between immigrants from certain regions, with the longest wait times seen in immigrants from Latin America & Caribbean and East Asia & Pacific. Addressing these inequalities will help improve quality of care in these populations.

8.2. Future directions

8.2.1. Knowledge translation and dissemination

Given the important role of primary care in managing breast cancer patients, our findings will be relevant to many audiences within Ontario and Canada. The results of this study will be of particular interest to clinicians, cancer care and primary care researchers, healthcare administrators and policy makers, including Cancer Care Ontario and the MOHLTC.

We plan to publish our results for a variety of audiences. We will present our data on PCP visits during chemotherapy for publication in a journal targeted towards practicing PCPs. We will present our data on wait times for publication in a journal targeted towards oncologists and/or PCPs. Publishing in these journals will help us disseminate our findings to researchers

and practicing physicians who are key stakeholders in developing methods for improved shared care of breast cancer patients undergoing chemotherapy.

We will also disseminate our findings through presentations to stakeholders. We have already presented our preliminary work at the Ca-PRI (Cancer and Primary Care Research International Network) conference in May 2019 as well as the NAPCRG (North American Primary Research Group) conference in November 2019 to audiences of primary care and cancer researchers. In addition to local rounds at the Department of Family and Community Medicine at the University of Toronto, we plan to present these findings at Continuing Medical Education accredited conferences, such as the national Family Medicine Forum organized by the College of Family Physicians of Canada, in order to engage with practicing physicians. We plan to present our findings, particularly our wait time findings, to Cancer Care Ontario, now part of Ontario Health, in order to ensure that the appropriate health administrators and policymakers are aware of the areas that can be targeted for improvement – such as reducing the surgery to chemotherapy interval, exploring regional variations in the Champlain LHIN and addressing disparities seen within the immigrant populations.

8.2.2. Future research

Since breast cancer patients frequently visit their PCPs during breast cancer chemotherapy, improving coordination of care and informational continuity with oncologists during this time is crucial. In February 2018, CanIMPACT launched a pragmatic randomized controlled trial of eOncoNote, an intervention consisting of a secure online asynchronous communication platform aimed at improving informational continuity of care between PCPs and oncologists through a patient's diagnosis, treatment and survivorship. This intervention is currently being trialed in the Champlain LHIN. With a plan to recruit 264 patients, the study will involve patient questionnaires, usage metrics, hospital data, PCP surveys and interview with patients, PCPs, cancer specialists, managers and administrators [158].

Primary care continuity and baseline PCP utilization were shown to impact wait times to receiving chemotherapy in certain populations. However, the impact of primary care continuity on survival outcomes has not been studied. Future research will use health administrative data to assess the impact of primary care continuity, utilization and wait times to receiving chemotherapy on breast cancer survival outcomes in our CanIMPACT cohort.

We demonstrated that PCP visits increase during adjuvant chemotherapy, with the greatest relative increase seen in those with low physical and/or mental comorbidity. It is possible that some of these PCP visits were due to relatively poor access to oncologists, resulting in patients being re-directed to or more easily seen by the PCP. Alternative reasons for the increase in PCP visits could be explored through qualitative interviews with patients or chart reviews.

We showed that low primary care utilization at baseline was associated with decreased times to chemotherapy. While later stage at presentation and higher urgency of work-up and treatment may explain some of this association, alternative reasons can be explored. For example, it is possible that those who present frequently to their PCP with concerns may not be taken as seriously or treated with as much urgency as those who present less frequently. This could be investigated through qualitative interviews with patients and providers.

We found disparities in the contact to chemotherapy interval based on LHIN and on immigrant region of origin. By engaging the proper stakeholders through CCO, we can conduct case studies to properly examine why wait times are longer in the Champlain LHIN and among immigrants from Latin America & Caribbean. With the provision of care currently being moved from LHINs to Ontario Health Teams, it is especially important to understand the shortcomings of the specific LHINs in order to improve processes when developing the Ontario Health Teams. We can also use a deeper understanding of potential biases in the provision of breast cancer care among immigrants to improve care of these populations under the Ontario Health Teams.

8.3. Overall conclusion

Breast cancer patients commonly see their PCPs when they are undergoing adjuvant chemotherapy. While patients with high physical and/or mental comorbidity see their PCP the most often during this time in absolute numbers, the greatest relative increase in PCP visits during adjuvant chemotherapy is seen in those with low physical and/or mental comorbidity. These visits are most commonly due to breast cancer-related concerns. PCPs should therefore have processes in place to help them deal with patient concerns that might arise during breast cancer chemotherapy.

Primary care continuity at baseline had a minimal effect on the wait times to chemotherapy in our main cohort. However, high primary care continuity was associated with shorter times to chemotherapy among immigrants with screen-detected breast cancers. Primary

care continuity may therefore be a more important focus when providing care for immigrant populations. Additionally, wide disparities were seen in the time to chemotherapy between certain groups of immigrants. Addressing the unequal processes that contribute to the longer time to treatment seen in those from Latin America & Caribbean and East Asia & Pacific will be important in improving care for these populations.

References

1. Del Giudice L, Bondy SJ, Chen Z, Maaten S. Physician care of cancer patients. In: Jaakkimainen L, Upshur REG, Klein-Geltink JE, et al, eds. *Primary care in ontario: ICES atlas.* Toronto, ON: the Institute for Clinical Evaluative Sciences (ICES); 2006:161-174.

2. Rubin G, Berendsen A, Crawford SM, et al. The expanding role of primary care in cancer control. *Lancet Oncol*. 2015;16(12):1231-1272.

3. Grunfeld E. It takes a team: CanIMPACT: Canadian team to improve community-based cancer care along the continuum. *Can Fam Physician*. 2016;62(10):781-782.

4. CanIMPACT. Quantitative subgroup: Administrative health data analysis. https://canimpact.utoronto.ca/streams-and-themes/quantitative/. Updated 2019. Accessed 12/16, 2019.

5. Groome PA, McBride ML, Jiang L, et al. Lessons learned: It takes a village to understand inter-sectoral care using administrative data across jurisdictions. *International Journal of Population Data Science*. 2018;3(3):8.

6. Jiang L, Lofters A, Moineddin R, et al. Primary care physician use across the breast cancer care continuum: CanIMPACT study using canadian administrative data. *Can Fam Physician*. 2016;62(10):e589-e598.

7. Bastedo SJ, Krzyzanowska MK, Moineddin R, Yun L, Enright KA, Grunfeld E. A population-based assessment of primary care visits during adjuvant chemotherapy for breast cancer. *Curr Oncol*. 2017;24(2):90-94.

8. Easley J, Miedema B, O'Brien MA, et al. The role of family physicians in cancer care: Perspectives of primary and specialty care providers. *Curr Oncol*. 2017;24(2):75-80.

9. Lofters AK, McBride ML, Li D, et al. Disparities in breast cancer diagnosis for immigrant women in ontario and BC: Results from the CanIMPACT study. *BMC Cancer*. 2019;19(1):42-018-5201-0.

10. O'Brien MA, Carroll JC, Manca DP, et al. Multigene expression profile testing in breast cancer: Is there a role for family physicians? *Curr Oncol*. 2017;24(2):95-102.

11. Statistics Canada. Focus on geography series, 2011 census: Province of ontario. https://www12.statcan.gc.ca/census-recensement/2011/as-sa/fogs-spg/Facts-pr-eng.cfm?Lang=eng&GC=35. Updated 2012. Accessed 08/19, 2019.

12. Ontario Ministry of Health and Long-Term Care. Ministry programs: Ontario health insurance plan. http://www.health.gov.on.ca/en/public/programs/ohip/ohipfaq_mn.aspx. Updated 2015. Accessed 08/19, 2019.

13. ICES Intranet. ICES physician database (IPDB). https://ssl.ices.on.ca/dataprog/Data%20Holdings/Care%20Providers/IPDB/,DanaInfo=.aioulhjFp

kn2K00Nrq,SSL+whatsnew.htm#2011_Specialty_numbers_by_different_definitions. Updated 2019. Accessed 12/17, 2019.

14. Ontario Medical Association. OMA factsheet. https://www.oma.org/sections/news-events/news-room/oma-factsheet/. Updated 2015. Accessed 08/19, 2019.

15. Finley CR, Chan DS, Garrison S, et al. What are the most common conditions in primary care? systematic review. *Can Fam Physician*. 2018;64(11):832-840.

16. The College of Family Physicians of Canada. Family medicine professional profile. . 2018.

17. Reid R, Haggerty J, McKendry R. Defusing the confusion: Concepts and measures of continuity of healthcare. . 2002.

18. Canadian Institute for Health Information. Continuity of care with family medicine physicians: Why it matters. . 2015.

19. Towards Optimized Practice. Evidence summary: The benefits of relational continuity in primary care. . 2017.

20. Marchildon GP, Hutchison B. Primary care in ontario, canada: New proposals after 15 years of reform. *Health Policy*. 2016;120(7):732-738.

21. Hutchison B, Levesque JF, Strumpf E, Coyle N. Primary health care in canada: Systems in motion. *Milbank Q*. 2011;89(2):256-288.

22. Fleming M. Ontario patient rostering. . 2010.

23. Aggarwal M. *Primary care reform: A case study of ontario.* [Doctor of philosophy]. Toronto: Department of Health Policy, Management and Evaluation, University of Toronto; 2009.

24. Glazier RH, Zagorski BM, Rayner JM. Comparison of primary care models in ontario by demographics, case mix and emergency department use, 2008/09 to 2009/10. . 2012.

25. Fitzpatrick S. Primary care: Ontario payment reform. . 2010.

26. Morreale M. Fact sheet: What factors can influence health care utilization? . 1998.

27. Grimsmo A, Siem H. Factors affecting primary health care utilization. *Fam Pract*. 1984;1(3):155-161.

28. Alkhawaldeh A, Holm MB, Qaddumi J, Petro W, Jaghbir M, Al Omari O. A cross-sectional study to examine factors associated with primary health care service utilization among older adults in the irbid governorate of jordan. *Curr Gerontol Geriatr Res*. 2014;2014:735235.

29. Yan S, Seng BJJ, Kwan YH, et al. Identifying heterogeneous health profiles of primary care utilizers and their differential healthcare utilization and mortality - a retrospective cohort study. *BMC Fam Pract*. 2019;20(1):54-019-0939-2.

30. Muggah E, Dahrouge S, Hogg W. Access to primary health care for immigrants: Results of a patient survey conducted in 137 primary care practices in ontario, canada. *BMC Fam Pract*. 2012;13:128-2296-13-128.

31. Aery A, McKenzie K. Primary care utilization trajectories for immigrants and refugees in ontario compared with long-term residents. . 2018.

32. Dassah E, Aldersey H, McColl MA, Davison C. Factors affecting access to primary health care services for persons with disabilities in rural areas: A "best-fit" framework synthesis. *Global health research and policy*. 2018;3(36).

33. Ferlay J, Soerjomataram I, Dikshit R, et al. Cancer incidence and mortality worldwide: Sources, methods and major patterns in GLOBOCAN 2012. *Int J Cancer*. 2015;136(5):E359-86.

34. Canadian Cancer Society's Advisory Committee on Cancer Statistics. ,Canadian cancer statistics 2017. . 2017.

35. Canadian Cancer Society. Breast cancer statistics. https://www.cancer.ca/en/cancer-information/cancer-type/breast/statistics/?region=on. Updated 2019. Accessed 08/30, 2019.

36. Cancer Care Ontario. Ontario cancer statistics 2018 report. . 2018.

37. Cancer Care Ontario. Ontario breast screening program (OBSP). https://www.cancercareontario.ca/en/cancer-care-ontario/programs/screening-programs/ontario-breast-obsp. Updated 2019. Accessed 08/30, 2019.

38. Cancer Quality Council of Ontario. Breast cancer screening participation and retention. https://www.csqi.on.ca/indicators/breast-cancer-screening-participation-retention. Updated 2017. Accessed 06/14, 2019.

39. Canadian Cancer Society. Stages of breast cancer. https://www.cancer.ca/en/cancer-information/cancer-type/breast/staging/?region=on. Updated 2019. Accessed 07/12, 2019.

40. Canadian Cancer Society. Radiation therapy for breast cancer. https://www.cancer.ca/en/cancer-information/cancer-type/breast/treatment/radiation-therapy/?region=on. Updated 2019. Accessed 07/18, 2019.

41. Kim CS, Algan O. Radiation therapy, breast cancer early stage. In: *StatPearls.* Treasure Island (FL): StatPearls Publishing LLC; 2017. NBK459174 [bookaccession].

42. Canadian Cancer Society. Grading breast cancer. https://www.cancer.ca/en/cancer-information/cancer-type/breast/grading/?region=on. Updated 2019. Accessed 07/12, 2019.

43. Anampa J, Makower D, Sparano JA. Progress in adjuvant chemotherapy for breast cancer: An overview. *BMC Med*. 2015;13:195-015-0439-8.

44. Canadian Cancer Society. Hormonal therapy for breast cancer. https://www.cancer.ca/en/cancer-information/cancer-type/breast/treatment/hormonal-therapy/?region=on. Updated 2019. Accessed 07/18, 2019.

45. Canadian Cancer Society. Targeted therapy for breast cancer. https://www.cancer.ca/en/cancer-information/cancer-type/breast/treatment/targeted-therapy/?region=on. Updated 2019. Accessed 07/18, 2019.

46. Canadian Cancer Society. Chemotherapy for breast cancer. https://www.cancer.ca/en/cancer-information/cancer-type/breast/treatment/chemotherapy/?region=on. Updated 2019. Accessed 07/15, 2019.

47. Miller KD, Siegel RL, Lin CC, et al. Cancer treatment and survivorship statistics, 2016. *CA Cancer J Clin*. 2016;66(4):271-289.

48. Powis M, Groome P, Biswanger N, et al. Cross-canada differences in early-stage breast cancer treatment and acute-care use. *Curr Oncol*. 2019;26(5):e624-e639.

49. Sisler JJ, DeCarolis M, Robinson D, Sivananthan G. Family physicians who have focused practices in oncology: Results of a national survey. *Can Fam Physician*. 2013;59(6):e290-7.

50. Canadian Medical Association. Medical oncology profile. https://www.cma.ca/sites/default/files/2019-01/medical-oncology-e.pdf. Updated 2018. Accessed 07/18, 2019.

51. Blouin L. Defining the role of GPOs: Pinch hitters or team players? *Oncology Exchange*. 2012;11(1):8-9.

52. Baena-Canada JM, Estalella-Mendoza S, Rosado-Varela P, et al. Use of health-care services during chemotherapy for breast cancer. *Eur J Cancer*. 2012;48(18):3328-3334.

53. Roorda C, de Bock GH, van der Veen WJ, Lindeman A, Jansen L, van der Meer K. Role of the general practitioner during the active breast cancer treatment phase: An analysis of health care use. *Support Care Cancer*. 2012;20(4):705-714.

54. Ben-Ami E, Merom H, Sikron F, Livneh J, Sadetzki S, Wolf I. Involvement of the family physician in the care of chemotherapy-treated patients with cancer: Patients' perspectives. *J Oncol Pract*. 2014;10(5):298-305.

55. Wallner LP, Li Y, Furgal AKC, et al. Patient preferences for primary care provider roles in breast cancer survivorship care. *J Clin Oncol*. 2017;35(25):2942-2948.

56. Ng HS, Vitry A, Koczwara B, Roder D, McBride ML. Patterns of comorbidities in women with breast cancer: A canadian population-based study. *Cancer Causes Control*. 2019.

57. Loh KY, Ng T, Lee CP, Ng R, Chan A. Medication use by early-stage breast cancer survivors: A 1-year longitudinal study. *Support Care Cancer*. 2016;24(4):1639-1647.

58. Haskins CB, McDowell BD, Carnahan RM, et al. Impact of preexisting mental illness on breast cancer endocrine therapy adherence. *Breast Cancer Res Treat*. 2019;174(1):197-208.

59. Nakash O, Levav I, Aguilar-Gaxiola S, et al. Comorbidity of common mental disorders with cancer and their treatment gap: Findings from the world mental health surveys. *Psychooncology*. 2014;23(1):40-51.

60. Jafari A, Goudarzian AH, Bagheri Nesami M. Depression in women with breast cancer: A systematic review of cross-sectional studies in iran. *Asian Pac J Cancer Prev*. 2018;19(1):1-7.

61. Jones SM, Rosenberg D, Ludman E, Arterburn D. Medical comorbidity and psychotropic medication fills in older adults with breast or prostate cancer. *Support Care Cancer*. 2015;23(10):3005-3009.

62. Prasad S, Sung B, Aggarwal BB. Age-associated chronic diseases require age-old medicine: Role of chronic inflammation. *Prev Med*. 2012;54 Suppl(Suppl):S29-37.

63. Hopman WM, Harrison MB, Coo H, Friedberg E, Buchanan M, VanDenKerkhof EG. Associations between chronic disease, age and physical and mental health status. *Chronic Dis Can*. 2009;29(3):108-116.

64. Roberts KC, Rao DP, Bennett TL, Loukine L, Jayaraman GC. Prevalence and patterns of chronic disease multimorbidity and associated determinants in canada. *Health Promot Chronic Dis Prev Can*. 2015;35(6):87-94.

65. Weeks WB, Kazis LE, Shen Y, et al. Differences in health-related quality of life in rural and urban veterans. *Am J Public Health*. 2004;94(10):1762-1767.

66. Gimeno-Feliu LA, Calderon-Larranaga A, Diaz E, et al. Multimorbidity and immigrant status: Associations with area of origin and length of residence in host country. *Fam Pract*. 2017;34(6):662-666.

67. Napolitano F, Napolitano P, Garofalo L, Recupito M, Angelillo IF. Assessment of continuity of care among patients with multiple chronic conditions in italy. *PLoS One*. 2016;11(5):e0154940.

68. Ell K, Sanchez K, Vourlekis B, et al. Depression, correlates of depression, and receipt of depression care among low-income women with breast or gynecologic cancer. *J Clin Oncol*. 2005;23(13):3052-3060.

69. Neal RD, Tharmanathan P, France B, et al. Is increased time to diagnosis and treatment in symptomatic cancer associated with poorer outcomes? systematic review. *Br J Cancer*. 2015;112 Suppl 1:S92-107.

70. Butler J, Foot C, Bomb M, et al. The international cancer benchmarking partnership: An international collaboration to inform cancer policy in australia, canada, denmark, norway, sweden and the united kingdom. *Health Policy*. 2013;112(1-2):148-155.

71. Weller D, Vedsted P, Rubin G, et al. The aarhus statement: Improving design and reporting of studies on early cancer diagnosis. *Br J Cancer*. 2012;106(7):1262-1267.

72. Weller D, Vedsted P, Anandan C, et al. An investigation of routes to cancer diagnosis in 10 international jurisdictions, as part of the international cancer benchmarking partnership: Survey development and implementation. *BMJ Open*. 2016;6(7):e009641-2015-009641.

73. Health Quality Ontario. Measuring wait times for cancer surgeries. . 2019.

74. Health Quality Ontario. Time from decision to having cancer surgery. https://www.hqontario.ca/System-Performance/Wait-Times-for-Surgeries-and-Procedures/Wait-Times-for-Cancer-Surgeries/Time-from-Decision-to-Having-Cancer-Surgery. Updated 2019. Accessed 07/25, 2019.

75. Cancer Care Ontario. Women with breast cancer are being appropriately assigned surgical wait times. https://www.cancercareontario.ca/en/cancer-facts/women-breast-cancer-are-being-appropriately-assigned-surgical-wait-times. Updated 2018. Accessed 07/25, 2019.

76. Cancer Care Ontario. Systemic treatment wait times. http://ocp.cancercare.on.ca/cms/One.aspx?portalId=327895&pageId=8888. Updated 2017. Accessed 12/16, 2019.

77. Mathews M, Ryan D, Bulman D. What does satisfaction with wait times mean to cancer patients? *BMC Cancer*. 2015;15:1017-015-2041-z.

78. Ermiah E, Abdalla F, Buhmeida A, Larbesh E, Pyrhonen S, Collan Y. Diagnosis delay in libyan female breast cancer. *BMC Res Notes*. 2012;5:452-0500-5-452.

79. Huo Q, Cai C, Zhang Y, et al. Delay in diagnosis and treatment of symptomatic breast cancer in china. *Ann Surg Oncol*. 2015;22(3):883-888.

80. Torring ML, Frydenberg M, Hansen RP, Olesen F, Vedsted P. Evidence of increasing mortality with longer diagnostic intervals for five common cancers: A cohort study in primary care. *Eur J Cancer*. 2013;49(9):2187-2198.

81. Lukacs G, Kovacs A, Csanadi M, et al. Benefits of timely care in pancreatic cancer: A systematic review to navigate through the contradictory evidence. *Cancer Manag Res*. 2019;11:9849-9861.

82. Redaniel MT, Martin RM, Ridd MJ, Wade J, Jeffreys M. Diagnostic intervals and its association with breast, prostate, lung and colorectal cancer survival in england: Historical cohort study using the clinical practice research datalink. *PLoS One*. 2015;10(5):e0126608.

83. Torring ML, Falborg AZ, Jensen H, et al. Advanced-stage cancer and time to diagnosis: An international cancer benchmarking partnership (ICBP) cross-sectional study. *Eur J Cancer Care (Engl)*. 2019;28(5):e13100.

84. Raphael MJ, Biagi JJ, Kong W, Mates M, Booth CM, Mackillop WJ. The relationship between time to initiation of adjuvant chemotherapy and survival in breast cancer: A systematic review and meta-analysis. *Breast Cancer Res Treat*. 2016;160(1):17-28.

85. Zhan QH, Fu JQ, Fu FM, Zhang J, Wang C. Survival and time to initiation of adjuvant chemotherapy among breast cancer patients: A systematic review and meta-analysis. *Oncotarget*. 2017;9(2):2739-2751.

86. Brazda A, Estroff J, Euhus D, et al. Delays in time to treatment and survival impact in breast cancer. *Ann Surg Oncol*. 2010;17 Suppl 3:291-296.

87. Mujar M, Dahlui M, Yip CH, Taib NA. Delays in time to primary treatment after a diagnosis of breast cancer: Does it impact survival? *Prev Med*. 2013;56(3-4):222-224.

88. Smith ER, Adams SA, Das IP, Bottai M, Fulton J, Hebert JR. Breast cancer survival among economically disadvantaged women: The influences of delayed diagnosis and treatment on mortality. *Cancer Epidemiol Biomarkers Prev*. 2008;17(10):2882-2890.

89. Khorana AA, Tullio K, Elson P, et al. Time to initial cancer treatment in the united states and association with survival over time: An observational study. *PLoS One*. 2019;14(3):e0213209.

90. Kupstas AR, Hoskin TL, Day CN, Habermann EB, Boughey JC. Effect of surgery type on time to adjuvant chemotherapy and impact of delay on breast cancer survival: A national cancer database analysis. *Ann Surg Oncol*. 2019.

91. Richards MA, Westcombe AM, Love SB, Littlejohns P, Ramirez AJ. Influence of delay on survival in patients with breast cancer: A systematic review. *Lancet*. 1999;353(9159):1119-1126.

92. Walter F, Webster A, Scott S, Emery J. The andersen model of total patient delay: A systematic review of its application in cancer diagnosis. *J Health Serv Res Policy*. 2012;17(2):110-118.

93. Chavez-MacGregor M, Clarke CA, Lichtensztajn DY, Giordano SH. Delayed initiation of adjuvant chemotherapy among patients with breast cancer. *JAMA Oncol*. 2016;2(3):322-329.

94. He X, Ye F, Zhao B, et al. Risk factors for delay of adjuvant chemotherapy in non-metastatic breast cancer patients: A systematic review and meta-analysis involving 186982 patients. *PLoS One*. 2017;12(3):e0173862.

95. Cabral ALLV, Giatti L, Casale C, Cherchiglia ML. Social vulnerability and breast cancer: Differentials in the interval between diagnosis and treatment of women with different sociodemographic profiles. *Cien Saude Colet*. 2019;24(2):613-622.

96. Li Y, Zhou Y, Mao F, et al. The influence on survival of delay in the treatment initiation of screening detected non-symptomatic breast cancer. *Sci Rep*. 2019;9(1):10158-019-46736-1.

97. Saint-Jacques N, Younis T, Dewar R, Rayson D. Wait times for breast cancer care. *Br J Cancer*. 2007;96(1):162-168.

98. Plotogea A, Chiarelli AM, Mirea L, et al. Factors associated with wait times across the breast cancer treatment pathway in ontario. *Springerplus*. 2013;2:388-1801-2-388. eCollection 2013.

99. Ramirez AJ, Westcombe AM, Burgess CC, Sutton S, Littlejohns P, Richards MA. Factors predicting delayed presentation of symptomatic breast cancer: A systematic review. *Lancet*. 1999;353(9159):1127-1131.

100. Blackmore KM, Weerasinghe A, Holloway CMB, et al. Comparison of wait times across the breast cancer treatment pathway among screened women undergoing organized breast assessment versus usual care. *Can J Public Health*. 2019.

101. McKevitt EC, Dingee CK, Leung SP, et al. Reduced time to breast cancer diagnosis with coordination of radiological and clinical care. *Cureus*. 2017;9(12):e1919.

102. de Melo Gagliato D, Chavez-MacGregor M. Delays in adjuvant chemotherapy among breast cancer patients: An unintended consequence of breast surgery? *Ann Surg Oncol*. 2018;25(7):1786-1787.

103. Losk K, Freedman RA, Lin NU, et al. Implementation of surgeon-initiated gene expression profile testing (onco type DX) among patients with early-stage breast cancer to reduce delays in chemotherapy initiation. *J Oncol Pract*. 2017;13(9):e815-e820.

104. Barisic A, Kish M, Gilbert J, et al. Family physician access to and wait times for cancer diagnostic investigations: Regional differences among 3 provinces. *Can Fam Physician*. 2016;62(10):e599-e607.

105. Groome PA, Webber C, Whitehead M, et al. Determining the cancer diagnostic interval using administrative health care data in a breast cancer cohort. *JCO Clinical Cancer Informatics*. 2019(3):1-10.

106. Velikova G, Booth L, Johnston C, Forman D, Selby P. Breast cancer outcomes in south asian population of west yorkshire. *British journal of cancer*. 2004;90(10):1926-1932.

107. Jenner DC, Middleton A, Webb WM, Oommen R, Bates T. In-hospital delay in the diagnosis of breast cancer. *Br J Surg*. 2000;87(7):914-919.

108. Goodson WH,3rd, Moore DH,2nd. Causes of physician delay in the diagnosis of breast cancer. *Arch Intern Med*. 2002;162(12):1343-1348.

109. Moodley J, Cairncross L, Naiker T, Constant D. From symptom discovery to treatment - women's pathways to breast cancer care: A cross-sectional study. *BMC Cancer*. 2018;18(1):312-018-4219-7.

110. Statistics Canada. Immigration and ethnocultural diversity in canada. https://www12.statcan.gc.ca/nhs-enm/2011/as-sa/99-010-x/99-010-x2011001-eng.cfm. Updated 2018. Accessed 07/12, 2019.

111. Vahabi M, Lofters A, Kumar M, Glazier RH. Breast cancer screening disparities among immigrant women by world region of origin: A population-based study in ontario, canada. *Cancer Med*. 2016;5(7):1670-1686.

112. Iqbal J, Ginsburg O, Fischer HD, et al. A population-based cross-sectional study comparing breast cancer stage at diagnosis between immigrant and canadian-born women in ontario. *Breast J*. 2017;23(5):525-536.

113. Roetzheim RG, Ferrante JM, Lee JH, et al. Influence of primary care on breast cancer outcomes among medicare beneficiaries. *Ann Fam Med*. 2012;10(5):401-411.

114. Jones LE, Doebbeling CC. Beyond the traditional prognostic indicators: The impact of primary care utilization on cancer survival. *J Clin Oncol*. 2007;25(36):5793-5799.

115. Ferrante JM, Lee JH, McCarthy EP, et al. Primary care utilization and colorectal cancer incidence and mortality among medicare beneficiaries: A population-based, case-control study. *Ann Intern Med*. 2013;159(7):437-446.

116. Provost S, Pineault R, Tousignant P, et al. Does the primary care experience influence the cancer diagnostic process? *Int J Family Med*. 2015;2015:176812.

117. Arnold LD, McGilvray MM, Kyle Cooper J, James AS. Inadequate cancer screening: Lack of provider continuity is a greater obstacle than medical mistrust. *J Health Care Poor Underserved*. 2017;28(1):362-377.

118. Parsonage RK, Hiscock J, Law RJ, Neal RD. Patient perspectives on delays in diagnosis and treatment of cancer: A qualitative analysis of free-text data. *Br J Gen Pract*. 2017;67(654):e49-e56.

119. ICES. Working with ICES data. https://www.ices.on.ca/Data-and-Privacy/ICES-data/Working-with-ICES-Data. Updated 2019. Accessed 07/04, 2019.

120. Kendell C, Decker KM, Groome PA, et al. Use of physician services during the survivorship phase: A multi-province study of women diagnosed with breast cancer. *Curr Oncol*. 2017;24(2):81-89.

121. McBride ML, Groome PA, Decker K, et al. Adherence to quality breast cancer survivorship care in four canadian provinces: A CanIMPACT retrospective cohort study. *BMC Cancer*. 2019;19(1):659-019-5882-z.

122. Cold S, During M, Ewertz M, Knoop A, Moller S. Does timing of adjuvant chemotherapy influence the prognosis after early breast cancer? results of the danish breast cancer cooperative group (DBCG). *Br J Cancer*. 2005;93(6):627-632.

123. Colleoni M, Bonetti M, Coates AS, et al. Early start of adjuvant chemotherapy may improve treatment outcome for premenopausal breast cancer patients with tumors not expressing estrogen receptors. the international breast cancer study group. *J Clin Oncol*. 2000;18(3):584-590.

124. Farolfi A, Scarpi E, Rocca A, et al. Time to initiation of adjuvant chemotherapy in patients with rapidly proliferating early breast cancer. *Eur J Cancer*. 2015;51(14):1874-1881.

125. Downing A, Twelves C, Forman D, Lawrence G, Gilthorpe MS. Time to begin adjuvant chemotherapy and survival in breast cancer patients: A retrospective observational study using latent class analysis. *Breast J*. 2014;20(1):29-36.

126. Ramjeesingh R, Chen BE, Pater JL, et al. Association between definitive surgery and times to administration of adjuvant chemotherapy and outcomes in early breast cancer: Analysis of adjuvant studies conducted by NCIC clinical trials group (NCIC CTG). *Cancer Research*. 2015:75.

127. Lohrisch C, Paltiel C, Gelmon K, et al. Impact on survival of time from definitive surgery to initiation of adjuvant chemotherapy for early-stage breast cancer. *J Clin Oncol*. 2006;24(30):4888-4894.

128. Vandergrift JL, Breslin TM, Niland JC, et al. The association between timing in adjuvant chemotherapy administration and overall survival for women with breast cancer within the national comprehensive cancer network (NCCN). *Cancer Research*. 2012;72(24 Suppl).

129. Prodhan S, King MJ, De P. GJ. Health services data: The ontario cancer registry (A unique, linked, and automated population-based registry). In: Sobolev B, Levy A, Goring S, eds. *Data and measures in health services research.* Boston, MA: Springer; 2016:1-27. https://doi.org/10.1007/978-1-4899-7673-4_18-1.

130. ICES Intranet. New drug funding program (NDFP). https://ssl.ices.on.ca/dataprog/Data%20Holdings/Acquired%20Cohorts%20or%20Registries/NDFP/,DanaInfo=.aioulhjFpkn2K00Nrq,SSL+index.htm. Updated 2019. Accessed 12/17, 2019.

131. Statistics Canada. Table 3-2011 national household survey (NHS) and 2006 census long-form response rates. https://www12.statcan.gc.ca/census-recensement/fc-rf/reports-rapports/r2_table-tableau_3-eng.cfm. Updated 2015. Accessed 12/17, 2019.

132. Statistics Canada. Postal code^{OM} conversion file (PCCF), reference guide. . 2016;Catalogue no. 92-154-G.

133. Chiu,Maria, Lebenbaum,Michael, Lam,Kelvin, et al. Describing the linkages of the immigration, refugees and citizenship canada permanent resident data and vital statistics death registry to ontarioâ€™s administrative health database. *BMC Medical Informatics and Decision Making*. 2016;16(135).

134. Glazier RH, Gozdyra P, Kim M, et al. Geographic variation in primary care need, service use and providers in ontario, 2015/16. . 2018.

135. Juurlink D, Preyra C, Croxford R, et al. Canadian institute for health information discharge abstract database: A validation study. . 2006.

136. Starfield B, Weiner J, Mumford L, Steinwachs D. Ambulatory care groups: A categorization of diagnoses for research and management. *Health Serv Res*. 1991;26(1):53-74.

137. Zielinski A, Kronogard M, Lenhoff H, Halling A. Validation of ACG case-mix for equitable resource allocation in swedish primary health care. *BMC Public Health*. 2009;9:347-2458-9-347.

138. Austin PC, van Walraven C, Wodchis WP, Newman A, Anderson GM. Using the johns hopkins aggregated diagnosis groups (ADGs) to predict mortality in a general adult population cohort in ontario, canada. *Med Care*. 2011;49(10):932-939.

139. Sibley LM, Moineddin R, Agha MM, Glazier RH. Risk adjustment using administrative data-based and survey-derived methods for explaining physician utilization. *Med Care*. 2010;48(2):175-182.

140. Austin PC, Stanbrook MB, Anderson GM, Newman A, Gershon AS. Comparative ability of comorbidity classification methods for administrative data to predict outcomes in patients with chronic obstructive pulmonary disease. *Ann Epidemiol*. 2012;22(12):881-887.

141. Grigoriadis S, Wilton AS, Kurdyak PA, et al. Perinatal suicide in ontario, canada: A 15-year population-based study. *CMAJ*. 2017;189(34):E1085-E1092.

142. Steele LS, Glazier RH, Lin E, Evans M. Using administrative data to measure ambulatory mental health service provision in primary care. *Med Care*. 2004;42(10):960-965.

143. Winkleby MA, Jatulis DE, Frank E, Fortmann SP. Socioeconomic status and health: How education, income, and occupation contribute to risk factors for cardiovascular disease. *Am J Public Health*. 1992;82(6):816-820.

144. Statistics Canada. Dissemination area (DA). https://www12.statcan.gc.ca/census-recensement/2011/ref/dict/geo021-eng.cfm. Updated 2015. Accessed June/11, 2019.

145. Statistics Canada. Census metropolitan influenced zone (MIZ). https://www12.statcan.gc.ca/census-recensement/2011/ref/dict/geo010-eng.cfm. Updated 2015. Accessed June/11, 2019.

146. Breslau N, Reeb KG. Continuity of care in a university-based practice. *J Med Educ*. 1975;50(10):965-969.

147. Rodriguez HP, Marshall RE, Rogers WH, Safran DG. Primary care physician visit continuity: A comparison of patient-reported and administratively derived measures. *J Gen Intern Med*. 2008;23(9):1499-1502.

148. Singletary SE, Connolly JL. Breast cancer staging: Working with the sixth edition of the AJCC cancer staging manual. *CA Cancer J Clin*. 2006;56(1):37-47; quiz 50-1.

149. Burstein HJ. Adjuvant chemotherapy for HER2-negative breast cancer. In: Hayes DF, Vora SR, eds. *UpToDate.* UpToDate; 2019.

150. SAS Institute Inc. Sas 9.4. . 2013.

151. Warton ME, Parker MM, Karter AJ. How D-I-D you do that? basic difference-in-differences models in SAS®. . 2016.

152. Wing C, Simon K, Bello-Gomez RA. Designing difference in difference studies: Best practices for public health policy research. *Annu Rev Public Health*. 2018;39:453-469.

153. Rastpour A, Begen MA, Louie AV, Zaric GS. Variability of waiting times for the 4 most prevalent cancer types in ontario: A retrospective population-based analysis. *CMAJ Open*. 2018;6(2):E227-E234.

154. McPhail S, Elliss-Brookes L, Shelton J, et al. Emergency presentation of cancer and short-term mortality. *Br J Cancer*. 2013;109(8):2027-2034.

155. Abel GA, Mendonca SC, McPhail S, Zhou Y, Elliss-Brookes L, Lyratzopoulos G. Emergency diagnosis of cancer and previous general practice consultations: Insights from linked patient survey data. *Br J Gen Pract*. 2017;67(659):e377-e387.

156. Easley J, Miedema B, Carroll JC, et al. Coordination of cancer care between family physicians and cancer specialists: Importance of communication. *Can Fam Physician*. 2016;62(10):e608-e615.

157. Jefford M, Baravelli C, Dudgeon P, et al. Tailored chemotherapy information faxed to general practitioners improves confidence in managing adverse effects and satisfaction with shared care: Results from a randomized controlled trial. *J Clin Oncol*. 2008;26(14):2272-2277.

158. CanIMPACT. Intervention study. https://canimpact.utoronto.ca/streams-and-themes/intervention-study/. Updated 2019. Accessed Nov/04, 2019.

159. Ontario Ministry of Health and Long-Term Care. Online resource manual for physicians section 4. In: *Online resource manual for physicians.* 2.0th ed. Ontario: ; 2015. http://www.health.gov.on.ca/english/providers/pub/ohip/physmanual/download/section_4.pdf.

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Appendix B. Dataset creation plan

Project Initiation This Section must be Completed Prior to Project Dataset(s) Creation		
Project Title:	Characterizing primary care use during active breast cancer treatment and wait times to receiving chemotherapy	
Project TRIM number:	2019 0990 234 000	
Research Program:	Cancer	
Site:	ICES Central	
Project Objectives:	*Insert Project Objectives as listed in the approved ICES Project PIA*	
	1. Identify factors that indicate which patients seek additional primary care support during chemotherapy 2. Explore the reasons for primary care visits during chemotherapy 3. Determine how primary care continuity and number of primary care visits impacts the timing of chemotherapy receipt 4. Describe how the timing of chemotherapy receipt impacts overall survival	
ICES Project PIA Initial Approval Date:	*The ICES Employee or agent who is responsible for creating the Project Dataset(s) is responsible for ensuring there is an approved ICES Project PIA and verifying the date of approval prior to creating the Project Dataset(s)*	
	2019-Apr-22	
Principal Investigator (PI):	Rachel Walsh	
Check the applicable box if the PI is an ICES Student/Trainee	☒ ICES Student☐ ICES Fellow ☐ ICES Post-Doctoral Trainee ☐ Visiting Scholar	
Responsible ICES Scientist:	*Name the Responsible ICES Scientist if the PI is not a Full Status ICES Scientist*	
	Eva Grunfeld	
Project Team Member(s) Responsible for Project Dataset Creation and/or Statistical Analysis and date joined (list all):	*All person(s) (ICES Analyst, Appointed Analyst, Analytic Epidemiologist, PI, and/or Student) responsible for creating the Project Dataset(s) and/or statistical analysis on the Research Analytics Environment (RAE) and the date they joined the project must be recorded*	
	Marlo Whitehead Rachel Walsh	2019-Feb-15 2019-Feb-15
Other ICES Project Team Members and date joined (list all):	*All other Research Project Team Members (e.g., Research Administrative Assistants, Research Assistants, Project Managers, Epidemiologists) and the date they joined the project must be recorded*	
	Aisha Lofters Rahim Moineddin Monika Krzyzanowska Patti Groome	2019-Feb-15 2019-Feb-15 2019-Feb-15 2019-Feb-15
Confirmation that DCP is consistent with Project Objectives:	*The following individuals must confirm that the ICES Data provided for in this DCP is relevant (e.g., with respect to cohort, timeframe, and variables) and required to achieve the Project Objectives stated in the ICES Project PIA prior to initial Project Dataset creation: 1) PI; 2) Responsible ICES Scientist if the PI is not a Full Status ICES Scientist, or a second ICES Scientist or the Scientific Program Lead if the PI is creating both the DCP and the Project Dataset[s]; 3) ICES Research and Analysis Staff creating the DCP; and 4) ICES Analytic Staff*	

	(ICES Employee or agent responsible for creating the Project Dataset[s]). This may be delegated either verbally or via e-mail.		
	Principal Investigator	☒	2019-May-08
	Responsible ICES Scientist or Second ICES Scientist/Lead	☒	2019-May-08
	ICES Research and Analysis Staff Creating the DCP	☐	yyyy-mon-dd
	ICES Analytic Staff	☐	yyyy-mon-dd
Designated ICES Research and Analysis Staff accountable for Project Documentation:	*The person named (ICES staff) is accountable for ensuring that the approved ICES Project PIA, ICES Project PIA Amendments, and DCP are saved on the T Drive, ensuring ICES Project PIA Amendments are submitted as required, ensuring DCP Amendments are documented, and sharing the final DCP with the PI/Responsible ICES Scientist at project completion*		
DCP Creation Date and Author:	*Date DCP was finalized prior to Project Dataset(s) creation*	*Name of person who created the DCP*	
	Date	***Name***	
	2019-May-08	Rachel Walsh	

ICES Data
This Section must be Completed Prior to Project Dataset(s) Creation

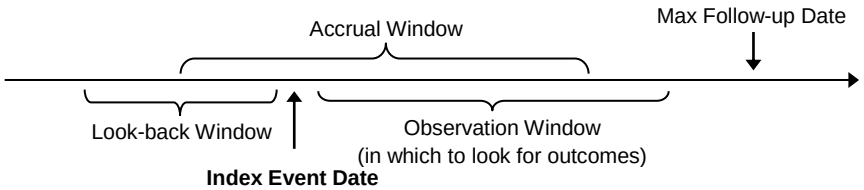
The ICES Employee or agent who is responsible for creating the Project Dataset(s) must ensure that this list includes only data listed in the ICES Project PIA *Changes to this list after initial ICES Project PIA approval require an ICES Project PIA Amendment*	*Mandatory for all datasets that are available by individual year*
General Use Datasets – Health Services	***Years (where applicable)***
CIHI DAD	April 1, 2004 – Dec 31, 2012
NACRS	April 1, 2004 - Dec 31, 2012
ODB	Jan 1, 2007 – Dec 31, 2012
OHIP	April 1, 2004 - Dec 31, 2012
CIHI SDS	
General Use Datasets – Care Providers	
CPDB	April 1, 2004 - Dec 31, 2012
IPDB	April 1, 2004 - Dec 31, 2012
General Use Datasets – Population	
RPDB	April 1, 2004 - Mar 31, 2018
See list	
General Use Datasets – Coding/Geography	
PCCF	April 1, 2004 - Dec 31, 2012
DIN	April 1, 2004 - Dec 31, 2012
REF	April 1, 2004 - Dec 31, 2012
General Use Datasets - Facilities	

See list	
General Use Datasets - Other	
CENSUSCA	2006
CAPE	April 1, 2004 - Dec 31, 2012
Controlled Use Datasets	
OCR	Jan 1, 1964 – Dec 31, 2012
OBSP	April 1, 2004 - Dec 31, 2012
NDFP	Jan 1, 2007 – Dec 31, 2012
ALR	Jan 1, 2007 – Dec 31, 2012
CIC	April 1, 1985 - Dec 31, 2012
Other Datasets	

Project Amendments and Reconciliation			
ICES Project PIA Amendment History (add additional rows as needed):	*Privacy approval date*	*Person who submitted amendment*	*Note that any changes to the list of ICES Data or Project Objectives require an ICES Project PIA Amendment*
	Date	***Name***	***Amendment***
	yyyy-mon-dd		
DCP Amendment History (add additional rows as needed):	*Date DCP amended*	*Person who made the DCP amendment*	*Note that any DCP amendments involving changes to the list of ICES Data or Project Objectives require an ICES Project PIA Amendment*
	Date	***Name***	***Amendment***
	2019-Jun-17 2019-Jun-20 2019-Jul-09	Rachel Walsh Rachel Walsh Rachel Walsh	- New variable “# of physical ADGs” on page 6 - Change “Primary Care Interval” on page 8 - Change “Primary Care Practice Enrolment” on page 12 • Change to reflect use of CanIMPACT cohort - Obtain death date from RPDB up to Mar 31, 2018. - Clarify physician “visit reasons” for variables on page 6 and page 9 (PCP visits during baseline & treatment intervals, oncology and other specialist visits during treatment interval). Keep OHIP fee codes and dxcodes for these visits in separate dataset. - Change “Number of cancer-related PCP visits (baseline)” strict definition on page 6. No longer include OHIP dxcode 300 under strict definition. - Added “specialty of first consult” on page 7 - Added “radiotherapy prior to adjuvant chemotherapy (Y/N)” variable on page 8

Project Amendments and Reconciliation		
	2019-Jul-19 Rachel Walsh 2019-Sep-09 Rachel Walsh	- Clarified "surgical oncologist" definition on page 9. Surgical oncologist defined as any physician performing mastectomy on our cohort of patients from the index contact date until 6 months after start of adjuvant chemotherapy. • Added date of last contact on page 7 - Added number of PCP visits per month on page 6
Date Programs/DCP reconciled	*The person(s) creating the dataset and/or analyzing the data are responsible for ensuring that the final DCP reflects the final program(s) when the project is completed*	
	yyyy-mon-dd	

Project SubCohort of the CanIMPACT Breast Cancer (CIBC) Cohort – TRIM 2015 0800 155 000		
Study Design	☒ Cohort study ☐ Matched cohort study ☐ Case-control study ☐ Cross-sectional study ☐ Other (specify):	
Index Event / Inclusion Criteria from the CIBC cohort	Diagnosis* of histologically confirmed invasive (*behaviour*=3, ICD-O) stage I-III breast cancer between Jan 1st, 2007 and Dec 31st, 2012 from the OCR using dxcode= 174.0 to 174.9 (ICD-9) - Include Stage I-III disease	
Estimated Size of Cohort (if known)	Approximately 15,400	
Exclusions from the CIBC cohort (in order)	*Step*	Description
	1	No record of lumpectomy or mastectomy within 9 months of diagnosis date (use variables created in the *Diagnosis DCP*)
	2	Did not receive adjuvant chemotherapy within 4 months of their initial surgery date
	3	New cancer diagnosis within 14 months of breast cancer diagnosis

Project Time Frame Definitions	
	
Accrual Start/End Dates	January 1, 2007 – December 31, 2012
Max Follow-up Date	Latest available
When does observation window terminate?	Death date or latest available follow-up.

Project Time Frame Definitions	
Lookback Window(s)	30-month period prior to breast cancer diagnosis to assign the Usual Provider Continuity (UPC) Index, and the John's Hopkins Aggregated Diagnosis Groups (ADGs) and Resource Utilization Bands (RUBs).

Variable Definitions (add additional rows as needed)	
Main Exposure or Risk Factor	**1. Comorbidity (ADGs: Aggregated Diagnosis Groups and RUBs: Resource Utilization Bands)** will be measured **within 6 and 30 months** prior to the diagnosis date including the date of diagnosis (i.e. during the baseline period) - **"# of ADGs"** accords with CIBC cohort variable - **"# of major ADGs"** accords with CIBC cohort variable - Keep RUB variable as well, which accords with CIBC cohort variable. 2. **# of physical ADGs**: sums up the total number of ADGS, excluding the major psychosocial ADGs (ADG 23, 24, 25), for each individual patient. **3. History of Mental Health Visits** (Y/N) - From OHIP databases, look for any mental health visit code **within 6 and 30 months** prior to the diagnosis date including the date of diagnosis for all patients. - *OHIP mental health diagnostic codes* = 295, 296, 297, 298, 300, 301, 302, 303, 304, 306, 307, 309, 311, 897, 898, 899, 900, 901, 902, 903, 904, 905, 906, 909 (see code description in Appendix 1). - If a patient did not have any mental health billing within 6 and 30 months prior to and including the date of diagnosis, assign mentalhealth="N" - Else, for patients with any mental health billing within 6 and 30 months prior to and including the date of diagnosis, assign mentalhealth="Y" **4. Continuity of care**: Accords with CIBC cohort variable **5. Number of PCP visits (baseline)**, corresponds to the '# of PCP visits' within 6 and 30 months prior to the diagnosis date as used to originally calculate Continuity of Care variable). **6. PCP visit reasons (baseline)** For OHIP physician claims identified for variable 4 above (number of PCP visits (baseline)): Keep OHIP fee code (feecode) and OHIP Diagnosis code (dxcode) in separate dataset. *Strategy from original CanIMPACT DCP to obtain PCP visits*: Get all OHIP physician claims within defined observation window for all patients in the identified cohort, and exclude OHIP physician claims with location code = E (Emergency Room), I (Inpatient) and U (Unknown) - For each unique IKN, aggregate all OHIP claims to the same physician on the same day (all claims to the same physician on the same day counted as one encounter) - Link OHIP physician claims with IPDB using the unique physician identifier to obtain physician main specialty. - Include visits where the physicians have *mainspecialty* = GP/FP; FP/Emergency Medicine in IPDB data. **7. Number of cancer-related PCP visits (Baseline**) – strict definition: From above identified PCP visits, count the # of visits where OHIP dxcode= 174, 199, 233 or 977. Dxcodes Translation: 174: Malignant Neoplasms - Female Breast 199: Malignant Neoplasms - Other malignant neoplasms 233: Carcinoma in Situ - Breast and genito-urinary system

Variable Definitions (add additional rows as needed)	
	977: Adverse Effects – of drugs and medications – including allergy, overdose, reactions 8. **Number of cancer-related PCP visits (Baseline) – broad definition**: From above identified PCP visits, count the # of visits where OHIP dxcodes= dxcodes of Category1-5 and Category 24 (see Appendix 2).
Primary Outcome Definition	**1. Number of PCP visits (Treatment)**: defined as the total number of visits to a PCP within **the treatment interval** (the 6 months following and including the *start date of adjuvant chemotherapy*) should accord with 'total # of PCP visits' during the chemotherapy treatment period as described in the CanIMPACT treatment DCP. **2. Number of PCP visits per month**: defined as the total number of visits to a PCP per 30 day period from 30 months prior to diagnosis to 6 months after start of adjuvant chemotherapy. **3. Reasons for PCP visits (Treatment)**: For OHIP physician claims identified for variable above (number of PCP visits (treatment)): Keep OHIP fee code (feecode) and OHIP Diagnosis code (dxcode) in separate dataset. **4. Number of cancer-related PCP visits (Treatment)**: Strict and Broad definitions accord with CIBC Treatment cohort variable. 5. **Contact to Chemotherapy Interval**: number of days in the time interval between **the index contact date** and the start date of adjuvant chemotherapy. Accords with "Time from first presentation to adjuvant chemotherapy initiation" variable defined in CanIMPACT treatment DCP. **6. Overall Survival**: Accords with CIBC treatment cohort variable. Update to include date of death up to March 31, 2018. - Will be measured as the number of days between the date of adjuvant chemotherapy initiation and the date of death **7. Date of last contact**: from RPDB
Secondary Outcome Definition(s)	**1. Primary Care interval** • The number of days in the interval from the index contact date (as defined in the CanIMPACT Diagnosis DCP) to the *date of first consult* • **Date of first consult**: earliest date of breast-related encounters (see relevant diagnosis codes listed in Category 1, 3, 4 of Appendix 2) captured in physician billing claims (OHIP) and the CIHI-DAD database in 6 months before, including, and after the date of diagnosis where the physician has *mainspecialty* = "Medical oncology", "radiation oncology" or the physician was an identified "surgical oncologist" in IPDB data. i. Additional medical oncologists will be identified by those who delivered chemotherapy (OHIP chemotherapy billing feecodes = G281, G339, G345, G359 or G381 (see code descriptions in Appendix 5)). ii. "Surgical oncologist" are defined as physicians who performed breast surgery (Category 11 codes in Appendix 2) or breast-related surgical consults (Category 12 encounters with dxcodes (provided in Categories 1, 3, and 4 of Appendix 2) on that encounter record) **2. Specialty of first consult:** Keep specialty from first consult as identified above. **3. Surgery to Chemotherapy interval**: Accords with "Time from surgery to adjuvant chemotherapy initiation" variable described in CanIMPACT treatment DCP.
Baseline Characteristics	*Note: Risk Factors (Immigration Status, Area-level SES, Regional Health Authority, and Urban Rural Residence) are based on geocoded information.*

Variable Definitions (add additional rows as needed)	
	Whenever a postal code is needed, please use the postal code at the time of diagnosis (if not available, use the one closest to the diagnosis date). **1. Age at Diagnosis**: Accords with CIBC cohort variable **2. Urban/Rural Residence**: Accords with CIBC cohort variable **3. Immigration Status**: Accords with CIBC cohort variable **4. Immigrant Characteristics** **- Years since immigration**: Accords with CIBC cohort variable **- Region of origin**: **i.** Get *fcob* (Country of birth) variable from the CIC database. **ii.** Use the chart available in appendix 3 to categorize country of birth into "Region of Origin" based on the *fcob* variable. "Region of Origin" will consist of the following groups: "Antarctica" "Canada" "East Asia & Pacific" "Europe & Central Asia" "Latin America & the Caribbean" "Middle East & North Africa" "South Asia" "Sub-Saharan Africa" "USA/New Zealand/Australia" "Western Europe" **- Immigrant class**: get *IMMIGRATION_CATEGORY* (Immigration category) from the CIC database. Use $CIC_IMMIGCATEG_IRCC_5CAT format to categorize immigrants into the following groups: "Sponsored family immigrants", "Economic immigrants", "Resettled Refugee and Protected Person in Canada", "Other Immigrants", and "Category not stated". See appendix 4 for $CIC_IMMIGCATEG_IRCC_5CAT format details. **5. Area-level SES**: **i. 1) Neighbourhood Income Quintile**: Accords with CIBC cohort variable **ii. 2) Material Deprivation Quintile**: Accords with CIBC cohort variable **6. Stage**: Accords with CIBC cohort variable **7. Histologic Grade**: Accords with CIBC cohort variable **8. Local Health Integration Network region (LHIN)**: Accords with CIBC cohort variable **9. Lumpectomy:** Accords with CIBC cohort variable (under 'components of treatment-related variables' in diagnosis DCP) **10. Mastectomy**: Accords with CIBC cohort variable (under 'components of treatment-related variables' in diagnosis DCP) **11. Chemotherapy Receipt (Adjuvant-alone/Neoadjuvant/Both Neoadjuvant and Adjuvant/Chemo-NOS/No chemo)** - Accords with CIBC cohort variable (under 'components of treatment-related variables' in diagnosis DCP) **12. Radiotherapy:** Accords with CIBC cohort variable (under 'components of treatment-related variables' in diagnosis DCP) **13. Radiotherapy prior to adjuvant chemotherapy (Y/N)**: Indicate if date of first radiotherapy occurred prior to date of first adjuvant chemotherapy. 14. **Receptor Status (ER/PR/HER2):** Accords with CIBC cohort variable (under 'components of treatment-related variables' in diagnosis DCP) **8. Primary Care Practice Enrolment**: Get *progtype* (Enrolment Program Type) at date of diagnosis from the CAPE database. - Also get *grpnum* of the enrolled patient's physician at date of diagnosis from the CAPE database. Link with CPDB.FHT file using the *grpnum* identifier to obtain FHT status (whether physician is associated with a FHT or not). **a.** Assign PCpay= 'team-based capitation' if *grpnum* identifies enrolled patient's physician is associated with a FHT **b.** Assign PCpay= 'enhanced FFS' if *progtype* = FHG or CCM

Variable Definitions (add additional rows as needed)	
	c. Assign PCpay= **'**capitation' if *progtype* = FHO or FHN **d.** Assign PCpay= 'other' if *progtype* = CHG, CSA, GHC, HSO, PCG, PCN, RAN, SMO, or STJ **e.** Else assign PCpay = 'straight FFS' (assumes patients with providers not in the CAPE database are - Get *Status_CAPE* (patient status on the roster) variable at date of diagnosis in order to further classify the relationship of the individual to the rostering organization. **a.** Assign enrolment = rostered if *status_CAPE* = 10, 11, 12, or 14 (see variable definition below) **b.** Assign enrolment = LTC if *status_CAPE* = 15 **c.** Assign enrolment = not rostered if *status_CAPE* = 13 **d.** Else assign enrolment = not rostered (assumes patients with providers not in the CAPE database are unenroled) *Status_CAPE* variable definitions: 10 = rostered (red-and-white-card) 11 = rostered (photo health card) 12 = patient was preloaded from existing program area, (ie. Health Services Organization) 13 = patient has declined enrolment 14 = assigned to roster (based on pre-FHG usage) 15 = patient resides in a LONG_TERM care facility **9. Detection Method (Screen/Symptomatic)**: Accords with the CIBC cohort variable
Other Variables	**1. Number of oncology visits (Treatment interval)**, defined as the total number of visits to each type of oncologist in the office, phone, home, LTC facility during **the treatment interval** (the 6 months following and including the *start date of adjuvant chemotherapy*). • Get all OHIP physician claims within defined observation window for all patients in the identified cohort, and exclude OHIP physician claims with location code = E (Emergency Room), I (Inpatient) and U (Unknown) (Note: Most of the undefined/unknown claims are items that would be billed with a visit e.g. taking blood, ECGs, or add-on codes for after hour visits). • For each unique patient identifier (ICES key number), aggregate all OHIP claims to the same physician on the same day (all claims to the same physician on the same day counted as one encounter) • Link OHIP physician claims with IPDB using the unique physician identifier to obtain physician main specialty. • Include visits where the physicians have mainspecialty = "Medical oncology", "radiation oncology" or the physician was an identified "surgical oncologist" in IPDB data – assigning each type to the relevant variable. • Additional medical oncologists will be identified by those who delivered chemotherapy (OHIP chemotherapy billing feecodes = G281, G339, G345, G359 or G381 (see code descriptions in Appendix 5)). • "Surgical oncologist" are defined as physicians who performed breast surgery (Category 11 codes in Appendix 2) among our cohort of patients during the interval between index contact date until 6 months after start of adjuvant chemotherapy. **2. Reasons for oncology visits (Treatment)**: keep OHIP feecode, and OHIP dxcode for above identified oncology visits in separate dataset.

Variable Definitions (add additional rows as needed)	
	3. Number of visits to other specialties (Treatment interval): defined as the total number of visits to non-primary care and non-oncology physicians in the office, phone, home, LTC facility during **the treatment interval** (the 6 months following and including the *start date of adjuvant chemotherapy*). Repeat process for **Number of oncology visits (Treatment)** above, but DO NOT include visits where the physician's *mainspecialty* = "GP/FP", "FP/Emergency Medicine", "Medical oncology", "radiation oncology" or the physician was an identified "surgical oncologist" in IPDB data (as above). Keep physician main specialty (*mainspecialty*). Count total number of visits to 'other' physicians, and to each different main specialty. **4. Reasons for visits to other specialties (Treatment)**: keep OHIP feecode, and OHIP dxcode for above identified visits to other specialties in separate dataset. **5. Number of visits to other specialties (Baseline)**: repeat process for **Number of visits to other specialties (Treatment interval)** above, but during **the baseline interval** (the 6-30 months prior to diagnosis), include all visits where the physician's *mainspecialty* ≠ "GP/FP"or "FP/Emergency Medicine". Count total number of visits to 'other' physicians, and to each different main specialty. **6. Diagnostic Interval**: Accords with the CIBC cohort variable. **7. Number of different PCPs during treatment phase**: create new variable "# of PCPs treatment" defined as the total number of unique Primary care Physicians (PCPs) in the office, phone, home, LTC facility (see the operational definition below) seen during the treatment phase (6 month from and including the start date of adjuvant chemotherapy: **-** Get all OHIP physician claims within **the treatment interval** (6 months from and including the start date of adjuvant chemotherapy) for all patients in the identified cohort, and exclude OHIP physician claims with location code = E (Emergency Room), I (Inpatient) and U (Unknown) - For OHIP physician claims: Keep OHIP fee code (feecode), **OHIP Diagnosis code (dxcode)**, **Date on which OHIP service was provided (servdate),** Encrypted 6-digit physician billing number (physnum). - For each unique IKN, aggregate all OHIP claims to the same physician on the same day (all claims to the same physician on the same day are counted as one encounter) - Link OHIP physician claims with IPDB using the unique physician identifier to obtain physician main specialty. - Include visits where the physicians have *mainspecialty* = GP/FP; FP/Emergency Medicine in IPDB data. - Count the total number of unique PCPs seen during the designated interval. **8. Number of different PCPs during baseline phase**: repeat process for **Number of different PCPs during treatment phase** (above), but within the baseline phase (6 to 30 months prior to date of diagnosis). **9. Mastectomy type**: Accords with CIBC cohort variable.

Appendix B-1. OHIP Mental Health Codes used for determining mental health visits to primary care [142,159]:

OHIP Number	Diagnosis
295	Schizophrenia
296	Manic depressive psychosis, involutional melancholia
297	Paranoid states
298	Other psychoses

300	Anxiety neurosis, hysteria, neurasthenia, obsessive compulsive neurosis, reactive depression
301	Personality disorders
302	Sexual deviations
303	Alcoholism
304	Drug dependence, drug addiction
306	Psychosomatic disturbances
307	Habit spasms, tics, stuttering, tension headaches, anorexia nervosa, sleep disorders, enuresis
309	Adjustment reaction
311	Depressive or other non-psychotic disorders, not elsewhere classified
897	Economic problems
898	Marital difficulties
899	Parent-child problems (e.g. child-abuse, battered child, child neglect)
900	Problems with aged parents or in-laws
901	Family disruption, divorce
902	Educational problems
903	Illegitimacy
904	Social maladjustment
905	Occupational problems, unemployment, difficulty at work
906	Legal problems, litigation, imprisonment
909	Other problems of social adjustment

1. Steele LS, Glazier RH, Lin E, Evans M. Using administrative data to measure ambulatory mental health service provision in primary care. *Med Care*. 2004;42(10):960-965.
2. Ontario Ministry of Health and Long-Term Care,. Online resource manual for physicians section 4. In: *Online resource manual for physicians.* 2.0th ed. Ontario: ; 2015. http://www.health.gov.on.ca/english/providers/pub/ohip/physmanual/download/section_4.pdf.

Appendix B-2

Diagnostic Grouping Scheme:			
Category Number	Category Description	Diagnostic Codes*	Hierarchy
1	Breast cancer	**OHIP↑:** 174, 175 **CIHI**:** C50^	3
2	Other related cancer	**OHIP:** 162, 170, 173 *195, 196*, 197, 198, 199, **CIHI:** C34.90 C44.5 C76.1 C76.4 C77.3 C78.0 C78.2 C78.7 C79.2 C79.3^ C79.5^ C79.8^ C79.9 C80^	4
3	Benign neoplasm / CIS	**OHIP:** 214, 217, 229, *232,* 233, 234, 238, 239 **CIHI:** D17.1 D24^ D04.5 D05^ D48.6^	5
4	Infectious/inflammatory conditions, breast	**OHIP:** 610, 611 **CIHI:** N61	6
5	Lymph system-related conditions	**OHIP:** 228, 457, 683 **CIHI:** L04.2	7
24	Anxiety-related	**OHIP:** 300, 309, 311 **CIHI:** F34.1, F40, F41, F42, F44, F45.0, F45.1, F45.2, F48, F99, F43.1, F43.2, F43.8, F32.9	
Fee Code (Procedure) Grouping Scheme:			

9	Breast biopsy (with/without ultrasound guidance)	**OHIP:** J149, R107, X121, Z141, Z143, E525, E542 **CCI:** *2YK71, 2YM71, 2MD71,* 3YM12 3YM94	13
10	Cyst aspiration or drainage	**OHIP:** Z118, Z139, Z140	12
11	Mastectomy – any type	**OHIP:** R105, R108, R109, R111, R117 **CCI:** 1YK87 1YL87 1YL89 1YM87 1YM89 1YM90 1YM91	14
12	Surgical consult with no procedure	**OHIP:** A035, A935 and not already categorized as 9,10,11	11
13***	Bilateral mammography	X185 **CCI:** *3YM10*	N/A
14	Diagnostic mammography and related procedures	X184, J004, J037, X192, X194, X201 **CCI:** 3YL10	8
15	Screening mammogram	**OHIP:** X172↑↑, X178↑↑	2
16	Breast ultrasound	**OHIP:** J127, J427 **CCI:** *3YM30*	9
17	Breast MRI	**OHIP:** X446, X447 and for 2007: X441, X445 **CCI:** *3YM40*	15
19	Other ultrasound	J182, J195, J202, J425, J482, J502, **CCI:** 3GY30	10
20	Other MRI	X421, X425, (Post 2007: X441, X445), X471, X475, X490, X492, X499 **CCI:** 3AN40	16
21	Nuclear medicine	J650, J666, J667, J850 **CCI:** 3YM70	17
Screening			
23	OBSP abnormal breast screening	Screened=2 (mammogram only) or 3 (yes, both PE and mammogram) **and** Finalres = C (breast cancer)	

↑ OHIP dxcodes are equivalent to ICD-9 codes most of the time, but sometimes they are different. Please double check the corresponding ICD-9 code translations before you use them.

* Diagnostic codes in italics did not demonstrate large increase in 3 months prior to diagnosis but are deemed synonymous with others in this category or included by Li Jiang in her thesis.

** "CIHI' refers to ICD codes in DAD and NACRS records. Read most responsible diagnosis only.

↑↑Available only from October 2010 forward. Increasing frequency of use levelled off by about January 2011.

*** Category 13 encounters were interim encounters that were reassigned to categories 14 or 15 based on the detection method variable.

Note: Procedure codes in *italics* were deemed synonymous with others in this category, are CCI codes and/or were included by Li Jiang in her thesis, by Claire Holloway in her breast diagnosis study, or in the 2008 ICES Surgical Atlas Technical Appendix if # observations was >0.

OHIP Dxcode↑ translations:

OHIP #	Disease Diagnosis	N per 10,000 3	ICD 10 equivalent Code**

		mths prior*	
162	Lung neoplasm	9	C34.90
170	Bone neoplasm	5	No observations
173	Other skin malignancies	19	C44.5
174	Female breast neoplasm	1114	C50^
175	Male breast neoplasm	154	C50^
195	Malignant neoplasms - Other ill defined sites	3	C76.1 C76.4
196	Secondary neoplasms of lymph nodes	0	C77.3
197	Secondary neoplasm of respiratory and digestive	0	C78.0 C78.2 C78.7
198	Malignant neoplasms – metastatic or secondary, carcinoma	15	C79.2 C79.3^ C79.5^ C79.8^ C79.9
199	Other malignant neoplasms	51	C80^
214	Malignant neoplasms - lipoma	13	D17.1
217	Benign neoplasms - breast	715	D24^
228	[Haemangioma] and lymphangioma	3	No observations***
229	Other benign neoplasms	14	No observations
232	CIS - Skin	5	D04.5
233	CIS - Breast and [genito-urinary system]	127	D05^
234	CIS - Other	21	No observations
238	Neoplasms uncertain behavior - other & unspecified sites	14	D48.6^
239	Unspecified neoplasms eg polycythemia vera	6	No observations
457	Lymphedema, lymphangitis	7	No observations
300	Anxiety neurosis, hysteria, neurasthenia, obsessive compulsive neurosis, reactive depression		F34.1, F40, F41, F42, F44, F45.0, F45.1, F45.2, F48, F99
309	Adjustment reaction		F43.1, F43.2, F43.8, ~~F93.0~~
311	Depressive or other non-psychotic disorders, not elsewhere classified		F32.9
610	Cystic mastitis, fibroadenosis of breast	1295	No observations
611	Breast abscess, gynecomastia, hypertrophy, other breast	1758	No observations
680	Boil, carbuncle, furunculosis	20	L02.2 L02.4
682	Cellulitis, abscess [acute lymphangitis in ICD10]	111	L03.10 L03.11 L03.30 L03.39
683	Acute lymphadenitis	20	L04.2
781	Leg cramps, leg pain, muscle pain, joint pain, …masses	408	No related codes (masses)
785	Chest pain, tachycardia, syncope, shock, edema, masses	420	No related codes (masses)
787	Anorexia, nausea and vomiting, dysphagia,…masses	390	R63.0 R63.4
788	Renal colic, urinary retention, nocturia, masses	68	No related codes (masses)
796	Other non-specific abnormal findings	191	No observations
799	Other ill-defined conditions	778	R64

917	Annual health examination	1163	N/A

↑ OHIP dxcodes are equivalent to ICD-9 codes most of the time, but sometimes they are different. Please double check the corresponding ICD-9 code translations before you use them.
* From GP/FP encounters in Groome's CIHR project
** Used ICD9 (basis for OHIP codes) converter to ICD-10 on ICD10Data.com In some instances only the more breast/cancer specific subcodes were included. ICD-9 781, 785 and 788 that mention 'masses' have no cancer-related subcodes in ICD-10.
*** "No observations' means there were no observations of ICD-10 equivalent codes in the CIHI DAD and NACRS data for our cohort.

Procedure <u>Code translations:</u>

OHIP #	**Procedure**	**N per 10,000 3 mths prior#**	**CIHI equivalent code**
A035	General surgery consultation	3144	
A135	Internal medicine consultation	423	
A935	General surgery special surgery consultation	348	
E525	Breast excision: Tumour or tissue for diagnostic biopsy and/or treatment, e.g.carcinoma, fibroadenoma or fibrocystic disease after mammographic localization, add $ to R107	52	
E542	Needle biopsy when performed outside hospital, add $ to Z141	154	
J004	Embolization of spinal arteriovenous malformation: intramammary needling for localization under mammographic control	113	
J037	Lymphangiogram: mammary ductography	15	
J105	Diag US: head and neck	89	
J125	Diag US: Chest masses, pleural effusion - A & B-mode	107	
J127	Diag US: scan B-mode (per breast)	5656	3YM30
J149	Ultrasonic guidance of biopsy, aspiration, amniocentesis or drainage procedures (one physician only)	758	
J182	Diag US Extremities: per limb (excluding vascular study)	441	
J195	Diag US Vascular: peri-art anal freq anal + scan – per limb *Not in April 2013 OHIP Schedule*	75	
J202	Diag US Vascular: duplex scan i.e. simultaneous real time, B-mode imaging and frequency/spectral analysis, unilateral	257	
J405	D & T US echography face & neck	38	
J425	Diag US Thorax etc: Chest masses, pleural effusion - A & B-mode	26	3GY30
J427	Diag US: scan B-mode (per breast)	1211	3ym30 needs to be here and look for

			other synonyms for the other CIHI codes
J482	Diag US Extremities: per limb (excluding vascular study)	160	
J502	Diag US Vascular: duplex scan i.e. simultaneous real time, B-mode imaging and frequency/spectral analysis, unilateral	32	
J650	Nuclear Muskuloskeletal: bone scintigraphy general survey	16	
J666	Nuclear Tomography: maximum one per Nuclear Medicine examination	6	3YM70
J667	Nuclear Cardiovascular: first transit with blood pool images	7	
J850	Nuclear Muskuloskeletal: bone scintigraphy general survey	126	
R105	Breast excision: partial mastectomy plus radical node dissection *Not in April 2013 OHIP Schedule*	1	
R107	Breast excision: Tumour or tissue for diagnostic biopsy and/or treatment, e.g.carcinoma, fibroadenoma or fibrocystic disease	23 + 76	
R108	Breast mastectomy – female w/wo biopsy - simple	3	1YM89 1YM90
R109	Breast mastectomy – female w/wo biopsy – radical or modified radical	6	1YM91
R111	Breast excision: partial mastectomy or wedge resection for treatment of breast disease, with or without biopsy, e.g. carcinoma or extensive fibrocystic disease	69	1YK87 1YL87 1YL89 1YM87
R117	Breast mastectomy – female w/wo biopsy - subcutaneous with nipple preservation	0	
X027	Xray: thoracic spine two views	26	
X028	Xray: lumbar or lumbosacral spine two or three views	84	
X035	Xray: sacro-iliac joints two or three views	28	
X037	Xray: pelvis and/or hip(s) two views	90	
X039	Xray: ribs two or more views	57	
X090	Xray: chest single view	171	
X091	Xray: chest two views	1467	3GY10
X092	Xray: chest three or more views	8	
X121	Xray special examinations: bronchogram stereotactic core breast biopsy	177	3YM12 3YM94
X172*	Mammogram – no signs or symptoms – dedicated equipment - unilateral	0 (count to 2010)	
X178*	Mammogram – no signs or symptoms – dedicated equipment - bilateral	0 (count to 2010)	
X184**	Mammogram – signs or symptoms - unilateral	1641	
X185**	Mammogram – signs or symptoms - bilateral	4917	3YM10
X192	Xray: Misc exams – mammary ductography	18	3YL10

X194*	Mammogram – no signs or symptoms – additional cone view w/wo magnification (limit two per breast)	3885	
X201	Mammogram – no signs or symptoms – breast biopsy specimen x-ray	274	
X202	Xray: spine and pelvis four or five views	71	
X204	Xray: thoracic spine >= 3 views	49	
X205	Xray: lumbar or lumbosacral spine four or five views	110	
X206	Xray: lumbar or lumbosacral spine six or more views	29	
X212	Xray Upper extremities: shoulder three or more views	83	
X400	CT head wo IV contrast	97	3AN20 3ER20
X401	CT head w/ IV contrast	12	
X406	CT thorax wo IV contrast	44	3GY20 3GT20
X407	CT thorax w/ IV contrast	121	
X417	CT spine 3D CT acquisition sequencing	43	
X421	MRI head multislice sequence	50	3AN40
X425	MRI head repeat	50	
X441	MRI thorax multislice sequence	291	
X445	MRI thorax repeat	287	
X446	MRI breast – unilateral or bilateral – multislice sequence	68	3YM40
X447	MRI breast - repeat	69	
X471	MRI extremity or joint – multislice sequence	94	
X475	MRI extremity or joint - repeat	93	
X490	MRI limited spine - multislice sequence	46	
X492	MRI limited spine - repeat	42	
X499	MRI complex spine – 3D MRI acquisition sequence	376	
Z118	Skin/subcutaneous operation: foreign body removal – aspiration of superficial lump for cytology	37	
Z139	Operations of the breast: aspiration of cyst – one or more	45	
Z140	Operations of the breast: drainage of intramammary abscess or haematoma – single or multilocated – local anaesthetic	5	
Z141	Operations of the breast: needle biopsy – one or more	286	2YK71 2YM71 2MD71
Z143	Operations of the breast: needle biopsy – large core biopsy	132	

[#] Used frequency for relevant specialty only but will search all records. Frequency data were obtained from Groome's CIHR breast project. Counts do not include diagnosis date.
***** Where the sole reason for the request for a mammogram is for an individual with identified risk factors in accordance with clinical practice guidelines. Start date of code: October 2010
****** For individuals with identified signs or symptoms or follow-up of established disease after October 2010. Before used for both non-symptomatic and symptomatic cases

Appendix B-5

OHIP Fee Codes for Chemotherapy

G281	Inj/inf. each add'l inj. with G381
G339	Inj/inf. chemotherapy & pt assess. single agent I.V.
G345	Inj/inf. chemotherapy & pt assess. multip. Agent I.V.
G359	Inj/inf. chemotherapy & pt assess. sp. single agent etc.
G381	Inj/inf. Chemotherapy (marrow suppress.) single inj.

Appendix C. Research ethics approval letters

QUEEN'S UNIVERSITY HEALTH SCIENCES & AFFILIATED TEACHING HOSPITALS RESEARCH ETHICS BOARD-DELEGATED REVIEW
May 05, 2014

Dr. Patricia Groome
Department of Cancer Care and Epidemiology
Queen's University

Dear Dr. Groome
Study Title: EPID-468-14 Canadian Team to Improve Community-Based Cancer Care along the Continuum (CanIMPACT)Step 1a
File # 6012581
Co-Investigators: Dr. M. Krzyzanowska, Dr. A. Lofters, Dr. R. Moineddin, Dr. E. Grunfeld, Ms. M. Whitehead

I am writing to acknowledge receipt of your recent ethics submission. We have examined the protocol, project activation worksheet and privacy impact assessment sent form for your project (as stated above) and consider it to be ethically acceptable. This approval is valid for one year from the date of the Chair's signature below. This approval will be reported to the Research Ethics Board. Please attend carefully to the following listing of ethics requirements you must fulfill over the course of your study.

Reporting of Amendments: If there are any changes to your study (e.g. consent, protocol, study procedures, etc.), you must submit an amendment to the Research Ethics Board for approval. Please use event form: HSREB Multi-Use Amendment/Full Board Renewal Form associated with your post review file **#6012581** in your Researcher Portal (https://eservices.queensu.ca/romeo_researcher/)

Reporting of Serious Adverse Events: Any unexpected serious adverse event occurring locally must be reported within 2 working days or earlier if required by the study sponsor. All other serious adverse events must be reported within 15 days after becoming aware of the information. Serious Adverse Event forms are located with your post-review file **6012581** in your Researcher Portal (https://eservices.queensu.ca/romeo_researcher/)

Reporting of Complaints: Any complaints made by participants or persons acting on behalf of participants must be reported to the Research Ethics Board within 7 days of becoming aware of the complaint. Note: All documents supplied to participants must have the contact information for the Research Ethics Board.

Annual Renewal: Prior to the expiration of your approval (which is one year from the date of the Chair's signature below), you will be reminded to submit your renewal form along with any new changes or amendments you wish to make to your study. If there have been no major changes to your protocol, your approval may be renewed for another year.

Yours sincerely,

Albert J. Clark.
Chair, Health Sciences Research Ethics Board
May 05, 2014

Investigators please note that if your trial is registered by the sponsor, you must take responsibility to ensure that the registration information is accurate and complete

RIS Protocol Number: 37074

Approval Date: 26-Mar-19

PI Name: Rachel Feldman

Division Name:

Dear Rachel Feldman:

Re: Your research protocol application entitled, "Characterizing primary care use during active breast cancer treatment and wait times to receiving chemotherapy: a population-based retrospective cohort study using CanIMPACT data"

The Health Sciences REB has conducted a Delegated review of your application and has granted approval to the attached protocol for the period 2019-03-26 to 2020-03-25.

Please note that this approval only applies to the use of human participants. Other approvals may be needed.

Please be reminded of the following points:

- An **Amendment** must be submitted to the REB for any proposed changes to the approved protocol. The amended protocol must be reviewed and approved by the REB prior to implementation of the changes.
- An annual **Renewal** must be submitted for ongoing research. You may submit up to 6 renewals for a maximum total span of 7 years. Renewals should be submitted between 15 and 30 days prior to the current expiry date.
- A **Protocol Deviation Report** (PDR) should be submitted when there is any departure from the REB-approved ethics review application form that has occurred without prior approval from the REB (e.g., changes to the study procedures, consent process, data protection measures). The submission of this form does not necessarily indicate wrong-doing; however follow-up procedures may be required.
- An **Adverse Events Report (AER)** must be submitted when adverse or unanticipated events occur to participants in the course of the research process.
- A **Protocol Completion Report** (PCR) is required when research using the protocol has been completed. For ongoing research, a PCR on the protocol will be required after 7 years, (Original and 6 Renewals). A continuation of work beyond 7 years will require the creation of a new protocol.
- If your research is funded by a third party, please contact the assigned Research Funding Officer in Research Services to ensure that your funds are released.

Best wishes for the successful completion of your research.

OFFICE OF RESEARCH ETHICS
McMurrich Building, 12 Queen's Park Crescent West, 2nd Floor, Toronto, ON M5S 1S8 Canada
Tel: +1 416 946-3273 ◆ Fax: +1 416 946-5763 ◆ ethics.review@utoronto.ca ◆ http://www.research.utoronto.ca/for-researchers-administrators/ethics

Appendix D. Table of baseline characteristics according to the median primary care interval in days stratified by the method of detection

	Total N= 12781	Primary care interval in days (from first contact to first oncology visit)					
		Screened N=2,916 (22.8%)			Symptomatic N=9,865 (77.2%)		
		Median (IQR)	90th percentile	Kruskal-Wallis P value*	Median (IQR)	90th percentile	Kruskal-Wallis P value*
Total		34 (21, 50)	72		34 (17, 62)	111	
Age (Categorical)				<0.0001			<0.0001
<40	1,102 (8.6%)	20 (18, 34)	51		29 (14, 56)	101	
40-49	3,481 (27.2%)	21 (9, 42)	85		35 (19, 64)	117	
50-59	4,225 (33.1%)	34 (21, 51)	74		35 (16, 64)	113	
60-69	3,045 (23.8%)	35 (22, 50)	70		34 (16, 63)	108	
70-74	607 (4.7%)	35 (20, 50)	67		34 (17, 59)	99	
>74	321 (2.5%)	37 (21, 60)	79		28 (14, 55)	83	
Urban/rural Residence				<0.0001			0.0078
Urban	11,189 (87.5%)	34 (20, 49)	70		34 (17, 63)	110	
Rural	699 (5.5%)	36 (21, 50)	74		35 (17, 62)	113	
Rural-remote	596 (4.7%)	41 (25, 60)	84		32 (15, 56)	106	
Rural-very remote	292-297 (2.3%)	43 (26, 70)	91		28 (12, 58)	113	
Rural-unknown	<=5	**	**		**	**	
Unknown	<=5	**	**		**	**	
Immigration Status				0.4322			0.9899
Long-term residents	11,075 (86.7%)	34 (21, 50)	71		34 (17, 62)	111	
Immigrants	1,706 (13.3%)	33 (17, 54)	76		34 (17, 63)	109	
Immigrant Characteristics							
Region of Origin				0.2853			0.0783
East Asia & Pacific	544 (4.3%)	33 (17, 62)	94		33 (15, 63)	112	
Eastern Europe & Central Asia	286 (2.2%)	27 (9, 51)	56		33 (16, 62)	112	
Latin America & Caribbean	239 (1.9%)	36 (21, 53)	84		41 (19, 72)	107	
Middle East & North Africa	145 (1.1%)	41 (16, 51)	62		42 (19, 75)	121	
South Asia	270 (2.1%)	30 (15, 44)	78		28 (15, 53)	95	
Sub-Saharan Africa	87 (0.7%)	41 (23, 55)	69		37 (18, 69)	90	
USA/New Zealand/Australia	37 (0.3%)	36 (28, 76)	105		36 (15, 60)	117	
Western Europe	98 (0.8%)	38 (24, 67)	113		29 (14, 49)	87	
Years since Arrival				0.8900			0.4860
<10y	618 (4.8%)	33 (22, 49)	61		33 (18, 60)	108	
>=10y	1,088 (8.5%)	33 (17, 55)	82		34 (16, 64)	111	
Immigrant Class				0.6663			0.6766
Economic	885 (6.9%)	33 (18, 53)	72		35 (16, 65)	112	
Family	571 (4.5%)	36 (16, 61)	86		31 (17, 57)	102	
Refugee	218 (1.7%)	32 (16, 42)	55		37 (18, 62)	121	
Other	32 (0.3%)	43 (22, 51)	56		37 (15, 73)	139	
Neighbourhood Income Quintile				0.7635			0.7172
1 (lowest)	2,020 (15.8%)	35 (21, 54)	75		34 (17, 62)	105	
2	2,384 (18.7%)	34 (21, 52)	71		34 (17, 63)	106	
3	2,523 (19.7%)	35 (21, 51)	72		34 (17, 63)	108	
4	2,819 (22.1%)	35 (21, 49)	70		34 (16, 59)	107	
5 (highest)	2,994 (23.4%)	34 (21, 49)	70		34 (17, 64)	122	
Unknown	41 (0.3%)	42 (25, 89)	102		42 (25, 63)	112	
Comorbidity Burden				0.9419			<0.0001
0-5 ADGs	7,287 (57.0%)	35 (21, 50)	71		33 (16, 59)	105	

6-9 ADGs	4,425 (34.6%)	34 (21, 51)	73		36 (18, 66)	115	
10+ ADGs	1,069 (8.4%)	35 (21, 53)	71		34 (17, 63)	120	
History of Mental Health Visits				0.6662			0.0007
Yes	4,127 (32.3%)	34 (21, 51)	72		35 (18, 65)	115	
No	8654 (67.7%)	35 (21, 50)	72		33 (16, 61)	108	
Stage				<0.0001			<0.0001
Stage I	2,839 (22.2%)	37 (23, 54)	76		39 (21, 71)	122	
Stage II	7,311 (57.2%)	33 (20, 49)	71		34 (17, 61)	106	
Stage III	2,631 (20.6%)	32 (19, 48)	69		29 (14, 56)	107	
Histological grade				0.0168			<0.0001
Well-differentiated	528 (4.1%)	38 (22, 52)	77		39 (20, 66)	101	
Moderately-differentiated	2,468 (19.3%)	35 (21, 51)	74		35 (19, 62)	112	
Poorly-differentiated	3,196 (25.0%)	32 (19, 48)	69		32 (15, 56)	102	
Unknown	6,589 (51.6%)	35 (21, 51)	71		35 (17, 64)	113	
Receptor Status				0.9970			0.6031
ER+ or PR+ and Her2-	2,930 (22.9%)	34 (21, 49)	73		34 (18, 60)	104	
ER+ or PR+ and HER2+	1,107 (8.7%)	35 (19, 52)	73		32 (17, 59)	115	
ER- and PR- and Her2+	519 (4.1%)	34 (22, 48)	65		31 (14, 60)	107	
ER- and PR- and Her2-	859 (6.7%)	32 (22, 49)	75		34 (17, 59)	97	
Unknown	7,366 (57.6%)	35 (21, 51)	71		34 (16, 63)	113	
Surgery Type				0.4204			0.0036
Lumpectomy	7,645 (59.8%)	35 (21, 51)	73		35 (18, 63)	111	
Mastectomy	3,896 (30.5%)	34 (20, 51)	70		33 (16, 59)	109	
Lumpectomy + Mastectomy	1,240 (9.7%)	34 (21, 50)	71		34 (15, 64)	111	
Receipt of Radiation				0.0010			0.0108
Yes	8,652 (67.7%)	33 (21, 49)	70		33 (16, 61)	110	
No	4,129 (32.3%)	36 (21, 55)	76		36 (18, 64)	112	
Primary Care Practice Model				0.5489			0.0078
Straight FFS	1,887 (14.8%)	36 (20, 52)	71		32 (15, 62)	103	
Enhanced FFS	6,281 (49.1%)	35 (21, 51)	71		35 (17, 62)	108	
Capitation	2,235 (17.5%)	35 (21, 50)	73		35 (17, 68)	119	
Team-based capitation	2,206 (17.3%)	33 (20, 50)	72		33 (17, 61)	115	
Other	172 (1.3%)	35 (25, 48)	63		27 (12, 49)	77	
Primary Care Enrolment Status				0.4377			0.0256
Rostered	10,900 (85.3%)	34 (21, 50)	72		34 (17, 62)	112	
Not rostered	1,881 (14.7%)	36 (20, 52)	71		32 (15, 62)	103	
LHIN				<0.0001			<0.0001
1 Erie St. Clair	713 (5.6%)	35 (21, 49)	71		40 (21, 68)	116	
2 South West	992 (7.8%)	44 (27, 67)	89		40 (20, 69)	119	
3 Waterloo Wellington	654 (5.1%)	33 (20, 44)	57		27 (14, 51)	105	
4 Hamilton Niagara Haldimand Brant	1,468 (11.5%)	29 (15, 43)	57		32 (16, 55)	99	
5 Central West	543 (4.2%)	39 (25, 50)	63		33 (17, 52)	90	
6 Mississauga Halton	750 (5.9%)	31 (17, 49)	78		35 (16, 65)	116	
7 Toronto Central	1,061 (8.3%)	34 (19, 55)	76		34 (16, 67)	120	
8 Central	1,784 (14.0%)	29 (17, 47)	69		31 (15, 61)	114	
9 Central East	1,710 (13.4%)	29 (18, 41)	52		32 (15, 58)	104	
10 South East	520 (4.1%)	40 (25, 61)	80		31 (17, 56)	103	
11 Champlain	1,335 (10.4%)	44 (30, 57)	70		46 (28, 74)	127	
12 North Simcoe Muskoka	518-522 (4.1%)	27 (17, 43)	68		27 (15, 58)	110	
13 North East	478 (3.7%)	32 (21, 43)	63		27 (12, 53)	91	
14 North West	252 (2.0%)	56 (37, 77)	95		35 (14, 63)	107	
Unknown	<=5	**	**		**	**	

*p-values calculated for median values

**values suppressed due to small cells

Appendix E. Table of baseline characteristics according to the median surgery to adjuvant chemotherapy interval in days

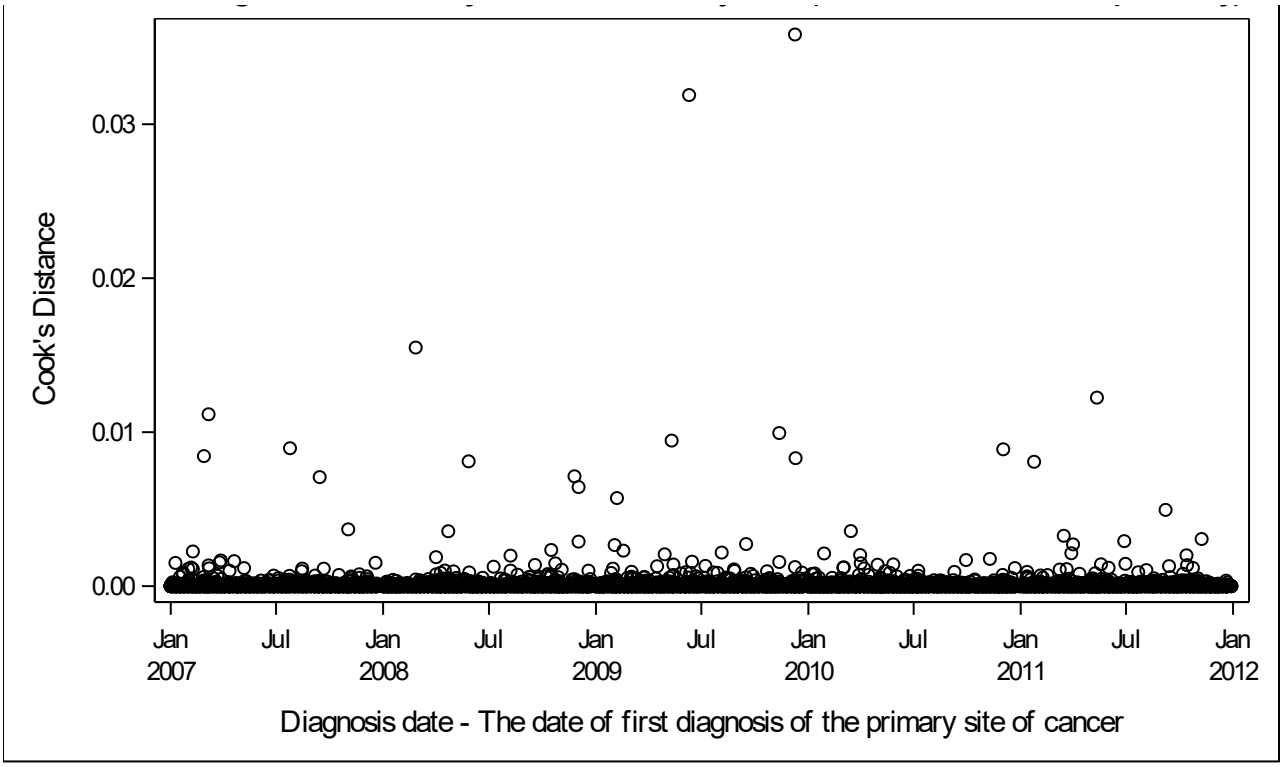
	Total N= 12781	Surgery to adjuvant chemotherapy interval in days		
		Median (IQR)	90th percentile	Kruskal-Wallis P value*
Total		58 (46, 74)	93	
Age (Categorical)				<0.0001
<40	1,102 (8.6%)	52 (41, 68)	87	
40-49	3,481 (27.2%)	56 (44, 71)	91	
50-59	4,225 (33.1%)	58 (46, 74)	93	
60-69	3,045 (23.8%)	60 (48, 76)	96	
70-74	607 (4.7%)	62 (49, 81)	98	
>74	321 (2.5%)	65 (49, 81)	105	
Urban/rural Residence				<0.0001
Urban	11,189 (87.5%)	57 (45, 73)	92	
Rural	699 (5.5%)	62 (48, 77)	94	
Rural-remote	596 (4.7%)	63 (50, 79)	98	
Rural-very remote	292-297 (2.3%)	66 (49, 86)	110	
Rural-unknown	<=5	**	**	
Unknown	<=5	**	**	
Immigration Status				0.2876
Long-term residents	11,075 (86.7%)	58 (46, 74)	93	
Immigrants	1,706 (13.3%)	57 (44, 75)	96	
Immigrant Characteristics				
Region of Origin				0.1119
East Asia & Pacific	544 (4.3%)	57 (43, 77)	98	
Eastern Europe & Central Asia	286 (2.2%)	56 (45, 70)	88	
Latin America & Caribbean	239 (1.9%)	59 (46, 77)	107	
Middle East & North Africa	145 (1.1%)	59 (43, 76)	91	
South Asia	270 (2.1%)	60 (46, 78)	102	
Sub-Saharan Africa	87 (0.7%)	53 (43, 70)	99	
USA/New Zealand/Australia	37 (0.3%)	52 (38, 72)	91	
Western Europe	98 (0.8%)	55 (42, 67)	87	
Years since Arrival				0.4967
<10y	618 (4.8%)	57 (43, 75)	96	
>=10y	1,088 (8.5%)	57 (45, 75)	95	
Immigrant Class				0.4315
Economic	885 (6.9%)	56 (44, 73)	91	
Family	571 (4.5%)	58 (43, 76)	99	
Refugee	218 (1.7%)	56 (47, 76)	96	
Other	32 (0.3%)	63 (49, 73)	96	
Neighbourhood Income Quintile				0.0456
1 (lowest)	2,020 (15.8%)	57 (45, 75)	93	
2	2,384 (18.7%)	58 (46, 75)	94	
3	2,523 (19.7%)	58 (46, 76)	96	
4	2,819 (22.1%)	58 (45, 73)	92	
5 (highest)	2,994 (23.4%)	57 (45, 72)	91	
Unknown	41 (0.3%)	62 (48, 85)	104	
Comorbidity Burden				0.0561
0-5 ADGs	7,287 (57.0%)	57 (46, 73)	92	
6-9 ADGs	4,425 (34.6%)	58 (46, 74)	94	
10+ ADGs	1,069 (8.4%)	59 (45, 78)	99	
History of Mental Health Visits				0.0595
Yes	4,127 (32.3%)	58 (46, 75)	94	
No	8654 (67.7%)	57 (45, 74)	92	
Stage				<0.0001

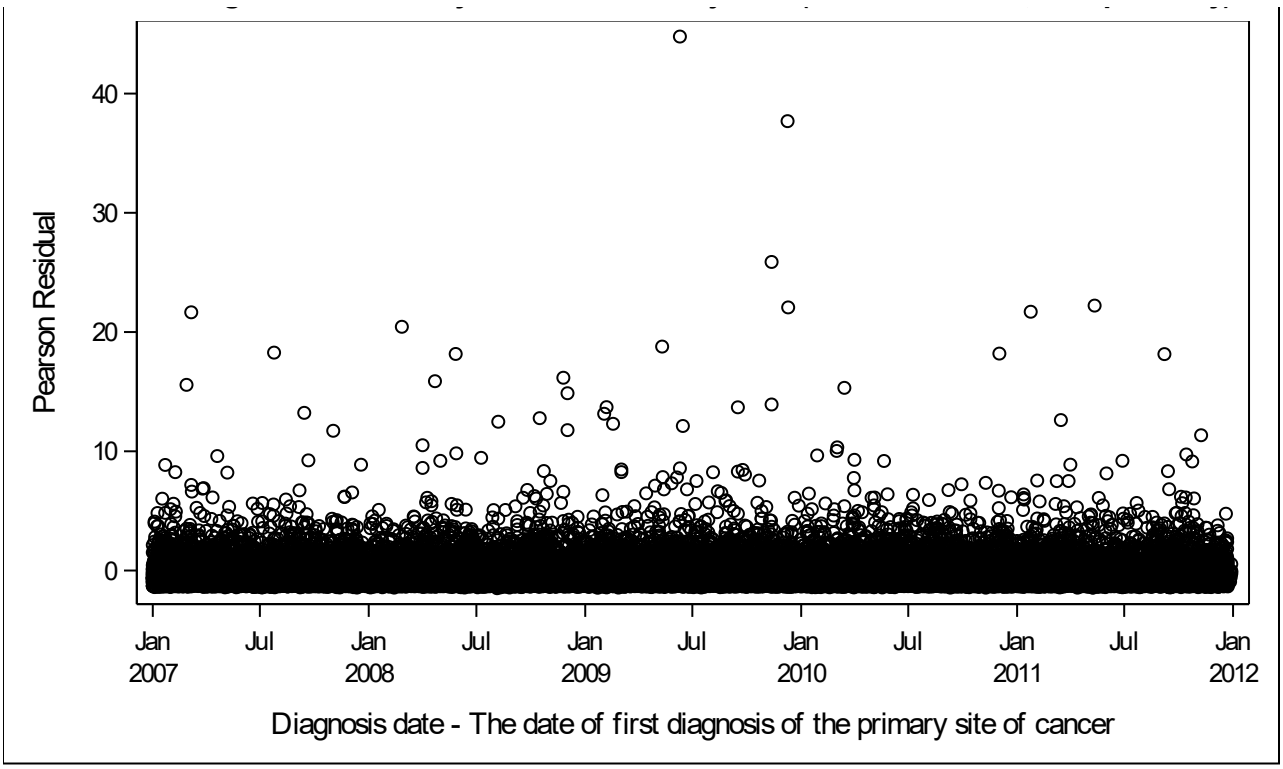
Stage I	2,839 (22.2%)	60 (48, 76)	98	
Stage II	7,311 (57.2%)	58 (47, 75)	93	
Stage III	2,631 (20.6%)	53 (41, 69)	87	
Histological grade				<0.0001
Well-differentiated	528 (4.1%)	61 (48, 78)	97	
Moderately-differentiated	2,468 (19.3%)	58 (46, 76)	95	
Poorly-differentiated	3,196 (25.0%)	55 (43, 70)	88	
Unknown	6,589 (51.6%)	59 (46, 75)	94	
Receptor Status				<0.0001
ER+ or PR+ and Her2-	2,930 (22.9%)	57 (46, 75)	93	
ER+ or PR+ and HER2+	1,107 (8.7%)	58 (47, 74)	94	
ER- and PR- and Her2+	519 (4.1%)	55 (43, 71)	88	
ER- and PR- and Her2-	859 (6.7%)	52 (42, 67)	82	
Unknown	7,366 (57.6%)	59 (46, 75)	94	
Surgery Type				<0.0001
Lumpectomy	7,645 (59.8%)	58 (46, 74)	92	
Mastectomy	3,896 (30.5%)	55 (43, 69)	84	
Lumpectomy + Mastectomy	1,240 (9.7%)	72 (53, 93)	124	
Receipt of Radiation				<0.0001
Yes	8,652 (67.7%)	55 (44, 70)	84	
No	4,129 (32.3%)	65 (50, 85)	112	
Primary Care Practice Model				0.1546
Straight FFS	1,887 (14.8%)	57 (45, 74)	96	
Enhanced FFS	6,281 (49.1%)	58 (45, 74)	94	
Capitation	2,235 (17.5%)	57 (45, 73)	92	
Team-based capitation	2,206 (17.3%)	59 (47, 73)	91	
Other	172 (1.3%)	56 (42, 75)	97	
Primary Care Enrolment Status				0.5820
Rostered	10,900 (85.3%)	58 (46, 74)	93	
Not rostered	1,881 (14.7%)	57 (45, 74)	96	
LHIN				<0.0001
1 Erie St. Clair	713 (5.6%)	50 (40, 69)	86	
2 South West	992 (7.8%)	63 (52, 79)	98	
3 Waterloo Wellington	654 (5.1%)	52 (41, 68)	83	
4 Hamilton Niagara Haldimand Brant	1,468 (11.5%)	56 (45, 70)	86	
5 Central West	543 (4.2%)	58 (44, 74)	98	
6 Mississauga Halton	750 (5.9%)	55 (43, 71)	92	
7 Toronto Central	1,061 (8.3%)	57 (45, 71)	96	
8 Central	1,784 (14.0%)	56 (43, 73)	93	
9 Central East	1,710 (13.4%)	57 (45, 74)	94	
10 South East	520 (4.1%)	59 (48, 73)	91	
11 Champlain	1,335 (10.4%)	65 (53, 79)	96	
12 North Simcoe Muskoka	518-522 (4.1%)	63 (51, 78)	93	
13 North East	478 (3.7%)	61 (45, 77)	107	
14 North West	252 (2.0%)	52 (36, 72)	97	
Unknown	<=5	**	**	

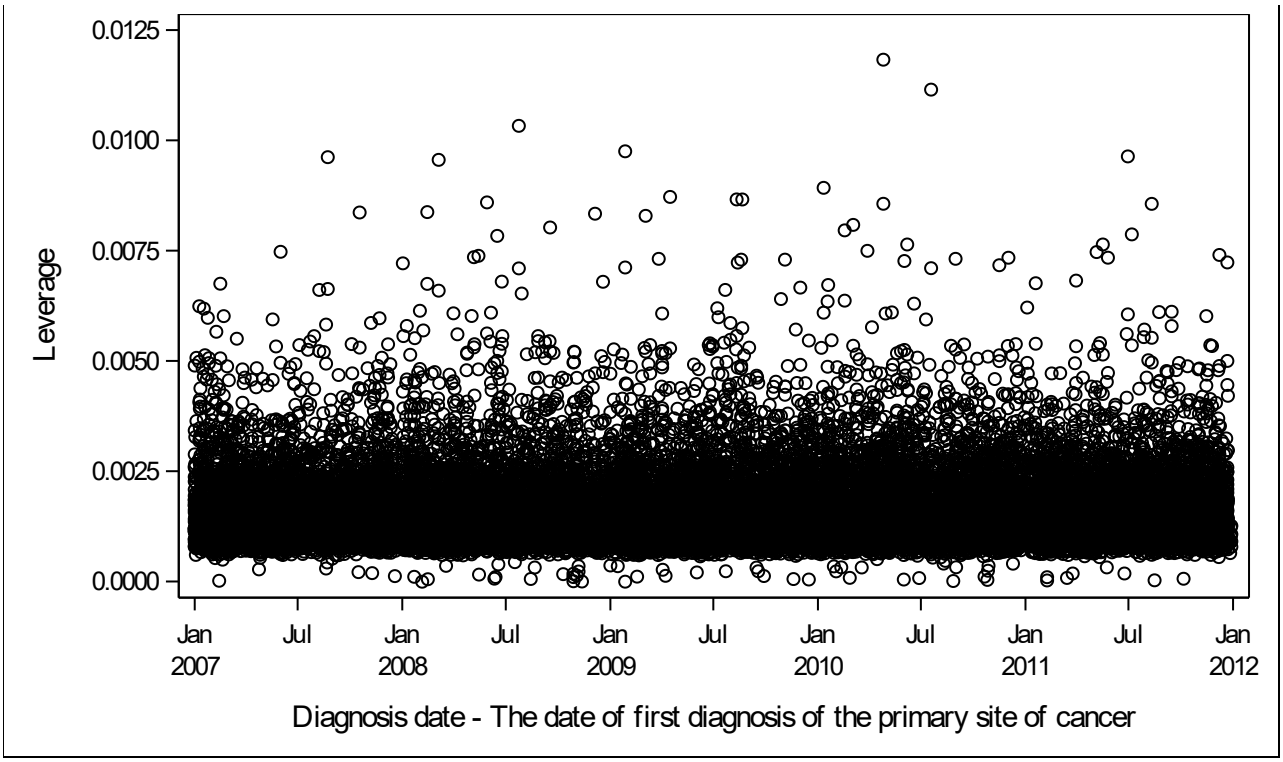
* p-values calculated for median values

**values suppressed due to small cells

Appendix F. Influence plots for difference-in-difference model






0.0125
0.0100
0.0075
0.0050
0.0025
0.0000
Leverage
Jan 2007
Jul
Jan 2008
Jul
Jan 2009
Jul
Jan 2010
Jul
Jan 2011
Jul
Jan 2012
Diagnosis date - The date of first diagnosis of the primary site of cancer

Appendix G. Difference-in-difference sensitivity analyses results

Table G-1. PCP visits rates between treatment and baseline periods by mental health and physical comorbidity groups – multivariable adjusted difference-in-difference model estimates using a negative binomial distribution. Sensitivity analysis 1: best-case worst-case sensitivity analysis for missing income quintile values (n=41)

N=12,777	Substitute high income (quintile 5) for missing income values *Exponentiated estimate (95% CI)*	Substitute low income (quintile 1) for missing income values *Exponentiated estimate (95% CI)*
Intercept	**0.01 (0.01-0.01)**	**0.01 (0.01-0.01)**
Treatment period	**2.52 (2.43-2.61)**	**2.52 (2.43-2.61)**
Mental Health History	**1.49 (1.44-1.54)**	**1.49 (1.44-1.54)**
No Mental Health History	reference	reference
Period*Mental Health History	**0.72 (0.69-0.75)**	**0.72 (0.69-0.75)**
0-5 ADGs	reference	reference
6-9 ADGs	**1.82 (1.76-1.88)**	**1.82 (1.76-1.88)**
10+ ADGs	**2.97 (2.82-3.12)**	**2.97 (2.82-3.12)**
Period*(6-9 ADGs)	**0.57 (0.54-0.59)**	**0.57 (0.54-0.59)**
Period*(10+ ADGs)	**0.46 (0.44-0.49)**	**0.46 (0.44-0.49)**
Age <40 years	**0.94 (0.89-0.99)**	**0.94 (0.89-0.99)**
Age 40-49 years	**0.94 (0.91-0.97)**	**0.94 (0.91-0.97)**
Age 50-59 years	Reference	Reference
Age 60-69 years	**1.04 (1.01-1.08)**	**1.04 (1.01-1.08)**
Age 70-74 years	**1.13 (1.07-1.18)**	**1.13 (1.07-1.18)**
Age >74 years	**1.19 (1.11-1.29)**	**1.19 (1.11-1.29)**
Non-immigrant	Reference	Reference
Immigrant	**1.03 (1.00-1.07)**	**1.03 (1.00-1.07)**
Income quintile 1	Reference	Reference
Income quintile 2	0.99 (0.95-1.03)	0.99 (0.95-1.03)
Income quintile 3	0.99 (0.95-1.03)	0.99 (0.95-1.03)
Income quintile 4	0.97 (0.93-1.01)	0.97 (0.93-1.01)
Income quintile 5	**0.93 (0.89-0.97)**	**0.93 (0.89-0.97)**
Urban	Reference	Reference
Rural	0.99 (0.94-1.05)	0.99 (0.94-1.05)
Rural-remote	0.96 (0.90-1.02)	0.96 (0.90-1.02)
Rural-very remote	**1.19 (1.09-1.29)**	**1.18 (1.09-1.29)**
LHIN 1 Erie St. Clair	1.06 (0.98-1.15)	1.06 (0.98-1.15)
LHIN 2 South West	**1.11 (1.04-1.20)**	**1.11 (1.04-1.20)**
LHIN 3 Waterloo Wellington	0.97 (0.90-1.05)	0.97 (0.90-1.05)
LHIN 4 Hamilton Niagara Haldimand Brant	**1.09 (1.02-1.17)**	**1.09 (1.02-1.17)**
LHIN 5 Central West	**1.10 (1.02-1.19)**	**1.10 (1.02-1.19)**
LHIN 6 Mississauga Halton	1.05 (0.97-1.13)	1.05 (0.97-1.13)
LHIN 7 Toronto Central	reference	reference
LHIN 8 Central	1.05 (0.98-1.12)	1.05 (0.98-1.12)
LHIN 9 Central East	1.07 (1.00-1.14)	1.07 (1.00-1.14)
LHIN 10 South East	**1.10 (1.01-1.20)**	**1.10 (1.01-1.20)**
LHIN 11 Champlain	**1.12 (1.04-1.21)**	**1.12 (1.04-1.21)**
LHIN 12 North Simcoe Muskoka	1.08 (0.98-1.19)	1.08 (0.98-1.19)
LHIN 13 North East	1.03 (0.94-1.13)	1.03 (0.94-1.13)
LHIN 14 North West	**1.16 (1.02-1.32)**	**1.16 (1.02-1.32)**
Continuity 0 visits	**0.25 (0.23-0.27)**	**0.25 (0.23-0.27)**

Continuity 1-2 visits	**0.39 (0.38-0.41)**	**0.39 (0.38-0.41)**
Continuity UPC <=0.75	**0.95 (0.93-0.98)**	**0.95 (0.93-0.98)**
Continuity UPC >0.75	Reference	Reference
PC model capitation	**0.89 (0.85-0.93)**	**0.89 (0.85-0.93)**
PC model enhanced FFS	1.00 (0.96-1.04)	1.00 (0.96-1.04)
PC model team-based capitation	**0.87 (0.83-0.92)**	**0.87 (0.83-0.92)**
PC model other	**0.74 (0.65-0.83)**	**0.74 (0.65-0.83)**
PC model straight FFS	Reference	Reference

Bolded values: p<0.05

Table G-2. Change in PCP visits rates between treatment and baseline periods by mental health and physical comorbidity groups – multivariable adjusted difference-in-difference model estimates using a negative binomial distribution. Sensitivity analysis 2: include significant DID estimates for other characteristics

	Exponentiated estimate (95% CI)	Estimate	SE	95% CI	p-value
Intercept	**0.01 (0.01-0.01)**	-4.6117	0.0482	-4.71, -4.52	<.0001
Treatment period	**1.47 (1.33-1.62)**	0.3848	0.0506	0.29, 0.48	<.0001
Mental Health History	**1.41 (1.36-1.45)**	0.3423	0.0164	0.31, 0.37	<.0001
No Mental Health History	reference				
Period*Mental Health History	**0.84 (0.80-0.87)**	-0.1779	0.0201	-0.22, -0.14	<.0001
0-5 ADGs	reference				
6-9 ADGs	**1.62 (1.57-1.67)**	0.4812	0.0165	0.45, 0.51	<.0001
10+ ADGs	**2.64 (2.52-2.77)**	0.9712	0.0247	0.92, 1.02	<.0001
Period*(6-9 ADGs)	**0.76 (0.73-0.79)**	-0.2733	0.0215	-0.32, -0.23	<.0001
Period*(10+ ADGs)	**0.63 (0.59-0.66)**	-0.4668	0.0287	-0.52, -0.41	<.0001
Age <40 years	**0.94 (0.90-0.99)**	-0.0595	0.0246	-0.11, -0.01	0.0158
Age 40-49 years	**0.95 (0.92-0.98)**	-0.0548	0.0165	-0.09, -0.02	0.0009
Age 50-59 years	Reference				
Age 60-69 years	**1.04 (1.01-1.08)**	0.0407	0.017	0.01, 0.07	0.0163
Age 70-74 years	**1.13 (1.07-1.18)**	0.119	0.0248	0.07, 0.17	<.0001
Age >74 years	**1.19 (1.10-1.28)**	0.1744	0.0388	0.10, 0.25	<.0001
Non-immigrant	Reference				
Immigrant	1.02 (0.99-1.06)	0.0244	0.0163	-0.01, 0.06	0.1338
Income quintile 1	Reference				
Income quintile 2	0.99 (0.95-1.03)	-0.0123	0.0198	-0.05, 0.03	0.5356
Income quintile 3	0.99 (0.95-1.03)	-0.0095	0.0195	-0.05, 0.03	0.626
Income quintile 4	0.97 (0.94-1.01)	-0.028	0.0191	-0.07, 0.01	0.142
Income quintile 5	**0.93 (0.90-0.97)**	-0.0682	0.0215	-0.11, -0.03	0.0015
Urban	Reference				
Rural	**0.94 (0.88-1.00)**	-0.0638	0.0324	-0.13, 0.00	0.0485
Rural-remote	**0.84 (0.80-0.90)**	-0.1692	0.0306	-0.23, -0.11	<.0001
Rural-very remote	**0.89 (0.82-0.97)**	-0.1137	0.0448	-0.20, -0.03	0.0111
Period*Rural	**1.14 (1.03-1.25)**	0.1283	0.0483	0.03, 0.22	0.0079
Period*Rural-remote	**1.31 (1.18-1.46)**	0.2706	0.0547	0.16, 0.38	<.0001
Period*Rural-very remote	**1.75 (1.53-1.99)**	0.5568	0.0683	0.42, 0.69	<.0001
LHIN 1 Erie St. Clair	0.99 (0.90-1.08)	-0.0118	0.0457	-0.10, 0.08	0.7967
LHIN 2 South West	0.99 (0.91-1.07)	-0.0144	0.0426	-0.10, 0.07	0.7352
LHIN 3 Waterloo Wellington	0.92 (0.85-1.01)	-0.0799	0.0438	-0.17, 0.01	0.0680
LHIN 4 Hamilton Niagara Haldimand Brant	0.99 (0.91-1.07)	-0.0112	0.0424	-0.09, 0.07	0.7911

LHIN 5 Central West	**1.09 (1.00-1.19)**	0.0873	0.0444	0.00, 0.17	0.0491
LHIN 6 Mississauga Halton	1.09 (1.00-1.19)	0.0829	0.0448	0.00, 0.17	0.0639
LHIN 7 Toronto Central	reference				
LHIN 8 Central	1.04 (0.96-1.13)	0.0423	0.0403	-0.04, 0.12	0.2946
LHIN 9 Central East	1.03 (0.95-1.11)	0.026	0.04	-0.05, 0.10	0.5154
LHIN 10 South East	1.09 (0.99-1.20)	0.0862	0.0506	-0.01, 0.19	0.0884
LHIN 11 Champlain	0.95 (0.87-1.04)	-0.0488	0.0455	-0.14, 0.04	0.2841
LHIN 12 North Simcoe Muskoka	**1.15 (1.01-1.31)**	0.1397	0.0662	0.01, 0.27	0.0347
LHIN 13 North East	1.00 (0.91-1.10)	0	0.0479	-0.09, 0.09	0.9993
LHIN 14 North West	0.93 (0.84-1.04)	-0.0686	0.0543	-0.17, 0.04	0.2064
Period*LHIN 1	**1.19 (1.07-1.33)**	0.1753	0.0555	0.07, 0.28	0.0016
Period*LHIN 2	**1.33 (1.21-1.47)**	0.2877	0.049	0.19, 0.38	<.0001
Period*LHIN 3	**1.14 (1.02-1.27)**	0.133	0.0557	0.02, 0.24	0.0170
Period*LHIN 4	**1.26 (1.15-1.39)**	0.2349	0.0465	0.14, 0.33	<.0001
Period*LHIN 5	1.01 (0.91-1.13)	0.0095	0.0554	-0.10, 0.12	0.8638
Period*LHIN 6	**0.89 (0.80-0.99)**	-0.1176	0.0556	-0.23, -0.01	0.0343
Period*LHIN 8	1.00 (0.92-1.10)	0.0041	0.0447	-0.08, 0.09	0.9268
Period*LHIN 9	**1.10 (1.00-1.20)**	0.0935	0.0452	0.00, 0.18	0.0388
Period*LHIN 10	1.05 (0.91-1.20)	0.0444	0.0705	-0.09, 0.18	0.5284
Period*LHIN 11	**1.45 (1.32-1.58)**	0.3701	0.0453	0.28, 0.46	<.0001
Period*LHIN 12	0.88 (0.75-1.02)	-0.1299	0.0775	-0.28, 0.02	0.0938
Period*LHIN 13	1.08 (0.94-1.24)	0.08	0.0697	-0.06, 0.22	0.2509
Period*LHIN 14	**1.50 (1.25-1.80)**	0.406	0.0931	0.22, 0.59	<.0001
Continuity <3 visits	**0.16 (0.15-0.17)**	-1.8373	0.0229	-1.88, -1.79	<.0001
Continuity UPC <=0.75	**0.95 (0.92-0.98)**	-0.0512	0.0156	-0.08, -0.02	0.001
Continuity UPC >0.75	Reference				
Period*<3 Visits	**4.39 (4.10-4.69)**	1.4785	0.034	1.41, 1.55	<.0001
Period*UPC <=0.75	1.01 (0.97-1.06)	0.0128	0.0211	-0.03, 0.05	0.5463
PC model capitation	**0.92 (0.87-0.97)**	-0.0834	0.028	-0.14, -0.03	0.0029
PC model enhanced FFS	1.01 (0.97-1.07)	0.0147	0.0254	-0.04, 0.06	0.5628
PC model team-based capitation	**0.83 (0.78-0.88)**	-0.1829	0.0303	-0.24, -0.12	<.0001
PC model other	**0.78 (0.69-0.87)**	-0.2545	0.0609	-0.37, -0.14	<.0001
PC model straight FFS	Reference				
Period*capitation	0.96 (0.89-1.03)	-0.0417	0.037	-0.11, 0.03	0.2607
Period*enhanced FFS	1.02 (0.95-1.08)	0.0149	0.0312	-0.05, 0.08	0.6332
Period*team-based capitation	**1.17 (1.08-1.26)**	0.1563	0.04	0.08, 0.23	<.0001
Period*other model	0.93 (0.76-1.15)	-0.0706	0.1067	-0.28, 0.14	0.5083

Bolded values: p<0.05

Table G-3. PCP visits rates between treatment and baseline periods by mental health and physical comorbidity groups – multivariable adjusted difference-in-difference model estimates using a negative binomial distribution. Sensitivity analysis 3: using total ADGs instead of separate physical ADGs and mental health history

	Exponentiated estimate (95% CI)	Estimate	SE	95% CI	p-value
Intercept	**0.01 (0.01-0.01)**	-4.7638	0.0391	-4.84, -4.69	<.0001
Treatment period	**2.46 (2.38-2.55)**	0.9011	0.0182	0.87, 0.94	<.0001
0-5 ADGs	reference				
6-9 ADGs	**1.97 (1.90-2.04)**	0.6781	0.0179	0.64, 0.71	<.0001
10+ ADGs	**3.48 (3.34-3.63)**	1.2479	0.0216	1.21, 1.29	<.0001

Period*(6-9 ADGs)	**0.51 (0.49-0.54)**	-0.6656	0.0232	-0.71, -0.62	<.0001
Period*(10+ ADGs)	**0.40 (0.38-0.42)**	-0.9139	0.0271	-0.97, -0.86	<.0001
Age <40 years	**0.95 (0.91-1.00)**	-0.0516	0.0245	-0.10, 0.00	0.0355
Age 40-49 years	**0.96 (0.93-0.99)**	-0.0445	0.0164	-0.08, -0.01	0.0067
Age 50-59 years	Reference				
Age 60-69 years	**1.04 (1.01-1.08)**	0.0393	0.0169	0.01, 0.07	0.0198
Age 70-74 years	**1.11 (1.06-1.17)**	0.1078	0.0252	0.06, 0.16	<.0001
Age >74 years	**1.15 (1.06-1.25)**	0.1428	0.0409	0.06, 0.22	0.0005
Non-immigrant	Reference				
Immigrant	1.01 (0.98-1.05)	0.0133	0.0166	-0.02, 0.05	0.4248
Income quintile 1	Reference				
Income quintile 2	1.00 (0.96-1.04)	-0.0004	0.02	-0.04, 0.04	0.9850
Income quintile 3	1.00 (0.96-1.04)	-0.0032	0.0196	-0.04, 0.04	0.8683
Income quintile 4	0.98 (0.94-1.01)	-0.0251	0.0194	-0.06, 0.01	0.1962
Income quintile 5	**0.94 (0.90-0.98)**	-0.0656	0.0214	-0.11, -0.02	0.0022
Urban	Reference				
Rural	0.99 (0.93-1.05)	-0.0101	0.0294	-0.07, 0.05	0.7325
Rural-remote	0.95 (0.89-1.02)	-0.0483	0.033	-0.11, 0.02	0.1428
Rural-very remote	**1.21 (1.11-1.33)**	0.1932	0.045	0.11, 0.28	<.0001
LHIN 1 Erie St. Clair	1.06 (0.98-1.14)	0.0557	0.0372	-0.02, 0.13	0.1338
LHIN 2 South West	**1.11 (1.04-1.19)**	0.107	0.0343	0.04, 0.17	0.0018
LHIN 3 Waterloo Wellington	0.98 (0.91-1.06)	-0.0199	0.0388	-0.10, 0.06	0.6074
LHIN 4 Hamilton Niagara Haldimand Brant	**1.09 (1.02-1.16)**	0.084	0.0333	0.02, 0.15	0.0117
LHIN 5 Central West	**1.09 (1.01-1.17)**	0.0877	0.0374	0.01, 0.16	0.0191
LHIN 6 Mississauga Halton	1.03 (0.96-1.11)	0.03	0.037	-0.04, 0.10	0.4178
LHIN 7 Toronto Central	reference				
LHIN 8 Central	1.04 (0.98-1.11)	0.0401	0.0327	-0.02, 0.10	0.2192
LHIN 9 Central East	1.06 (0.99-1.13)	0.0563	0.0323	-0.01, 0.12	0.0817
LHIN 10 South East	**1.09 (1.00-1.19)**	0.0875	0.043	0.00, 0.17	0.0421
LHIN 11 Champlain	**1.12 (1.04-1.20)**	0.1105	0.035	0.04, 0.18	0.0016
LHIN 12 North Simcoe Muskoka	1.08 (0.98-1.20)	0.0813	0.0511	-0.02, 0.18	0.1118
LHIN 13 North East	1.04 (0.95-1.14)	0.0374	0.0476	-0.06, 0.13	0.4317
LHIN 14 North West	**1.14 (1.00-1.30)**	0.1318	0.0647	0.00, 0.26	0.0418
Continuity 0 visits	**0.24 (0.22-0.27)**	-1.4119	0.0483	-1.51, -1.32	<.0001
Continuity 1-2 visits	**0.39 (0.37-0.41)**	-0.9422	0.0214	-0.98, -0.90	<.0001
Continuity UPC <=0.75	**0.95 (0.92-0.98)**	-0.0523	0.0139	-0.08, -0.03	0.0002
Continuity UPC >0.75	Reference				
PC model capitation	**0.89 (0.85-0.93)**	-0.1197	0.0237	-0.17, -0.07	<.0001
PC model enhanced FFS	1.00 (0.96-1.04)	-0.0016	0.0204	-0.04, 0.04	0.9363
PC model team-based capitation	**0.87 (0.83-0.91)**	-0.1427	0.0248	-0.19, -0.09	<.0001
PC model other	**0.73 (0.64-0.82)**	-0.3194	0.0634	-0.44, -0.20	<.0001
PC model straight FFS	Reference				

Bolded values: p<0.05

Table G-4. PCP visits rates between treatment and baseline periods by mental health and physical comorbidity groups – multivariable adjusted difference-in-difference model estimates using a negative binomial distribution. Sensitivity analysis 4: exclude PCP visits that took place in cancer clinics.

	Exponentiated estimate (95% CI)	Estimate	SE	95% CI	p-value
Intercept	**0.01 (0.01-0.01)**	-4.7446	0.0428	-4.83, -4.66	<.0001
Treatment period	**2.13 (2.05-2.21)**	0.7543	0.0194	0.72, 0.79	<.0001
Mental Health History	**1.48 (1.43-1.54)**	0.3945	0.0174	0.36, 0.43	<.0001
No Mental Health History	reference				
Period*Mental Health History	**0.74 (0.71-0.77)**	-0.3059	0.0217	-0.35, -0.26	<.0001
0-5 ADGs	reference				
6-9 ADGs	**1.78 (1.72-1.85)**	0.5793	0.0177	0.54, 0.61	<.0001
10+ ADGs	**2.91 (2.76-3.06)**	1.0681	0.0261	1.02, 1.12	<.0001
Period*(6-9 ADGs)	**0.59 (0.56-0.62)**	-0.527	0.023	-0.57, -0.48	<.0001
Period*(10+ ADGs)	**0.51 (0.48-0.54)**	-0.6806	0.03	-0.74, -0.62	<.0001
Age <40 years	**0.94 (0.89-0.99)**	-0.0641	0.0257	-0.11, -0.01	0.0125
Age 40-49 years	**0.94 (0.91-0.97)**	-0.0598	0.0173	-0.09, -0.03	0.0005
Age 50-59 years	Reference				
Age 60-69 years	**1.05 (1.01-1.08)**	0.0454	0.018	0.01, 0.08	0.0117
Age 70-74 years	**1.13 (1.07-1.18)**	0.1187	0.0256	0.07, 0.17	<.0001
Age >74 years	**1.21 (1.12-1.30)**	0.1882	0.0394	0.11, 0.27	<.0001
Non-immigrant	Reference				
Immigrant	1.03 (1.00-1.07)	0.0317	0.017	0.00, 0.07	0.0621
Income quintile 1	Reference				
Income quintile 2	0.98 (0.94-1.02)	-0.0197	0.0208	-0.06, 0.02	0.3447
Income quintile 3	0.98 (0.94-1.02)	-0.0213	0.0204	-0.06, 0.02	0.2967
Income quintile 4	0.97 (0.93-1.00)	-0.0355	0.0201	-0.07, 0.00	0.0775
Income quintile 5	**0.92 (0.88-0.97)**	-0.0788	0.0228	-0.12, -0.03	0.0006
Urban	Reference				
Rural	1.00 (0.94-1.06)	-0.0003	0.0294	-0.06, 0.06	0.9925
Rural-remote	0.98 (0.92-1.05)	-0.0188	0.0351	-0.09, 0.05	0.5925
Rural-very remote	**1.21 (1.11-1.33)**	0.193	0.0459	0.10, 0.28	<.0001
LHIN 1 Erie St. Clair	1.04 (0.96-1.13)	0.0381	0.0408	-0.04, 0.12	0.3496
LHIN 2 South West	**0.92 (0.86-0.99)**	-0.0809	0.0376	-0.15, -0.01	0.0316
LHIN 3 Waterloo Wellington	0.98 (0.91-1.06)	-0.02	0.0399	-0.10, 0.06	0.6165
LHIN 4 Hamilton Niagara Haldimand Brant	**1.11 (1.04-1.19)**	0.1072	0.0358	0.04, 0.18	0.0027
LHIN 5 Central West	**1.11 (1.03-1.20)**	0.1053	0.0395	0.03, 0.18	0.0076
LHIN 6 Mississauga Halton	1.06 (0.99-1.15)	0.0614	0.039	-0.01, 0.14	0.1149
LHIN 7 Toronto Central	reference				
LHIN 8 Central	1.04 (0.97-1.11)	0.0405	0.0346	-0.03, 0.11	0.2410
LHIN 9 Central East	1.06 (0.99-1.13)	0.0559	0.0349	-0.01, 0.12	0.1089
LHIN 10 South East	1.01 (0.92-1.11)	0.009	0.0466	-0.08, 0.10	0.8468
LHIN 11 Champlain	**0.92 (0.84-0.99)**	-0.0888	0.0408	-0.17, -0.01	0.0294
LHIN 12 North Simcoe Muskoka	1.09 (0.98-1.20)	0.0828	0.0511	-0.02, 0.18	0.1050
LHIN 13 North East	1.04 (0.95-1.15)	0.0434	0.0489	-0.05, 0.14	0.3751
LHIN 14 North West	1.11 (0.97-1.28)	0.1071	0.0698	-0.03, 0.24	0.1250
Continuity 0 visits	**0.21 (0.19-0.23)**	-1.5661	0.0572	-1.68, -1.45	<.0001
Continuity 1-2 visits	**0.36 (0.35-0.38)**	-1.0113	0.0231	-1.06, -0.97	<.0001
Continuity UPC <=0.75	**0.95 (0.92-0.98)**	-0.0505	0.0144	-0.08, -0.02	0.0005
Continuity UPC >0.75	Reference				
PC model capitation	**0.88 (0.84-0.93)**	-0.1255	0.0247	-0.17, -0.08	<.0001
PC model enhanced FFS	1.00 (0.96-1.04)	0.001	0.022	-0.04, 0.04	0.9645
PC model team-based capitation	**0.86 (0.82-0.91)**	-0.1461	0.026	-0.20, -0.10	<.0001
PC model other	**0.72 (0.63-0.81)**	-0.3329	0.0647	-0.46, -0.21	<.0001

PC model straight FFS	Reference				

Bolded values: p<0.05

Table G-5. PCP visits rates between treatment and baseline periods by mental health and physical comorbidity groups – multivariable adjusted difference-in-difference model estimates using a negative binomial distribution. Sensitivity analysis 5: immigrant-only population.

N=1,705	Exponentiated estimate (95% CI)	Estimate	SE	95% CI	p-value
Intercept	**0.01 (0.01-0.01)**	-4.7212	0.0804	-4.88, -4.56	<.0001
Treatment period	**2.11 (1.95-2.29)**	0.7472	0.0412	0.67, 0.83	<.0001
Mental Health History	**1.32 (1.24-1.40)**	0.2764	0.0324	0.21, 0.34	<.0001
No Mental Health History	reference				
Period*Mental Health History	**0.85 (0.77-0.95)**	-0.1592	0.0534	-0.26, -0.05	0.0029
0-5 ADGs	reference				
6-9 ADGs	**1.88 (1.76-2.02)**	0.6336	0.0349	0.57, 0.70	<.0001
10+ ADGs	**3.20 (2.91-3.51)**	1.1618	0.0478	1.07, 1.26	<.0001
Period*(6-9 ADGs)	**0.60 (0.54-0.67)**	-0.5156	0.0552	-0.62, -0.41	<.0001
Period*(10+ ADGs)	**0.42 (0.37-0.48)**	-0.861	0.0674	-0.99, -0.73	<.0001
Age <40 years	**0.90 (0.82-0.99)**	-0.1047	0.0504	-0.20, -0.01	0.0379
Age 40-49 years	**0.94 (0.88-1.00)**	-0.0651	0.0314	-0.13, 0.00	0.0382
Age 50-59 years	Reference				
Age 60-69 years	1.07 (0.98-1.18)	0.0721	0.0456	-0.02, 0.16	0.1138
Age 70-74 years	**1.23 (1.01-1.48)**	0.2031	0.0971	0.01, 0.39	0.0365
Age >74 years	1.03 (0.76-1.41)	0.0326	0.1575	-0.28, 0.34	0.8359
East Asia & Pacific	Reference				
Eastern Europe & Central Asia	**0.90 (0.82-0.99)**	-0.1065	0.0467	-0.20, -0.02	0.0226
Latin America & Caribbean	0.99 (0.90-1.08)	-0.0129	0.0464	-0.10, 0.08	0.7802
Middle East & North Africa	1.07 (0.97-1.17)	0.0641	0.0493	-0.03, 0.16	0.1935
South Asia	1.03 (0.95-1.12)	0.0343	0.0412	-0.05, 0.12	0.4046
Sub-Saharan Africa	1.04 (0.93-1.17)	0.0429	0.059	-0.07, 0.16	0.4669
US/New Zealand/Australia	0.86 (0.71-1.05)	-0.146	0.1004	-0.34, 0.05	0.1460
Western Europe	0.97 (0.86-1.10)	-0.0266	0.0623	-0.15, 0.10	0.6699
<10 years since arrival	1.03 (0.97-1.09)	0.0256	0.0296	-0.03, 0.08	0.3872
>=10 years since arrival	Reference				
Economic-class immigrant	Reference				
Family-class immigrant	1.00 (0.93-1.06)	-0.0048	0.0331	-0.07, 0.06	0.8856
Refugee-class immigrant	0.94 (0.87-1.02)	-0.0646	0.0409	-0.14, 0.02	0.1144
Other-class immigrant	1.06 (0.84-1.34)	0.0626	0.1185	-0.17, 0.29	0.5976
Income quintile 1	Reference				
Income quintile 2	0.97 (0.89-1.05)	-0.0322	0.0406	-0.11, 0.05	0.4285
Income quintile 3	1.00 (0.93-1.08)	-0.0002	0.0396	-0.08, 0.08	0.9952
Income quintile 4	**0.89 (0.81-0.97)**	-0.1198	0.0444	-0.21, -0.03	0.0069
Income quintile 5	**0.86 (0.78-0.95)**	-0.1512	0.0493	-0.25, -0.05	0.0021
Urban	Reference				
Rural	1.25 (0.85-1.84)	0.2209	0.1981	-0.17, 0.61	0.2650
Rural-remote	1.35 (0.58-3.15)	0.3001	0.4322	-0.55, 1.15	0.4874
Rural-very remote	2.67 (0.97-7.34)	0.9805	0.5171	-0.03, 1.99	0.0579
LHIN 1 Erie St. Clair	0.95 (0.80-1.13)	-0.0483	0.087	-0.22, 0.12	0.5789
LHIN 2 South West	1.10 (0.89-1.36)	0.0954	0.1086	-0.12, 0.31	0.3796
LHIN 3 Waterloo Wellington	1.05 (0.89-1.23)	0.0442	0.0819	-0.12, 0.20	0.5896

LHIN 4 Hamilton Niagara Haldimand Brant	**1.19 (1.02-1.38)**	0.1737	0.0763	0.02, 0.32	0.0228
LHIN 5 Central West	1.06 (0.94-1.21)	0.0625	0.0637	-0.06, 0.19	0.3268
LHIN 6 Mississauga Halton	1.03 (0.91-1.16)	0.0277	0.0618	-0.09, 0.15	0.6539
LHIN 7 Toronto Central	reference				
LHIN 8 Central	1.04 (0.93-1.15)	0.0353	0.0547	-0.07, 0.14	0.5192
LHIN 9 Central East	1.05 (0.94-1.17)	0.0479	0.0547	-0.06, 0.16	0.3805
LHIN 10 South East	1.18 (0.91-1.51)	0.1617	0.1288	-0.09, 0.41	0.2093
LHIN 11 Champlain	1.10 (0.96-1.26)	0.0962	0.0706	-0.04, 0.23	0.1735
LHIN 12 North Simcoe Muskoka	1.09 (0.72-1.65)	0.0865	0.2123	-0.33, 0.50	0.6837
LHIN 13 North East	1.06 (0.38-2.91)	0.0563	0.5162	-0.96, 1.07	0.9131
LHIN 14 North West	0.74 (0.27-2.02)	-0.3001	0.5111	-1.30, 0.70	0.5571
Continuity 0 visits	**0.36 (0.29-0.45)**	-1.0126	0.1091	-1.23, -0.80	<.0001
Continuity 1-2 visits	**0.41 (0.37-0.47)**	-0.8824	0.0596	-1.00, -0.77	<.0001
Continuity UPC <=0.75	0.99 (0.94-1.05)	-0.0079	0.0278	-0.06, 0.05	0.7754
Continuity UPC >0.75	Reference				
PC model capitation	0.92 (0.82-1.03)	-0.086	0.0565	-0.20, 0.02	0.1282
PC model enhanced FFS	1.03 (0.95-1.11)	0.0285	0.04	-0.05, 0.11	0.4760
PC model team-based capitation	**0.87 (0.77-0.99)**	-0.1337	0.0654	-0.26, -0.01	0.0409
PC model other	0.67 (0.31-1.43)	-0.4047	0.3878	-1.16, 0.36	0.2967
PC model straight FFS	Reference				

Appendix H. Table of median and 90th percentile primary care intervals - quantile regression multivariable adjusted models

		Screened		Symptomatic	
Parameter	Group	Median	90th percentile	Median	90th percentile
Intercept		36.00 (30.03, 41.97)	70.53 (59.69, 81.37)	33.15 (29.50, 36.81)	125.34 (107.29, 143.38)
Continuity	0 Visits	-3.67 (-8.24, 0.90)	-2.86 (-15.19, 9.47)	**-8.04 (-10.55, -5.52)**	**-28.14 (-39.68, -16.60)**
	1-2 Visits	**-3.67 (-7.24, -0.09)**	0.93 (-5.83, 7.69)	**-3.74 (-5.95, -1.53)**	-10.28 (-22.28, 1.72)
	UPC <=0.75	1.00 (-1.43, 3.43)	-2.13 (-6.47, 2.20)	-0.34 (-2.12, 1.45)	7.23 (-0.74, 15.21)
	UPC >0.75	Reference	Reference	Reference	Reference
Age	<40 years	**-11.33 (-20.60, -2.07)**	-23.31 (-76.90, 30.28)	**-5.29 (-7.50, -3.08)**	**-16.90 (-28.30, -5.50)**
	40-49 years	**-12.00 (-18.54, -5.46)**	6.79 (-26.52, 40.10)	-0.51 (-2.35, 1.32)	0.34 (-8.10, 8.77)
	50-59 years	Reference	Reference	Reference	Reference
	60-69 years	1.00 (-1.08, 3.08)	-3.95 (-8.11, 0.21)	-1.33 (-3.53, 0.88)	-3.90 (-14.49, 6.70)
	70-74 years	3.33 (-0.37, 7.04)	**-8.08 (-15.25, -0.90)**	-2.67 (-6.20, 0.86)	**-15.45 (-28.80, -2.10)**
	>74 years	3.00 (-4.73, 10.73)	8.98 (-11.63, 29.59)	**-7.36 (-11.12, -3.59)**	**-27.05 (-44.00, -10.09)**
Immigrant	Immigrants	0.00 (-4.60, 4.60)	6.53 (-3.65, 16.72)	0.37 (-2.17, 2.91)	2.90 (-6.03, 11.84)
	Long-term residents	Reference	Reference	Reference	Reference
Income quintile	1 (low)	0.67 (-2.67, 4.01)	4.60 (-2.62, 11.83)	0.52 (-1.88, 2.92)	**-15.15 (-26.39, -3.91)**
	2	-1.00 (-4.56, 2.56)	3.52 (-2.35, 9.39)	0.64 (-1.66, 2.94)	**-13.97 (-24.03, -3.90)**
	3	1.67 (-1.15, 4.49)	1.47 (-5.12, 8.06)	0.85 (-1.30, 2.99)	**-14.14 (-23.80, -4.49)**
	4	1.33 (-1.27, 3.93)	-0.48 (-5.26, 4.30)	-0.48 (-2.52, 1.57)	**-11.91 (-23.15, -0.67)**
	5 (high)	Reference	Reference	Reference	Reference
Physical comorbidities	0-5 ADGs	Reference	Reference	Reference	Reference
	6-9 ADGs	-1.67 (-3.88, 0.55)	2.36 (-2.16, 6.88)	**2.25 (0.26, 4.25)**	4.49 (-3.03, 12.01)
	10+ ADGs	-1.00 (-5.09, 3.09)	5.01 (-2.26, 12.27)	0.61 (-1.95, 3.16)	10.71 (-4.96, 26.38)
History of mental health visits	Yes	-0.67 (-2.69, 1.36)	0.01 (-4.59, 4.61)	0.47 (-1.22, 2.17)	1.32 (-7.03, 9.68)
	No	Reference	Reference	Reference	Reference
Rurality	Rural	-1.00 (-5.82, 3.82)	-1.74 (-11.64, 8.15)	0.00 (-3.70, 3.70)	4.54 (-11.23, 20.32)
	Rural-remote	3.00 (-3.00, 9.00)	9.43 (-3.40, 22.27)	-3.74 (-7.62, 0.14)	-1.95 (-18.02, 14.13)
	Rural-very remote	6.67 (-0.93, 14.27)	**20.94 (4.71, 37.17)**	-5.31 (-11.09, 0.48)	0.76 (-23.77, 25.29)
	Urban	Reference	Reference	Reference	Reference
LHIN	1 Erie St. Clair	-1.00 (-6.89, 4.89)	-1.00 (-24.87, 22.87)	**7.09 (2.73, 11.45)**	2.96 (-16.54, 22.46)
	2 South West	**9.67 (3.19, 16.14)**	**14.53 (3.56, 25.51)**	**7.46 (2.59, 12.32)**	-7.30 (-26.41, 11.80)
	3 Waterloo Wellington	-1.67 (-7.71, 4.38)	-11.34 (-25.33, 2.65)	-4.14 (-7.88, -0.39)	-17.56 (-38.69, 3.56)
	4 Hamilton Niagara Haldimand Brant	-5.00 (-10.02, 0.02)	**-15.19 (-24.64, -5.74)**	-0.62 (-3.56, 2.31)	**-16.99 (-32.61, -1.36)**
	5 Central West	5.00 (-1.79, 11.79)	-8.20 (-21.22, 4.82)	-0.99 (-5.05, 3.07)	-32.94 (-53.83, -12.04)
	6 Mississauga Halton	-1.00 (-8.50, 6.50)	0.53 (-22.90, 23.97)	1.12 (-2.71, 4.96)	-0.27 (-20.14, 19.61)
	7 Toronto Central	Reference	Reference	Reference	Reference
	8 Central	-3.33 (-8.42, 1.75)	-5.29 (-15.65, 5.06)	-1.28 (-4.58, 2.02)	-1.69 (-16.95, 13.56)
	9 Central East	-4.67 (-9.60, 0.27)	**-17.23 (-26.76, -7.71)**	-1.44 (-4.70, 1.83)	-12.64 (-26.70, 1.41)
	10 South East	4.00 (-3.26, 11.26)	4.47 (-12.20, 21.14)	0.12 (-4.85, 5.10)	-16.29 (-36.75, 4.16)
	11 Champlain	**9.00 (3.54, 14.46)**	-6.12 (-15.06, 2.83)	**13.83 (10.32, 17.35)**	8.16 (-11.13, 27.44)
	12 North Simcoe Muskoka	**-7.33 (-13.98, -0.69)**	-4.60 (-21.80, 12.61)	**-5.06 (-8.91, -1.21)**	-14.66 (-40.01, 10.69)
	13 North East	-4.00 (-10.34, 2.34)	-15.57 (-31.67, 0.53)	-5.03 (-10.18, 0.12)	-19.03 (-42.27, 4.21)
	14 North West	**18.33 (7.50, 29.17)**	**20.63 (4.03, 37.22)**	4.90 (-0.78, 10.58)	-6.64 (-35.25, 21.97)
Primary care enrollment model	Capitation	-1.67 (-5.65, 2.31)	3.16 (-3.84, 10.15)	2.23 (-0.55, 5.02)	**13.79 (0.76, 26.83)**
	Enhanced FFS	-1.33 (-4.85, 2.18)	3.19 (-2.86, 9.23)	0.68 (-1.26, 2.61)	-1.44 (-11.63, 8.75)
	Other	2.00 (-6.32, 10.32)	3.21 (-16.19, 22.61)	1.90 (-6.85, 10.64)	-7.10 (-29.39, 15.18)
	Team-based capitation	-3.00 (-6.45, 0.45)	-1.76 (-8.71, 5.19)	1.42 (-0.67, 3.52)	12.21 (-1.82, 26.24)
	Straight FFS	Reference	Reference	Reference	Reference

Appendix I. Table of median and 90th percentile surgery to chemotherapy wait times - quantile regression multivariable adjusted models

Parameter	Group	Median	90th percentile
Intercept		55.87 (53.74, 58.01)	93.77 (88.13, 99.41)
Continuity	0 Visits	0.86 (-1.08, 2.80)	2.18 (-3.17, 7.54)
	1-2 Visits	0.59 (-0.66, 1.84)	0.91 (-2.72, 4.53)
	UPC <=0.75	0.04 (-0.90, 0.98)	0.16 (-2.30, 2.63)
	UPC >0.75	Reference	Reference
Age	<40 years	**-5.86 (-7.49, -4.22)**	**-6.77 (-10.14, -3.40)**
	40-49 years	**-2.73 (-3.72, -1.74)**	**-3.82 (-6.76, -0.87)**
	50-59 years	Reference	Reference
	60-69 years	**1.20 (0.10, 2.30)**	1.97 (-0.82, 4.77)
	70-74 years	**3.22 (0.71, 5.72)**	**6.61 (1.68, 11.54)**
	>74 years	**6.38 (3.24, 9.52)**	**12.55 (1.50, 23.60)**
Immigrant	Immigrants	**1.77 (0.53, 3.01)**	**4.80 (1.12, 8.49)**
	Long-term residents	Reference	Reference
Income quintile	1 (low)	0.86 (-0.36, 2.08)	1.42 (-2.05, 4.89)
	2	1.16 (-0.01, 2.34)	1.84 (-1.40, 5.07)
	3	**1.44 (0.11, 2.77)**	3.64 (-0.26, 7.53)
	4	0.97 (-0.18, 2.12)	1.08 (-1.68, 3.84)
	5 (high)	Reference	Reference
Physical comorbidities	0-5 ADGs	Reference	Reference
	6-9 ADGs	0.42 (-0.53, 1.36)	1.93 (-0.49, 4.36)
	10+ ADGs	0.82 (-1.14, 2.77)	**4.95 (0.22, 9.67)**
History of mental health visits	Yes	0.81 (-0.13, 1.75)	1.02 (-1.44, 3.48)
	No	Reference	Reference
Rurality	Rural	2.27 (-0.04, 4.59)	2.64 (-2.34, 7.63)
	Rural-remote	**2.48 (0.52, 4.44)**	**7.64 (2.71, 12.57)**
	Rural-very remote	**7.31 (3.95, 10.68)**	14.63 (-0.38, 29.64)
	Urban	Reference	Reference
LHIN	1 Erie St. Clair	**-5.83 (-8.83, -2.83)**	**-11.11 (-16.28, -5.93)**
	2 South West	**4.30 (2.29, 6.32)**	0.33 (-5.36, 6.01)
	3 Waterloo Wellington	**-5.79 (-8.48, -3.10)**	**-10.94 (-16.48, -5.40)**
	4 Hamilton Niagara Haldimand Brant	-1.42 (-3.27, 0.43)	**-8.13 (-13.11, -3.15)**
	5 Central West	-0.15 (-2.63, 2.32)	1.05 (-5.14, 7.23)
	6 Mississauga Halton	-1.64 (-3.92, 0.65)	-3.07 (-11.05, 4.91)
	7 Toronto Central	Reference	Reference
	8 Central	-1.00 (-2.81, 0.81)	-3.93 (-8.85, 0.99)
	9 Central East	-0.88 (-2.79, 1.02)	-2.39 (-8.30, 3.51)
	10 South East	0.09 (-2.50, 2.68)	-4.95 (-11.13, 1.23)
	11 Champlain	**7.15 (5.29, 9.02)**	-0.94 (-6.26, 4.38)
	12 North Simcoe Muskoka	**3.33 (0.98, 5.68)**	-2.39 (-9.51, 4.73)
	13 North East	**3.75 (0.52, 6.98)**	7.45 (-2.25, 17.16)
	14 North West	**-5.80 (-10.40, -1.20)**	-2.97 (-15.33, 9.38)
Primary care enrollment model	Capitation	0.01 (-1.44, 1.46)	-2.74 (-6.80, 1.33)
	Enhanced FFS	0.54 (-0.61, 1.69)	-1.45 (-4.84, 1.93)
	Other	-5.34 (-10.89, 0.21)	-8.18 (-19.01, 2.65)
	Team-based capitation	0.96 (-0.51, 2.42)	-3.06 (-6.88, 0.76)
	Straight FFS	Reference	Reference

Appendix J. Quantile regression sensitivity analyses results

Table J-1a. Median and 90th percentile contact to chemotherapy intervals - quantile regression multivariable adjusted model. Sensitivity analysis 1: best-case worst-case sensitivity analysis for missing income quintile values (n=41). Missing income values substituted for quintile 5 (high income).

		Screened n=2914		Symptomatic n=9593	
Parameter	Group	Median	90th percentile	Median	90th percentile
Intercept		121.15 (112.41, 129.89)	173.50 (150.68, 196.32)	132.86 (127.21, 138.51)	236.85 (222.95, 250.76)
Continuity	0 Visits	-1.65 (-10.32, 7.02)	-2.00 (-21.68, 17.68)	**-10.44 (-15.37, -5.51)**	**-24.97 (-37.46, -12.49)**
	1-2 Visits	-1.75 (-5.74, 2.24)	1.25 (-10.50, 13.00)	**-5.83 (-9.63, -2.02)**	-1.38 (-13.36, 10.60)
	UPC <=0.75	2.12 (-1.75, 5.99)	-1.25 (-9.68, 7.18)	**-3.06 (-5.80, -0.33)**	5.64 (-1.22, 12.50)
	UPC >0.75	Reference	Reference	Reference	Reference
Age	<40 years	**-26.68 (-47.57, -5.80)**	15.25 (-123.72, 154.22)	**-15.03 (-18.37, -11.69)**	**-29.27 (-39.78, -18.76)**
	40-49 years	**-11.62 (-21.74, -1.49)**	-3.25 (-33.86, 27.36)	**-3.49 (-6.44, -0.53)**	-1.15 (-9.06, 6.76)
	50-59 years	Reference	Reference	Reference	Reference
	60-69 years	1.60 (-1.45, 4.65)	2.25 (-5.59, 10.09)	1.49 (-1.89, 4.88)	-2.06 (-11.46, 7.34)
	70-74 years	4.00 (-2.85, 10.85)	5.50 (-14.41, 25.41)	3.74 (-3.21, 10.69)	-7.98 (-22.52, 6.56)
	>74 years	**11.08 (1.54, 20.63)**	6.75 (-12.68, 26.18)	2.59 (-5.61, 10.79)	-9.11 (-27.59, 9.37)
Immigrant	Immigrants	6.90 (-0.01, 13.81)	12.00 (-2.80, 26.80)	**7.62 (3.99, 11.26)**	3.27 (-6.43, 12.98)
	Long-term residents	Reference	Reference	Reference	Reference
Income quintile	1 (low)	**5.45 (1.01, 9.89)**	6.75 (-5.77, 19.27)	**5.65 (1.96, 9.34)**	-3.99 (-13.00, 5.01)
	2	**6.07 (1.16, 10.98)**	-1.75 (-12.53, 9.03)	2.79 (-0.91, 6.48)	2.49 (-6.47, 11.46)
	3	**5.02 (0.13, 9.90)**	0.75 (-10.20, 11.70)	**4.38 (1.23, 7.53)**	-5.51 (-15.36, 4.33)
	4	3.10 (-1.45, 7.65)	-2.75 (-12.51, 7.01)	1.00 (-2.36, 4.36)	-4.38 (-14.52, 5.76)
	5 (high)	Reference	Reference	Reference	Reference
Physical comorbidities	0-5 ADGs	Reference	Reference	Reference	Reference
	6-9 ADGs	-1.10 (-4.30, 2.10)	1.75 (-6.46, 9.96)	**4.33 (1.57, 7.10)**	**15.50 (7.69, 23.30)**
	10+ ADGs	-1.37 (-8.52, 5.79)	-4.25 (-16.59, 8.09)	**6.62 (1.00, 12.25)**	**27.06 (14.05, 40.08)**
History of mental health visits	Yes	0.87 (-2.53, 4.26)	**9.50 (1.81, 17.19)**	2.11 (-0.69, 4.91)	-0.88 (-7.42, 5.66)
	No	Reference	Reference	Reference	Reference
Rurality	Rural	5.28 (-1.70, 12.26)	0.75 (-16.95, 18.45)	0.34 (-4.57, 5.24)	-0.51 (-16.30, 15.29)
	Rural-remote	6.05 (-1.95, 14.05)	9.50 (-8.28, 27.28)	-2.76 (-10.59, 5.07)	13.12 (-8.22, 34.47)
	Rural-very remote	**27.50 (17.78, 37.22)**	44.00 (-2.47, 90.47)	5.60 (-4.82, 16.02)	**26.10 (5.71, 46.50)**
	Urban	Reference	Reference	Reference	Reference
LHIN	1 Erie St. Clair	**-9.48 (-18.06, -0.91)**	-1.75 (-35.60, 32.10)	**-14.83 (-20.71, -8.96)**	**-34.21 (-50.92, -17.50)**
	2 South West	6.00 (-3.05, 15.05)	13.50 (-6.82, 33.82)	-3.40 (-9.70, 2.90)	-14.76 (-30.87, 1.35)
	3 Waterloo Wellington	-3.13 (-14.34, 8.07)	-15.25 (-37.40, 6.90)	**-21.73 (-27.57, -15.89)**	**-32.11 (-48.83, -15.39)**
	4 Hamilton Niagara Haldimand Brant	**-9.65 (-16.76, -2.54)**	-16.25 (-36.40, 3.90)	**-15.23 (-20.06, -10.41)**	**-28.65 (-43.14, -14.15)**
	5 Central West	-8.60 (-18.32, 1.12)	-9.50 (-33.74, 14.74)	**-8.77 (-15.69, -1.85)**	-17.84 (-36.12, 0.43)
	6 Mississauga Halton	-6.20 (-17.00, 4.60)	14.50 (-17.01, 46.01)	**-11.96 (-19.31, -4.62)**	-10.32 (-28.77, 8.12)
	7 Toronto Central	Reference	Reference	Reference	Reference
	8 Central	-2.72 (-10.61, 5.18)	3.50 (-17.79, 24.79)	**-7.07 (-12.03, -2.11)**	-9.91 (-22.99, 3.17)
	9 Central East	**-14.85 (-23.03, -6.67)**	-7.25 (-27.29, 12.79)	**-7.24 (-12.35, -2.13)**	**-20.78 (-34.64, -6.91)**
	10 South East	-0.50 (-10.60, 9.60)	0.25 (-19.80, 20.30)	**-10.28 (-17.58, -2.99)**	**-25.58 (-47.98, -3.18)**

	11 Champlain	**17.48 (10.15, 24.82)**	3.75 (-16.13, 23.63)	**14.04 (7.94, 20.13)**	7.02 (-10.12, 24.15)
	12 North Simcoe Muskoka	-3.15 (-13.98, 7.68)	-3.00 (-31.43, 25.43)	**-11.88 (-19.27, -4.49)**	-13.67 (-33.87, 6.53)
	13 North East	**-13.63 (-23.20, -4.06)**	-14.50 (-44.45, 15.45)	**-15.16 (-24.05, -6.27)**	**-31.11 (-57.43, -4.80)**
	14 North West	5.75 (-5.36, 16.86)	13.00 (-26.98, 52.98)	-7.56 (-19.51, 4.40)	-8.60 (-28.95, 11.75)
Primary care enrolment model	Capitation	-0.27 (-5.48, 4.94)	1.50 (-10.98, 13.98)	2.49 (-1.65, 6.62)	**11.30 (0.21, 22.38)**
	Enhanced FFS	3.48 (-1.23, 8.19)	11.00 (-1.53, 23.53)	-0.62 (-3.85, 2.61)	0.80 (-7.20, 8.79)
	Other	4.12 (-8.16, 16.39)	20.00 (-12.30, 52.30)	0.46 (-14.80, 15.72)	-13.99 (-46.14, 18.15)
	Team-based capitation	-2.97 (-8.00, 2.06)	1.25 (-11.24, 13.74)	-1.62 (-5.61, 2.37)	5.79 (-5.11, 16.70)
	Straight FFS	Reference	Reference	Reference	Reference

Bolded values: p<0.05

Table J-1b. Median and 90th percentile contact to chemotherapy intervals - quantile regression multivariable adjusted model. Sensitivity analysis 1: best-case worst-case sensitivity analysis for missing income quintile values (n=41). Missing income values substituted for quintile 1 (low income).

		Screened		Symptomatic	
Parameter	Group	Median	90th percentile	Median	90th percentile
Intercept		120.95 (113.18, 128.72)	172.36 (149.64, 195.08)	132.88 (126.87, 138.88)	237.87 (222.86, 252.88)
Continuity	0 Visits	-1.70 (-9.69, 6.28)	-2.53 (-20.12, 15.07)	**-10.50 (-14.82, -6.18)**	**-25.05 (-37.81, -12.30)**
	1-2 Visits	-1.69 (-5.49, 2.10)	1.23 (-10.83, 13.29)	**-5.89 (-9.65, -2.14)**	-1.40 (-13.56, 10.77)
	UPC <=0.75	2.14 (-1.85, 6.13)	-1.02 (-9.37, 7.33)	**-3.03 (-5.96, -0.10)**	6.13 (-1.64, 13.91)
	UPC >0.75	Reference	Reference	Reference	Reference
Age	<40 years	**-24.41 (-45.09, -3.72)**	15.60 (-143.87, 175.07)	**-14.98 (-18.35, -11.61)**	**-29.57 (-41.27, -17.87)**
	40-49 years	**-11.55 (-21.57, -1.52)**	-2.85 (-30.73, 25.04)	**-3.55 (-6.51, -0.58)**	-1.62 (-10.47, 7.22)
	50-59 years	Reference	Reference	Reference	Reference
	60-69 years	1.69 (-1.22, 4.61)	2.53 (-5.34, 10.39)	1.57 (-1.85, 5.00)	-2.93 (-12.76, 6.89)
	70-74 years	4.00 (-2.95, 10.95)	5.61 (-16.11, 27.33)	3.66 (-2.67, 10.00)	-8.30 (-24.77, 8.16)
	>74 years	**11.13 (0.94, 21.31)**	5.41 (-10.74, 21.56)	2.58 (-6.16, 11.31)	-9.44 (-26.59, 7.71)
Immigrant	Immigrants	6.93 (-0.24, 14.10)	12.29 (-0.69, 25.26)	**7.53 (4.17, 10.89)**	3.06 (-6.05, 12.16)
	Long-term residents	Reference	Reference	Reference	Reference
Income quintile	1 (low)	**5.57 (1.02, 10.11)**	8.64 (-6.36, 23.64)	**5.80 (1.57, 10.03)**	-4.87 (-15.29, 5.56)
	2	**6.17 (1.25, 11.09)**	-1.17 (-11.91, 9.58)	2.82 (-1.19, 6.82)	2.53 (-6.71, 11.77)
	3	**5.09 (0.73, 9.45)**	1.37 (-9.91, 12.65)	**4.46 (0.95, 7.97)**	-5.88 (-15.80, 4.03)
	4	3.23 (-0.94, 7.39)	-1.99 (-12.28, 8.31)	1.00 (-2.46, 4.46)	-4.73 (-14.14, 4.67)
	5 (high)	Reference	Reference	Reference	Reference
Physical comorbidities	0-5 ADGs	Reference	Reference	Reference	Reference
	6-9 ADGs	-1.10 (-4.51, 2.31)	2.13 (-6.28, 10.54)	**4.34 (1.49, 7.19)**	**15.32 (8.20, 22.45)**
	10+ ADGs	-1.32 (-7.64, 5.00)	-4.22 (-16.35, 7.91)	**6.66 (1.24, 12.07)**	**27.07 (13.89, 40.24)**
History of mental health visits	Yes	0.91 (-2.61, 4.43)	**8.99 (0.67, 17.31)**	2.09 (-0.70, 4.87)	-0.70 (-8.21, 6.81)
	No	Reference	Reference	Reference	Reference
Rurality	Rural	5.17 (-1.72, 12.06)	0.33 (-14.88, 15.53)	0.34 (-4.32, 4.99)	-0.14 (-17.33, 17.06)
	Rural-remote	6.14 (-2.11, 14.38)	9.90 (-6.36, 26.16)	-2.74 (-11.03, 5.55)	12.97 (-12.23, 38.17)
	Rural-very remote	**27.61 (18.43, 36.80)**	**43.81 (0.80, 86.83)**	5.62 (-4.85, 16.08)	**26.28 (4.88, 47.69)**
	Urban	Reference	Reference	Reference	Reference
LHIN	1 Erie St. Clair	**-9.39 (-16.39, -2.38)**	-0.85 (-30.31, 28.62)	**-14.98 (-21.15, -8.81)**	**-33.67 (-52.61, -14.72)**
	2 South West	6.05 (-2.19, 14.28)	14.51 (-2.65, 31.67)	-3.46 (-9.70, 2.78)	-15.43 (-31.83, 0.97)
	3 Waterloo Wellington	-3.17 (-14.22, 7.88)	-14.12 (-37.17, 8.94)	**-21.56 (-27.91, -15.22)**	**-32.18 (-48.97, -15.40)**

	4 Hamilton Niagara Haldimand Brant	**-9.55 (-16.51, -2.58)**	-15.72 (-32.75, 1.32)	**-15.28 (-20.43, -10.12)**	**-28.64 (-44.01, -13.27)**
	5 Central West	-8.56 (-17.98, 0.87)	-9.24 (-34.30, 15.82)	**-8.89 (-16.75, -1.02)**	-18.33 (-36.91, 0.25)
	6 Mississauga Halton	-5.95 (-15.66, 3.75)	14.98 (-14.36, 44.31)	**-12.13 (-20.01, -4.24)**	-10.52 (-28.80, 7.76)
	7 Toronto Central	Reference	Reference	Reference	Reference
	8 Central	-2.70 (-10.43, 5.02)	4.22 (-14.80, 23.24)	**-7.16 (-12.70, -1.62)**	-10.40 (-24.12, 3.33)
	9 Central East	**-14.83 (-22.28, -7.38)**	-6.41 (-26.26, 13.45)	**-7.25 (-12.40, -2.10)**	**-20.73 (-33.33, -8.14)**
	10 South East	-0.42 (-10.19, 9.35)	1.39 (-17.77, 20.56)	**-10.33 (-18.05, -2.61)**	**-25.27 (-49.41, -1.13)**
	11 Champlain	**17.55 (10.78, 24.31)**	4.81 (-12.85, 22.46)	**13.98 (7.63, 20.34)**	7.18 (-10.50, 24.86)
	12 North Simcoe Muskoka	-3.09 (-12.49, 6.31)	-3.50 (-29.55, 22.55)	**-11.95 (-20.42, -3.48)**	-13.37 (-33.72, 6.99)
	13 North East	**-13.51 (-22.35, -4.67)**	-13.98 (-40.77, 12.80)	**-15.16 (-24.10, -6.23)**	**-30.85 (-57.12, -4.57)**
	14 North West	5.74 (-4.76, 16.23)	13.41 (-21.27, 48.10)	-7.68 (-21.16, 5.81)	-8.30 (-29.99, 13.39)
Primary care enrolment model	Capitation	-0.26 (-5.45, 4.93)	1.53 (-12.44, 15.50)	2.49 (-1.72, 6.71)	10.80 (-1.02, 22.62)
	Enhanced FFS	3.50 (-1.05, 8.05)	10.46 (-3.03, 23.94)	-0.63 (-3.50, 2.25)	0.43 (-7.76, 8.61)
	Other	3.94 (-8.41, 16.30)	20.07 (-13.19, 53.33)	0.40 (-13.35, 14.14)	-14.60 (-46.75, 17.56)
	Team-based capitation	-3.01 (-7.72, 1.69)	0.74 (-13.88, 15.37)	-1.60 (-5.36, 2.16)	4.77 (-6.95, 16.49)
	Straight FFS	Reference	Reference	Reference	Reference

Bolded values: p<0.05

Table J-2. Median and 90th percentile contact to chemotherapy intervals - quantile regression multivariable adjusted model. Sensitivity analysis 2: missing index contact date values listed as diagnosis date

		Screened n=2906		Symptomatic n=9834	
Parameter	Group	Median	90th percentile	Median	90th percentile
Intercept		121.48 (113.15, 129.81)	171.79 (147.78, 195.81)	130.87 (124.97, 136.77)	234.98 (219.81, 250.14)
Continuity	0 Visits	-2.48 (-11.69, 6.73)	-2.70 (-23.14, 17.74)	**-11.14 (-16.18, -6.10)**	**-24.37 (-38.33, -10.41)**
	1-2 Visits	-1.93 (-6.02, 2.17)	1.43 (-11.01, 13.88)	**-6.18 (-9.56, -2.80)**	-2.56 (-14.46, 9.35)
	UPC <=0.75	1.48 (-2.09, 5.06)	-1.51 (-9.59, 6.57)	**-3.23 (-5.86, -0.61)**	4.17 (-2.80, 11.14)
	UPC >0.75	Reference	Reference	Reference	Reference
Age	<40 years	**-23.78 (-45.94, -1.62)**	15.38 (-145.65, 176.40)	**-14.48 (-18.00, -10.97)**	**-23.59 (-34.23, -12.96)**
	40-49 years	**-10.96 (-21.90, -0.03)**	-0.98 (-31.38, 29.41)	**-3.86 (-6.91, -0.81)**	-0.19 (-8.72, 8.33)
	50-59 years	Reference	Reference	Reference	Reference
	60-69 years	1.63 (-1.32, 4.58)	3.23 (-4.23, 10.69)	1.14 (-2.43, 4.72)	-2.17 (-12.58, 8.24)
	70-74 years	4.00 (-3.01, 11.01)	5.38 (-15.15, 25.90)	3.31 (-3.36, 9.99)	-9.88 (-23.72, 3.96)
	>74 years	**11.70 (2.72, 20.69)**	6.75 (-8.46, 21.97)	1.43 (-6.55, 9.41)	-11.80 (-29.41, 5.81)
Immigrant	Immigrants	7.26 (-0.16, 14.68)	12.89 (-2.15, 27.93)	**7.22 (4.02, 10.42)**	0.21 (-8.46, 8.89)
	Long-term residents	Reference	Reference	Reference	Reference
Income quintile	1 (low)	**5.56 (0.51, 10.61)**	6.53 (-6.78, 19.84)	**6.23 (2.28, 10.19)**	-3.81 (-13.75, 6.14)
	2	**6.11 (1.57, 10.65)**	-1.72 (-12.48, 9.05)	2.94 (-0.81, 6.68)	3.29 (-6.35, 12.93)
	3	**5.04 (0.04, 10.03)**	1.83 (-8.45, 12.11)	**4.68 (0.90, 8.45)**	-4.83 (-15.59, 5.93)
	4	3.33 (-0.99, 7.66)	-2.91 (-13.15, 7.34)	1.38 (-1.74, 4.49)	-3.57 (-13.38, 6.24)
	5 (high)	Reference	Reference	Reference	Reference
Physical comorbidities	0-5 ADGs	Reference	Reference	Reference	Reference
	6-9 ADGs	-1.30 (-4.75, 2.15)	1.77 (-6.48, 10.03)	**4.77 (1.89, 7.64)**	**14.91 (7.75, 22.08)**
	10+ ADGs	-1.48 (-7.95, 4.99)	-4.02 (-16.31, 8.27)	**6.43 (0.91, 11.95)**	**24.71 (11.89, 37.53)**
History of mental health visits	Yes	0.89 (-2.37, 4.15)	**8.75 (0.34, 17.17)**	2.32 (-0.26, 4.91)	0.80 (-6.63, 8.23)
	No	Reference	Reference	Reference	Reference

Rurality	Rural	4.48 (-1.92, 10.89)	-0.34 (-15.32, 14.64)	1.00 (-3.67, 5.67)	-0.97 (-17.00, 15.06)
	Rural-remote	6.44 (-0.87, 13.76)	10.13 (-7.70, 27.97)	-2.77 (-10.27, 4.74)	12.27 (-7.43, 31.97)
	Rural-very remote	**28.15 (17.18, 39.11)**	**47.34 (5.57, 89.11)**	6.27 (-3.61, 16.15)	**26.74 (5.46, 48.01)**
	Urban	Reference	Reference	Reference	Reference
LHIN	1 Erie St. Clair	**-9.70 (-17.21, -2.20)**	-1.17 (-32.49, 30.15)	**-13.69 (-19.89, -7.48)**	**-32.28 (-50.47, -14.08)**
	2 South West	6.00 (-3.37, 15.37)	14.64 (-5.57, 34.85)	-2.27 (-8.62, 4.08)	**-17.68 (-33.11, -2.25)**
	3 Waterloo Wellington	-3.22 (-14.21, 7.77)	-14.45 (-38.83, 9.93)	**-19.01 (-25.55, -12.48)**	**-31.65 (-46.99, -16.30)**
	4 Hamilton Niagara Haldimand Brant	**-9.81 (-16.64, -2.99)**	-15.28 (-35.25, 4.69)	**-13.86 (-19.35, -8.36)**	**-27.28 (-41.66, -12.89)**
	5 Central West	-9.00 (-18.50, 0.50)	-9.34 (-38.67, 19.99)	-6.47 (-14.83, 1.89)	**-17.88 (-34.16, -1.59)**
	6 Mississauga Halton	-6.63 (-17.28, 4.02)	16.36 (-13.68, 46.39)	**-10.61 (-18.35, -2.87)**	-8.56 (-26.51, 9.38)
	7 Toronto Central	Reference	Reference	Reference	Reference
	8 Central	-2.85 (-10.73, 5.03)	4.68 (-15.73, 25.09)	**-5.32 (-10.56, -0.09)**	-10.38 (-22.54, 1.77)
	9 Central East	**-14.93 (-22.25, -7.60)**	-7.21 (-28.20, 13.79)	-5.70 (-11.59, 0.19)	**-20.28 (-32.68, -7.87)**
	10 South East	-0.37 (-9.81, 9.06)	0.62 (-21.16, 22.40)	**-7.99 (-15.71, -0.26)**	**-23.25 (-41.95, -4.55)**
	11 Champlain	**17.30 (10.52, 24.07)**	5.40 (-14.43, 25.23)	**15.30 (8.87, 21.73)**	5.97 (-11.86, 23.80)
	12 North Simcoe Muskoka	-1.44 (-12.39, 9.50)	-3.02 (-34.20, 28.16)	**-9.53 (-16.61, -2.45)**	-10.45 (-27.58, 6.69)
	13 North East	**-12.33 (-21.37, -3.30)**	-15.38 (-46.01, 15.25)	**-13.35 (-23.30, -3.40)**	**-29.09 (-53.24, -4.93)**
	14 North West	4.74 (-7.35, 16.83)	9.74 (-28.69, 48.17)	-5.03 (-17.08, 7.03)	-8.82 (-28.85, 11.21)
Primary care enrolment model	Capitation	-0.89 (-7.14, 5.36)	2.23 (-11.03, 15.48)	1.88 (-1.93, 5.70)	**12.13 (0.47, 23.79)**
	Enhanced FFS	3.30 (-1.87, 8.47)	11.47 (-1.62, 24.56)	-0.69 (-3.96, 2.59)	2.30 (-6.30, 10.90)
	Other	2.22 (-11.78, 16.22)	21.92 (-6.22, 50.07)	1.55 (-11.88, 14.97)	-6.91 (-39.61, 25.78)
	Team-based capitation	-3.30 (-9.19, 2.59)	2.04 (-12.20, 16.28)	-1.30 (-5.38, 2.78)	6.30 (-6.26, 18.85)
	Straight FFS	Reference	Reference	Reference	Reference

Bolded values: p<0.05

Table J-3a. Median and 90th percentile contact to chemotherapy intervals - quantile regression multivariable adjusted model. Sensitivity analysis 3: include only patients with >2 PCP visits during baseline period.

N=		Screened n=2414		Symptomatic N=7780	
Parameter	Group	Median	90th percentile	Median	90th percentile
Intercept		119.07 (109.73, 128.42)	172.44 (147.63, 197.25)	136.87 (130.19, 143.55)	241.08 (225.39, 256.77)
Continuity	UPC <=0.75	1.00 (-2.81, 4.81)	-2.40 (-10.25, 5.45)	-2.47 (-5.26, 0.33)	**7.60 (0.12, 15.09)**
	UPC >0.75	Reference	Reference	Reference	Reference
Age	<40 years	**-25.90 (-47.55, -4.26)**	-37.88 (-201.91, 126.15)	**-16.53 (-20.60, -12.47)**	**-35.42 (-47.40, -23.43)**
	40-49 years	-6.90 (-17.88, 4.07)	1.40 (-24.25, 27.05)	**-4.45 (-7.81, -1.10)**	-4.31 (-12.84, 4.21)
	50-59 years	Reference	Reference	Reference	Reference
	60-69 years	1.48 (-1.88, 4.83)	1.32 (-6.78, 9.42)	0.36 (-3.94, 4.66)	-5.73 (-16.03, 4.57)
	70-74 years	4.17 (-3.43, 11.76)	5.60 (-17.02, 28.22)	2.82 (-4.73, 10.37)	-10.60 (-26.55, 5.34)
	>74 years	**11.21 (0.97, 21.46)**	10.08 (-7.77, 27.93)	-1.72 (-10.50, 7.06)	-13.62 (-33.40, 6.15)
Immigrant	Immigrants	**8.29 (0.55, 16.02)**	14.64 (-1.64, 30.92)	**6.64 (2.44, 10.85)**	2.44 (-7.83, 12.70)
	Long-term residents	Reference	Reference	Reference	Reference
Income quintile	1 (low)	5.67 (-0.07, 11.40)	4.72 (-9.30, 18.74)	**7.10 (2.31, 11.89)**	-5.21 (-15.90, 5.49)
	2	**7.31 (1.97, 12.65)**	3.44 (-9.71, 16.59)	1.61 (-2.49, 5.72)	4.87 (-5.69, 15.44)
	3	5.26 (-0.01, 10.53)	0.32 (-12.29, 12.93)	3.50 (-0.64, 7.64)	-5.27 (-15.56, 5.02)
	4	2.62 (-1.98, 7.22)	-5.00 (-16.35, 6.35)	0.00 (-3.99, 3.99)	-3.17 (-14.30, 7.97)

	5 (high)	Reference	Reference	Reference	Reference
Physical comorbidities	0-5 ADGs	Reference	Reference	Reference	Reference
	6-9 ADGs	-1.21 (-4.52, 2.09)	3.68 (-5.35, 12.71)	**4.24 (1.34, 7.14)**	**14.88 (8.04, 21.72)**
	10+ ADGs	-1.00 (-7.52, 5.52)	-4.96 (-16.64, 6.72)	**7.73 (2.24, 13.22)**	**25.85 (11.35, 40.36)**
History of mental health visits	Yes	1.31 (-2.25, 4.87)	6.04 (-2.83, 14.91)	1.26 (-1.57, 4.08)	-1.27 (-8.14, 5.60)
	No	Reference	Reference	Reference	Reference
Rurality	Rural	3.02 (-3.61, 9.66)	-0.16 (-20.42, 20.10)	0.10 (-5.75, 5.95)	1.17 (-16.93, 19.26)
	Rural-remote	3.17 (-6.76, 13.09)	13.44 (-6.28, 33.16)	0.78 (-9.02, 10.58)	19.15 (-9.92, 48.23)
	Rural-very remote	**30.38 (17.00, 43.76)**	44.20 (-2.78, 91.18)	8.67 (-4.65, 21.98)	**34.29 (12.93, 55.65)**
	Urban	Reference	Reference	Reference	Reference
LHIN	1 Erie St. Clair	**-9.19 (-17.55, -0.83)**	-20.16 (-51.56, 11.24)	**-16.39 (-23.15, -9.63)**	**-35.35 (-54.53, -16.18)**
	2 South West	**11.00 (0.56, 21.44)**	12.08 (-8.52, 32.68)	-5.05 (-11.83, 1.74)	**-22.39 (-37.82, -6.97)**
	3 Waterloo Wellington	-1.79 (-14.47, 10.89)	-15.76 (-47.60, 16.08)	**-24.02 (-31.35, -16.68)**	**-37.83 (-55.80, -19.87)**
	4 Hamilton Niagara Haldimand Brant	**-9.74 (-17.18, -2.30)**	-17.24 (-36.31, 1.83)	**-16.73 (-22.38, -11.08)**	**-29.96 (-44.31, -15.60)**
	5 Central West	**-11.62 (-20.89, -2.35)**	-8.32 (-33.82, 17.18)	**-10.87 (-19.08, -2.67)**	**-23.56 (-43.27, -3.84)**
	6 Mississauga Halton	-4.45 (-15.98, 7.07)	17.88 (-11.19, 46.95)	**-11.87 (-20.12, -3.62)**	-15.10 (-34.45, 4.24)
	7 Toronto Central	Reference	Reference	Reference	Reference
	8 Central	-0.79 (-10.03, 8.46)	1.40 (-20.67, 23.47)	**-8.66 (-14.62, -2.70)**	-13.12 (-28.68, 2.43)
	9 Central East	**-14.05 (-21.78, -6.32)**	-14.00 (-35.69, 7.69)	**-8.84 (-14.50, -3.18)**	**-20.17 (-34.48, -5.85)**
	10 South East	2.31 (-10.05, 14.66)	-1.60 (-24.67, 21.47)	**-14.76 (-22.95, -6.57)**	**-31.85 (-55.66, -8.04)**
	11 Champlain	**19.38 (12.06, 26.70)**	4.00 (-16.56, 24.56)	**12.00 (5.32, 18.68)**	0.02 (-18.43, 18.48)
	12 North Simcoe Muskoka	-3.69 (-14.82, 7.44)	-10.28 (-37.88, 17.32)	-8.97 (-18.69, 0.75)	-14.29 (-33.90, 5.31)
	13 North East	**-13.74 (-24.70, -2.78)**	-20.32 (-48.64, 8.00)	**-17.03 (-26.40, -7.66)**	-19.97 (-50.41, 10.48)
	14 North West	5.07 (-5.56, 15.70)	5.08 (-33.18, 43.34)	-6.67 (-21.87, 8.52)	-8.27 (-34.57, 18.02)
Primary care enrolment model	Capitation	-0.12 (-6.35, 6.11)	2.96 (-13.65, 19.57)	1.33 (-4.07, 6.72)	**13.04 (0.77, 25.32)**
	Enhanced FFS	4.45 (-1.34, 10.25)	15.48 (-0.29, 31.25)	-2.00 (-6.09, 2.09)	1.31 (-9.23, 11.85)
	Other	14.79 (-1.54, 31.11)	32.64 (-8.72, 74.00)	0.18 (-23.22, 23.58)	-39.97 (-87.67, 7.72)
	Team-based capitation	-1.86 (-8.01, 4.30)	6.24 (-10.20, 22.68)	-4.11 (-8.47, 0.24)	2.04 (-9.81, 13.89)
	Straight FFS	Reference	Reference	Reference	Reference

Bolded values: p<0.05

Table J-3b. Median and 90th percentile primary care intervals - quantile regression multivariable adjusted model. Sensitivity analysis 3: include only patients with >2 PCP visits during baseline period.

		Screened		Symptomatic	
Parameter	Group	Median	90th percentile	Median	90th percentile
Intercept		33.55 (26.95, 40.14)	68.88 (58.68, 79.08)	34.99 (30.89, 39.09)	123.68 (104.67, 142.69)
Continuity	UPC <=0.75	1.24 (-1.20, 3.68)	-3.40 (-7.55, 0.75)	-0.19 (-2.02, 1.65)	4.76 (-3.19, 12.71)
	UPC >0.75	Reference	Reference	Reference	Reference
Age	<40 years	-11.38 (-23.51, 0.74)	-27.58 (-109.08, 53.92)	**-6.77 (-9.38, -4.16)**	**-21.42 (-34.39, -8.45)**
	40-49 years	**-10.36 (-17.33, -3.38)**	-1.02 (-28.89, 26.84)	-2.10 (-4.40, 0.20)	2.00 (-8.78, 12.77)
	50-59 years	Reference	Reference	Reference	Reference
	60-69 years	0.38 (-1.91, 2.67)	-2.66 (-7.09, 1.76)	-1.73 (-4.50, 1.03)	-8.27 (-18.71, 2.17)

	70-74 years	2.81 (-1.51, 7.13)	-6.69 (-16.89, 3.52)	**-5.14 (-8.71, -1.56)**	**-21.90 (-37.74, -6.07)**
	>74 years	3.24 (-3.91, 10.38)	9.86 (-10.56, 30.27)	**-7.80 (-12.02, -3.59)**	**-29.99 (-50.85, -9.13)**
Immigrant	Immigrants	0.29 (-5.21, 5.78)	12.01 (-0.30, 24.32)	1.03 (-1.91, 3.97)	3.26 (-6.76, 13.28)
	Long-term residents	Reference	Reference	Reference	Reference
Income quintile	1 (low)	0.71 (-2.69, 4.12)	0.70 (-6.57, 7.97)	1.78 (-1.20, 4.76)	**-14.43 (-25.75, -3.12)**
	2	-0.98 (-4.80, 2.84)	2.66 (-4.14, 9.47)	0.19 (-2.44, 2.81)	**-16.79 (-28.19, -5.38)**
	3	1.00 (-2.16, 4.16)	-1.45 (-7.60, 4.71)	0.77 (-1.77, 3.31)	**-19.13 (-28.77, -9.50)**
	4	1.38 (-1.60, 4.36)	-1.31 (-7.11, 4.49)	-0.49 (-3.06, 2.08)	**-15.87 (-28.13, -3.60)**
	5 (high)	Reference	Reference	Reference	Reference
Physical comorbidities	0-5 ADGs	Reference	Reference	Reference	Reference
	6-9 ADGs	-1.10 (-3.26, 1.07)	1.76 (-2.78, 6.30)	**2.05 (0.21, 3.88)**	7.27 (-0.12, 14.65)
	10+ ADGs	-1.05 (-5.44, 3.34)	-0.02 (-7.67, 7.62)	0.57 (-1.99, 3.14)	15.19 (-0.09, 30.48)
History of mental health visits	Yes	-0.67 (-2.71, 1.37)	0.76 (-4.12, 5.64)	0.37 (-1.41, 2.16)	-1.39 (-9.17, 6.39)
	No	Reference	Reference	Reference	Reference
Rurality	Rural	-1.71 (-6.71, 3.28)	-4.05 (-18.12, 10.03)	-2.40 (-6.25, 1.45)	7.83 (-8.37, 24.03)
	Rural-remote	3.55 (-4.14, 11.23)	10.48 (-3.59, 24.56)	-5.44 (-9.65, -1.24)	-0.71 (-21.53, 20.11)
	Rural-very remote	5.69 (-5.01, 16.39)	22.92 (4.01, 41.82)	-3.69 (-9.83, 2.44)	-2.36 (-34.22, 29.50)
	Urban	Reference	Reference	Reference	Reference
LHIN	1 Erie St. Clair	2.02 (-4.81, 8.86)	-0.95 (-19.28, 17.37)	**6.35 (1.19, 11.51)**	3.01 (-21.01, 27.02)
	2 South West	**12.02 (5.00, 19.05)**	**18.10 (7.63, 28.56)**	**7.90 (2.34, 13.45)**	-5.30 (-24.40, 13.79)
	3 Waterloo Wellington	1.60 (-4.83, 8.02)	-9.65 (-25.36, 6.06)	**-6.16 (-10.86, -1.46)**	-16.18 (-40.69, 8.34)
	4 Hamilton Niagara Haldimand Brant	-3.45 (-8.78, 1.87)	**-10.67 (-20.99, -0.36)**	-0.52 (-4.42, 3.38)	-18.48 (-37.49, 0.53)
	5 Central West	**8.26 (1.52, 15.00)**	-3.64 (-19.04, 11.76)	-1.56 (-5.94, 2.82)	**-31.00 (-50.75, -11.25)**
	6 Mississauga Halton	1.55 (-6.60, 9.69)	9.14 (-14.93, 33.22)	2.04 (-2.97, 7.05)	3.25 (-18.46, 24.96)
	7 Toronto Central	Reference	Reference	Reference	Reference
	8 Central	-1.76 (-7.61, 4.08)	0.43 (-9.98, 10.85)	-2.00 (-5.71, 1.71)	-1.24 (-17.15, 14.67)
	9 Central East	-3.07 (-8.36, 2.22)	**-13.51 (-22.80, -4.21)**	-2.32 (-5.93, 1.28)	-8.50 (-23.91, 6.90)
	10 South East	9.17 (-0.35, 18.69)	11.14 (-4.89, 27.18)	1.31 (-4.80, 7.41)	-16.89 (-35.34, 1.55)
	11 Champlain	**11.83 (6.45, 17.21)**	-3.43 (-12.01, 5.15)	**13.96 (9.85, 18.08)**	5.18 (-12.64, 23.00)
	12 North Simcoe Muskoka	-6.17 (-12.64, 0.31)	1.24 (-15.80, 18.28)	**-5.59 (-9.69, -1.50)**	-2.58 (-24.11, 18.95)
	13 North East	-3.12 (-10.33, 4.09)	-14.57 (-31.32, 2.19)	-3.51 (-9.34, 2.32)	-1.53 (-25.54, 22.47)
	14 North West	**18.88 (7.42, 30.35)**	**24.84 (9.24, 40.44)**	3.41 (-3.20, 10.03)	-6.01 (-32.49, 20.46)
Primary care enrolment model	Capitation	-1.43 (-5.68, 2.83)	1.07 (-6.97, 9.11)	2.29 (-0.84, 5.42)	**17.18 (2.76, 31.59)**
	Enhanced FFS	-1.10 (-4.82, 2.63)	3.24 (-3.08, 9.56)	0.15 (-2.20, 2.49)	4.59 (-6.33, 15.51)
	Other	4.57 (-5.15, 14.29)	6.90 (-33.04, 46.85)	1.83 (-12.38, 16.04)	-12.01 (-40.75, 16.73)
	Team-based capitation	-1.93 (-6.08, 2.22)	-1.93 (-9.54, 5.68)	0.33 (-2.31, 2.97)	**14.70 (1.14, 28.25)**
	Straight FFS	Reference	Reference	Reference	Reference

Bolded values: p<0.05

Table J-3c. Median and 90th percentile surgery to chemotherapy intervals - quantile regression multivariable adjusted model. Sensitivity analysis 3: include only patients with >2 PCP visits during baseline period.

Parameter	Group	Median	90th percentile
Intercept		55.37 (53.27, 57.47)	95.44 (89.06, 101.82)
Continuity	UPC <=0.75	0.23 (-0.67, 1.14)	0.46 (-1.93, 2.85)
	UPC >0.75	Reference	Reference

Age	<40 years	**-6.13 (-8.14, -4.12)**	**-7.36 (-11.61, -3.11)**
	40-49 years	**-2.77 (-3.84, -1.69)**	**-5.68 (-8.50, -2.86)**
	50-59 years	Reference	Reference
	60-69 years	**1.23 (0.02, 2.45)**	0.62 (-2.38, 3.62)
	70-74 years	**3.06 (0.24, 5.88)**	**6.32 (0.49, 12.15)**
	>74 years	**6.35 (3.53, 9.18)**	8.32 (-0.67, 17.31)
Immigrant	Immigrants	**1.93 (0.53, 3.34)**	**5.02 (0.78, 9.26)**
	Long-term residents	Reference	Reference
Income quintile	1 (low)	**1.37 (0.01, 2.72)**	2.58 (-1.04, 6.20)
	2	0.83 (-0.54, 2.21)	1.30 (-1.91, 4.51)
	3	**1.60 (0.06, 3.14)**	**4.38 (0.85, 7.91)**
	4	**1.13 (0.05, 2.22)**	2.14 (-1.14, 5.42)
	5 (high)	Reference	Reference
Physical comorbidities	0-5 ADGs	Reference	Reference
	6-9 ADGs	0.47 (-0.45, 1.39)	**2.62 (0.02, 5.22)**
	10+ ADGs	0.83 (-1.06, 2.73)	**6.12 (1.75, 10.50)**
History of mental health visits	Yes	0.77 (-0.14, 1.67)	1.14 (-1.43, 3.71)
	No	Reference	Reference
Rurality	Rural	**2.53 (0.19, 4.87)**	3.78 (-1.67, 9.23)
	Rural-remote	**3.20 (0.74, 5.66)**	**11.66 (5.25, 18.08)**
	Rural-very remote	**7.70 (3.47, 11.93)**	**18.76 (1.96, 35.56)**
	Urban	Reference	Reference
LHIN	1 Erie St. Clair	**-6.10 (-9.03, -3.17)**	**-10.78 (-16.52, -5.04)**
	2 South West	**4.70 (2.33, 7.07)**	-2.06 (-8.71, 4.59)
	3 Waterloo Wellington	**-5.43 (-8.04, -2.83)**	**-7.60 (-14.28, -0.93)**
	4 Hamilton Niagara Haldimand Brant	-0.17 (-2.06, 1.73)	**-9.00 (-14.46, -3.54)**
	5 Central West	-0.63 (-3.43, 2.16)	2.10 (-4.25, 8.45)
	6 Mississauga Halton	-1.38 (-3.51, 0.76)	-4.38 (-12.52, 3.76)
	7 Toronto Central	Reference	Reference
	8 Central	-0.70 (-2.77, 1.37)	-2.90 (-8.78, 2.98)
	9 Central East	-0.47 (-2.31, 1.38)	-2.84 (-8.97, 3.29)
	10 South East	0.93 (-1.78, 3.65)	-7.06 (-14.74, 0.62)
	11 Champlain	**7.03 (4.98, 9.08)**	-2.30 (-8.61, 4.01)
	12 North Simcoe Muskoka	**4.67 (1.90, 7.44)**	-4.04 (-11.39, 3.31)
	13 North East	**4.87 (1.53, 8.20)**	5.94 (-3.09, 14.97)
	14 North West	-5.19 (-10.44, 0.06)	-0.84 (-15.40, 13.72)
Primary care enrolment model	Capitation	0.27 (-1.34, 1.88)	-4.56 (-9.40, 0.28)
	Enhanced FFS	0.50 (-0.80, 1.80)	-4.06 (-8.24, 0.12)
	Other	**-7.20 (-14.31, -0.09)**	-9.90 (-28.85, 9.05)
	Team-based capitation	0.37 (-1.23, 1.97)	-3.60 (-8.38, 1.18)
	Straight FFS	Reference	Reference

Bolded values: p<0.05

Table J-4a. Median and 90th percentile contact to chemotherapy intervals - quantile regression multivariable adjusted model. Sensitivity analysis 4: include the immigrant population only.

		Screened n=217		Symptomatic n=1443	
Parameter	Group	Median	90th percentile	Median	90th percentile
Intercept		**145.19 (96.22, 194.17)**	**209.36 (23.95, 394.77)**	**125.32 (105.23, 145.41)**	**216.33 (159.78, 272.87)**
Continuity	0 Visits	-24.20 (-54.25, 5.84)	-14.90 (-110.63, 80.83)	-10.48 (-21.69, 0.73)	-18.67 (-54.27, 16.92)
	1-2 Visits	-21.33 (-57.90, 15.23)	-4.31 (-181.75, 173.14)	-4.84 (-19.41, 9.73)	-9.56 (-43.22, 24.09)
	UPC <=0.75	**17.43 (0.09, 34.76)**	**59.37 (4.06, 114.67)**	-6.18 (-12.61, 0.24)	-6.95 (-23.07, 9.17)
	UPC >0.75	Reference	Reference	Reference	Reference

Age	<40 years	-65.60 (-420.66, 289.47)	-243.63 (-1,042.31, 555.06)	**-13.00 (-23.31, -2.69)**	-12.95 (-41.88, 15.98)
	40-49 years	**-24.62 (-42.33, -6.90)**	-10.75 (-66.29, 44.79)	-2.85 (-12.36, 6.67)	7.17 (-12.45, 26.79)
	50-59 years	Reference	Reference	Reference	Reference
	60-69 years	-7.10 (-27.90, 13.71)	-6.63 (-61.51, 48.24)	-1.86 (-13.56, 9.83)	3.55 (-28.25, 35.36)
	70-74 years	-1.82 (-57.54, 53.90)	-40.44 (-204.36, 123.47)	-7.82 (-28.87, 13.23)	-21.05 (-109.52, 67.43)
	>74 years	33.14 (-129.13, 195.40)	-56.32 (-1,107.31, 994.66)	-33.01 (-69.05, 3.02)	-53.12 (-329.89, 223.64)
Country of birth	East Asia & Pacific	-24.70 (-63.79, 14.38)	-52.02 (-176.25, 72.20)	14.13 (-1.27, 29.54)	4.75 (-38.61, 48.11)
	Eastern Europe & Central Asia	-15.42 (-58.25, 27.41)	-44.29 (-176.01, 87.43)	7.43 (-8.89, 23.76)	-0.69 (-45.31, 43.94)
	Latin America & Caribbean	-28.63 (-73.21, 15.95)	-25.50 (-178.51, 127.51)	17.06 (-1.62, 35.73)	15.97 (-28.06, 60.01)
	Middle East & North Africa	-17.83 (-56.35, 20.68)	-46.96 (-184.57, 90.65)	9.42 (-9.10, 27.94)	-1.42 (-56.93, 54.10)
	South Asia	-26.46 (-69.21, 16.29)	-43.42 (-179.32, 92.48)	11.21 (-4.65, 27.06)	-6.65 (-52.00, 38.70)
	Sub-Saharan Africa	-27.51 (-80.32, 25.29)	-79.51 (-246.98, 87.96)	10.63 (-11.67, 32.92)	-3.22 (-61.70, 55.25)
	US/New Zealand/Australia	-7.47 (-91.96, 77.03)	-88.17 (-343.90, 167.55)	7.87 (-22.15, 37.89)	29.44 (-60.15, 119.03)
	Western Europe	Reference	Reference	Reference	Reference
Time since immigration	<10 years	-2.24 (-21.31, 16.83)	35.20 (-31.69, 102.08)	-2.27 (-8.81, 4.27)	-6.22 (-22.28, 9.84)
	>=10 years	Reference	Reference	Reference	Reference
Immigration class	Economic	Reference	Reference	Reference	Reference
	Family	11.30 (-8.84, 31.45)	29.05 (-22.68, 80.78)	0.95 (-6.39, 8.28)	-12.89 (-29.39, 3.62)
	Refugee	3.37 (-25.68, 32.41)	11.93 (-69.75, 93.61)	6.79 (-3.12, 16.69)	4.71 (-23.79, 33.20)
	Other	24.19 (-37.02, 85.39)	-31.53 (-353.45, 290.39)	15.07 (-12.20, 42.34)	-33.53 (-159.39, 92.32)
Income quintile	1 (low)	**24.13 (0.17, 48.08)**	28.49 (-50.13, 107.11)	9.35 (-2.46, 21.16)	17.28 (-11.27, 45.84)
	2	4.44 (-19.62, 28.49)	-2.92 (-75.26, 69.42)	9.93 (-2.37, 22.23)	20.89 (-9.15, 50.93)
	3	0.91 (-27.37, 29.18)	9.26 (-73.10, 91.63)	4.34 (-6.89, 15.58)	5.43 (-22.95, 33.81)
	4	-11.16 (-35.00, 12.68)	-15.22 (-97.69, 67.25)	-2.50 (-13.37, 8.37)	15.37 (-13.98, 44.71)
	5 (high)	Reference	Reference	Reference	Reference
Physical comorbidities	0-5 ADGs	Reference	Reference	Reference	Reference
	6-9 ADGs	-5.04 (-22.48, 12.41)	-10.96 (-57.54, 35.62)	1.20 (-6.43, 8.83)	11.88 (-5.78, 29.54)
	10+ ADGs	-1.63 (-26.98, 23.71)	-15.04 (-92.19, 62.11)	4.87 (-6.55, 16.28)	22.53 (-3.62, 48.68)
History of mental health visits	Yes	7.27 (-8.43, 22.97)	11.66 (-42.70, 66.01)	-0.90 (-9.04, 7.24)	9.20 (-10.92, 29.31)
	No	Reference	Reference	Reference	Reference
Rurality	Rural	22.54 (-400.62, 445.70)	26.45 (-1,670.00, 1,722.90)	-2.87 (-36.62, 30.88)	1.49 (-109.20, 112.18)
	Rural-remote	40.56 (-100.82, 181.94)	23.63 (-592.78, 640.04)	67.07 (-336.10, 470.24)	28.48 (-1,272.79, 1,329.75)
	Rural-very remote	-	-	-39.53 (-323.00, 243.94)	-69.64 (-1,692.29, 1,553.00)
	Urban	Reference	Reference	Reference	Reference
LHIN	1 Erie St. Clair	-34.66 (-90.73, 21.41)	-0.95 (-19.28, 17.37)	6.62 (-22.18, 35.41)	-17.51 (-100.27, 65.25)
	2 South West	3.93 (-67.38, 75.23)	-101.65 (-485.07, 281.76)	3.75 (-20.74, 28.24)	-67.50 (-143.90, 8.91)
	3 Waterloo Wellington	-8.85 (-54.15, 36.46)	-52.60 (-549.16, 443.96)	**-24.75 (-41.02, -8.49)**	**-62.96 (-113.86, -12.06)**
	4 Hamilton Niagara Haldimand Brant	7.12 (-40.36, 54.60)	-30.23 (-405.49, 345.03)	-9.68 (-27.23, 7.87)	-4.61 (-53.31, 44.10)
	5 Central West	17.19 (-14.62, 49.01)	-5.87 (-175.36, 163.63)	3.13 (-12.82, 19.07)	-9.23 (-43.74, 25.29)
	6 Mississauga Halton	16.80 (-22.01, 55.60)	12.01 (-91.30, 115.32)	-3.72 (-17.99, 10.55)	24.55 (-17.47, 66.58)
	7 Toronto Central	Reference	Reference	Reference	Reference
	8 Central	13.56 (-14.65, 41.77)	34.98 (-59.71, 129.67)	-2.87 (-15.47, 9.73)	2.65 (-27.44, 32.75)
	9 Central East	2.44 (-29.29, 34.18)	15.19 (-94.29, 124.66)	1.51 (-11.11, 14.13)	1.65 (-29.73, 33.04)
	10 South East	29.36 (-97.69, 156.41)	47.80 (-963.93, 1,059.52)	3.60 (-54.96, 62.16)	-33.89 (-466.08, 398.30)
	11 Champlain	31.23 (-4.13, 66.59)	-10.81 (-133.64, 112.02)	**22.89 (5.87, 39.90)**	44.98 (-2.64, 92.60)

	12 North Simcoe Muskoka	-	-	3.00 (-53.43, 59.43)	6.16 (-511.14, 523.46)
	13 North East	-136.69 (-639.44, 366.07)	-232.56 (-2,431.88, 1,966.76)	-2.46 (-847.50, 842.58)	-73.73 (-4,938.94, 4,791.47)
	14 North West	-	-	-2.93 (-285.63, 279.77)	-86.76 (-2,122.94, 1,949.43)
Primary care enrolment model	Capitation	-1.03 (-28.80, 26.73)	-2.24 (-98.05, 93.57)	5.17 (-8.30, 18.63)	8.65 (-29.90, 47.21)
	Enhanced FFS	-17.19 (-39.37, 4.99)	-19.24 (-83.35, 44.86)	-2.05 (-9.97, 5.87)	-5.78 (-24.30, 12.74)
	Other	-53.53 (-264.30, 157.23)	-59.33 (-1,001.51, 882.85)	16.83 (-111.37, 145.03)	-9.74 (-987.46, 967.99)
	Team-based capitation	-10.87 (-47.15, 25.42)	-13.83 (-121.31, 93.66)	-5.62 (-20.16, 8.93)	-7.75 (-46.22, 30.72)
	Straight FFS	Reference	Reference	Reference	Reference

Bolded values: p<0.05

Table J-4b. Median and 90th percentile primary care intervals - quantile regression multivariable adjusted model. Sensitivity analysis 4: include the immigrant population only.

		Screened n=217		Symptomatic n=1443	
Parameter	Group	Median	90th percentile	Median	90th percentile
Intercept		53.78 (15.89, 91.67)	113.36 (41.18, 185.54)	26.99 (14.42, 39.57)	115.31 (72.94, 157.68)
Continuity	0 Visits	3.58 (-16.19, 23.34)	0.94 (-34.33, 36.22)	**-14.52 (-21.25, -7.79)**	**-45.25 (-68.01, -22.49)**
	1-2 Visits	7.88 (-20.72, 36.47)	-8.22 (-61.53, 45.10)	-7.19 (-14.81, 0.43)	**-26.08 (-50.28, -1.87)**
	UPC <=0.75	**15.45 (4.00, 26.90)**	17.64 (-1.72, 37.00)	0.93 (-3.55, 5.41)	-2.59 (-17.37, 12.18)
	UPC >0.75	Reference	Reference	Reference	Reference
Age	<40 years	-2.64 (-186.40, 181.12)	-54.26 (-770.65, 662.12)	-3.71 (-8.92, 1.51)	18.02 (-3.45, 39.50)
	40-49 years	-11.35 (-24.05, 1.35)	-0.19 (-25.87, 25.50)	0.59 (-3.95, 5.13)	11.33 (-4.90, 27.56)
	50-59 years	Reference	Reference	Reference	Reference
	60-69 years	1.61 (-10.60, 13.81)	-4.44 (-29.79, 20.91)	-0.94 (-9.45, 7.57)	-6.18 (-29.47, 17.11)
	70-74 years	1.28 (-30.91, 33.47)	-14.63 (-92.66, 63.40)	-4.85 (-21.51, 11.81)	-8.87 (-87.12, 69.39)
	>74 years	15.88 (-86.19, 117.95)	-0.61 (-386.91, 385.70)	-9.66 (-28.24, 8.92)	-54.59 (-377.09, 267.90)
Country of birth	East Asia & Pacific	-5.31 (-36.17, 25.56)	-37.77 (-96.24, 20.70)	5.64 (-4.32, 15.60)	5.08 (-29.25, 39.41)
	Eastern Europe & Central Asia	-23.68 (-53.84, 6.48)	**-61.81 (-120.21, -3.41)**	5.57 (-5.40, 16.55)	12.04 (-24.59, 48.67)
	Latin America & Caribbean	-8.38 (-41.86, 25.11)	-46.84 (-111.69, 18.00)	11.41 (-0.47, 23.28)	-1.60 (-38.66, 35.47)
	Middle East & North Africa	-10.85 (-40.95, 19.24)	-42.46 (-108.68, 23.76)	8.93 (-4.07, 21.93)	17.99 (-18.79, 54.76)
	South Asia	-20.26 (-49.77, 9.25)	**-57.71 (-112.77, -2.64)**	1.26 (-9.24, 11.75)	-5.90 (-41.95, 30.16)
	Sub-Saharan Africa	-4.96 (-43.31, 33.40)	-45.76 (-111.32, 19.81)	9.53 (-3.08, 22.14)	-5.10 (-48.00, 37.79)
	US/New Zealand/Australia	-2.45 (-67.84, 62.95)	-22.43 (-127.08, 82.22)	1.60 (-17.00, 20.19)	15.68 (-53.35, 84.71)
	Western Europe	Reference	Reference	Reference	Reference
Time since immigration	<10 years	-0.88 (-12.63, 10.88)	**-26.20 (-48.53, -3.86)**	3.02 (-0.70, 6.73)	-12.63 (-25.90, 0.65)
	>=10 years	Reference	Reference	Reference	Reference
Immigration class	Economic	Reference	Reference	Reference	Reference
	Family	4.07 (-7.23, 15.37)	**22.26 (0.51, 44.01)**	-2.39 (-6.96, 2.17)	-5.44 (-20.17, 9.30)
	Refugee	-7.96 (-20.43, 4.51)	-1.95 (-34.46, 30.56)	1.74 (-5.03, 8.50)	-1.35 (-26.73, 24.03)
	Other	11.78 (-18.29, 41.84)	19.08 (-56.87, 95.04)	-1.65 (-24.94, 21.64)	26.43 (-71.64, 124.50)
Income quintile	1 (low)	3.55 (-10.52, 17.61)	7.31 (-19.93, 34.55)	0.52 (-6.60, 7.64)	-5.06 (-24.88, 14.76)
	2	-4.23 (-19.20, 10.74)	-3.74 (-30.52, 23.04)	4.72 (-2.18, 11.61)	14.20 (-9.99, 38.39)
	3	-1.18 (-19.34, 16.97)	15.07 (-16.57, 46.71)	2.26 (-4.36, 8.88)	-5.07 (-28.10, 17.97)
	4	-9.87 (-24.50, 4.77)	-4.21 (-34.42, 26.00)	-0.98 (-7.65, 5.69)	-4.39 (-27.78, 19.01)
	5 (high)	Reference	Reference	Reference	Reference
Physical comorbidities	0-5 ADGs	Reference	Reference	Reference	Reference
	6-9 ADGs	5.91 (-2.93, 14.75)	-0.16 (-20.51, 20.19)	0.20 (-4.32, 4.73)	3.58 (-12.90, 20.05)
	10+ ADGs	16.42 (-1.29, 34.13)	-9.03 (-54.17, 36.11)	0.06 (-8.04, 8.16)	18.32 (-8.58, 45.23)
	Yes	5.14 (-4.60, 14.88)	15.50 (-6.37, 37.37)	**-4.61 (-8.83, -0.39)**	2.81 (-17.25, 22.87)

History of mental health visits	No	Reference	Reference	Reference	Reference
Rurality	Rural	24.67 (-176.98, 226.31)	-2.93 (-763.40, 757.54)	1.50 (-20.46, 23.47)	-9.11 (-141.61, 123.39)
	Rural-remote	0.07 (-97.33, 97.46)	45.38 (-261.95, 352.71)	58.44 (-145.62, 262.51)	22.39 (-990.79, 1,035.57)
	Rural-very remote	-	-	-5.68 (-223.74, 212.38)	-43.69 (-1,150.83, 1,063.45)
	Urban	Reference	Reference	Reference	Reference
LHIN	1 Erie St. Clair	-23.10 (-68.09, 21.89)	-26.45 (-155.75, 102.85)	**21.58 (5.49, 37.67)**	46.48 (-11.46, 104.41)
	2 South West	-4.50 (-68.20, 59.21)	-18.48 (-199.29, 162.33)	8.36 (-5.67, 22.40)	-39.00 (-114.61, 36.61)
	3 Waterloo Wellington	11.46 (-10.36, 33.27)	4.25 (-108.08, 116.58)	-6.24 (-15.61, 3.12)	-34.71 (-70.47, 1.05)
	4 Hamilton Niagara Haldimand Brant	-12.91 (-43.72, 17.91)	-40.45 (-116.25, 35.36)	3.34 (-5.94, 12.63)	-21.47 (-60.29, 17.35)
	5 Central West	3.11 (-12.61, 18.83)	-0.56 (-39.65, 38.53)	2.71 (-5.34, 10.76)	-18.89 (-50.08, 12.29)
	6 Mississauga Halton	1.68 (-18.95, 22.31)	5.06 (-38.68, 48.80)	4.21 (-4.70, 13.12)	35.53 (-4.29, 75.35)
	7 Toronto Central	Reference	Reference	Reference	Reference
	8 Central	-3.77 (-18.94, 11.39)	13.43 (-19.10, 45.96)	-0.42 (-6.76, 5.92)	0.66 (-20.38, 21.70)
	9 Central East	-15.69 (-32.94, 1.56)	-20.74 (-69.16, 27.67)	1.11 (-6.07, 8.30)	0.30 (-26.74, 27.33)
	10 South East	-7.44 (-69.61, 54.73)	-12.55 (-276.71, 251.61)	-3.64 (-48.54, 41.25)	13.86 (-341.47, 369.19)
	11 Champlain	3.45 (-17.93, 24.82)	-10.42 (-54.67, 33.83)	**19.90 (9.11, 30.69)**	19.13 (-13.07, 51.32)
	12 North Simcoe Muskoka	-	-	1.91 (-23.45, 27.26)	-43.61 (-320.59, 233.37)
	13 North East	-73.14 (-315.13, 168.84)	-98.82 (-784.26, 586.61)	-8.50 (-503.57, 486.56)	-62.32 (-3,758.28, 3,633.65)
	14 North West	-	-	15.56 (-125.71, 156.83)	-32.38 (-1,381.37, 1,316.61)
Primary care enrolment model	Capitation	-15.42 (-34.11, 3.27)	-8.19 (-38.01, 21.62)	**9.93 (0.86, 18.99)**	-1.98 (-27.42, 23.46)
	Enhanced FFS	**-15.47 (-29.42, -1.51)**	-10.81 (-36.56, 14.94)	-0.42 (-5.38, 4.54)	-13.33 (-28.10, 1.44)
	Other	-3.27 (-122.66, 116.12)	36.85 (-418.90, 492.60)	-11.38 (-56.51, 33.75)	-34.87 (-587.29, 517.54)
	Team-based capitation	0.46 (-23.37, 24.29)	15.14 (-20.44, 50.71)	-3.92 (-12.66, 4.82)	-6.13 (-38.27, 26.01)
	Straight FFS	Reference	Reference	Reference	Reference

Bolded values: p<0.05

Table J-4c. Median and 90th percentile surgery to chemotherapy intervals - quantile regression multivariable adjusted model. Sensitivity analysis 4: include the immigrant population only.

		Screened n=217		Symptomatic n=1443	
Parameter	Group	Median	90th percentile	Median	90th percentile
Intercept		62.84 (37.55, 88.14)	103.01 (21.04, 184.99)	47.12 (39.90, 54.33)	77.08 (56.26, 97.89)
Continuity	0 Visits	-10.61 (-24.18, 2.97)	-37.74 (-97.55, 22.07)	2.42 (-2.67, 7.50)	5.48 (-13.47, 24.43)
	1-2 Visits	-6.33 (-26.04, 13.38)	-18.86 (-111.85, 74.13)	4.72 (-0.91, 10.35)	1.01 (-11.84, 13.86)
	UPC <=0.75	5.76 (-2.59, 14.10)	10.30 (-23.49, 44.08)	1.73 (-0.72, 4.18)	-4.69 (-11.86, 2.47)
	UPC >0.75	Reference	Reference	Reference	Reference
Age	<40 years	-40.71 (-209.89, 128.47)	-110.08 (-1,182.14, 961.98)	**-7.86 (-12.30, -3.42)**	-5.64 (-17.52, 6.24)
	40-49 years	-8.01 (-17.82, 1.79)	-20.53 (-51.53, 10.46)	**-3.35 (-6.63, -0.07)**	-2.59 (-11.13, 5.95)
	50-59 years	Reference	Reference	Reference	Reference
	60-69 years	-2.70 (-15.10, 9.71)	-4.24 (-42.92, 34.44)	-0.01 (-5.08, 5.07)	-3.77 (-16.49, 8.96)
	70-74 years	-5.96 (-35.56, 23.64)	-15.36 (-147.99, 117.27)	2.76 (-10.49, 16.01)	3.22 (-55.06, 61.50)
	>74 years	20.95 (-56.80, 98.71)	-24.76 (-786.17, 736.65)	3.15 (-22.18, 28.47)	-17.96 (-175.15, 139.24)
	East Asia & Pacific	-8.84 (-29.45, 11.77)	-23.79 (-83.07, 35.48)	2.72 (-3.03, 8.47)	6.05 (-11.24, 23.34)

Country of birth	Eastern Europe & Central Asia	-6.84 (-29.25, 15.58)	-22.23 (-94.65, 50.19)	0.43 (-5.43, 6.29)	-4.54 (-22.74, 13.67)
	Latin America & Caribbean	-6.65 (-30.55, 17.24)	-17.64 (-91.16, 55.88)	5.00 (-1.91, 11.90)	12.73 (-7.50, 32.95)
	Middle East & North Africa	-7.94 (-30.09, 14.21)	-14.62 (-80.67, 51.42)	7.22 (-0.55, 14.98)	-3.00 (-22.74, 16.75)
	South Asia	-9.78 (-30.39, 10.84)	6.09 (-63.27, 75.45)	3.27 (-3.26, 9.80)	4.40 (-15.36, 24.16)
	Sub-Saharan Africa	-25.63 (-51.39, 0.13)	-39.54 (-122.78, 43.70)	-2.31 (-10.24, 5.62)	21.57 (-4.34, 47.49)
	US/New Zealand/Australia	-27.74 (-60.09, 4.61)	-62.08 (-222.31, 98.14)	-3.26 (-18.22, 11.70)	7.13 (-21.19, 35.45)
	Western Europe	Reference	Reference	Reference	Reference
Time since immigration	<10 years	2.42 (-6.67, 11.50)	14.27 (-23.33, 51.87)	-0.37 (-3.49, 2.76)	3.11 (-4.17, 10.39)
	>=10 years	Reference	Reference	Reference	Reference
Immigration class	Economic	Reference	Reference	Reference	Reference
	Family	5.95 (-3.58, 15.48)	18.51 (-17.32, 54.34)	2.32 (-0.60, 5.24)	2.54 (-5.34, 10.42)
	Refugee	7.40 (-3.80, 18.60)	7.88 (-42.39, 58.15)	0.48 (-3.34, 4.30)	2.77 (-8.86, 14.40)
	Other	11.69 (-21.42, 44.81)	-12.88 (-212.13, 186.37)	6.53 (-3.90, 16.95)	11.08 (-35.51, 57.67)
Income quintile	1 (low)	6.46 (-6.75, 19.67)	-0.16 (-43.43, 43.12)	**5.42 (1.77, 9.07)**	5.30 (-4.26, 14.86)
	2	4.26 (-8.24, 16.76)	-9.41 (-56.65, 37.83)	3.32 (-0.57, 7.22)	9.28 (-2.26, 20.82)
	3	1.23 (-10.79, 13.26)	-15.34 (-63.31, 32.64)	2.70 (-1.74, 7.14)	9.22 (-1.31, 19.75)
	4	-1.67 (-14.03, 10.69)	-19.79 (-59.54, 19.96)	**4.83 (0.83, 8.83)**	5.28 (-5.10, 15.65)
	5 (high)	Reference	Reference	Reference	Reference
Physical comorbidities	0-5 ADGs	Reference	Reference	Reference	Reference
	6-9 ADGs	-2.42 (-10.01, 5.17)	4.65 (-23.41, 32.70)	1.34 (-1.60, 4.27)	**7.47 (0.13, 14.80)**
	10+ ADGs	-1.87 (-16.61, 12.88)	3.04 (-48.76, 54.85)	1.19 (-4.52, 6.91)	2.25 (-11.70, 16.19)
History of mental health visits	Yes	0.56 (-7.24, 8.36)	5.78 (-23.61, 35.18)	1.83 (-1.19, 4.84)	6.80 (-0.78, 14.38)
	No	Reference	Reference	Reference	Reference
Rurality	Rural	41.33 (-163.29, 245.94)	24.68 (-527.60, 576.96)	-2.72 (-26.89, 21.46)	10.81 (-59.87, 81.50)
	Rural-remote	6.08 (-59.00, 71.16)	4.79 (-388.44, 398.03)	1.82 (-152.99, 156.64)	-10.08 (-799.92, 779.75)
	Rural-very remote	-	-	-36.40 (-147.11, 74.30)	-18.15 (-547.16, 510.87)
	Urban	Reference	Reference	Reference	Reference
LHIN	1 Erie St. Clair	-2.59 (-27.76, 22.57)	-24.58 (-150.92, 101.76)	-5.88 (-14.67, 2.92)	-2.03 (-41.15, 37.09)
	2 South West	8.25 (-33.38, 49.88)	1.03 (-228.45, 230.52)	**14.63 (6.52, 22.73)**	21.62 (-13.53, 56.76)
	3 Waterloo Wellington	-10.57 (-29.23, 8.09)	-31.71 (-170.00, 106.59)	**-10.42 (-16.13, -4.71)**	**-25.85 (-43.72, -7.98)**
	4 Hamilton Niagara Haldimand Brant	-11.99 (-33.34, 9.37)	-28.53 (-219.98, 162.92)	6.27 (-0.04, 12.58)	4.52 (-14.48, 23.52)
	5 Central West	2.34 (-12.23, 16.91)	12.54 (-47.61, 72.68)	**6.55 (0.08, 13.01)**	12.40 (-5.92, 30.72)
	6 Mississauga Halton	7.11 (-6.92, 21.13)	29.20 (-29.07, 87.47)	2.83 (-2.29, 7.94)	-0.66 (-15.75, 14.43)
	7 Toronto Central	Reference	Reference	Reference	Reference
	8 Central	9.03 (-2.92, 20.97)	30.61 (-14.56, 75.78)	2.09 (-2.35, 6.54)	5.78 (-5.89, 17.44)
	9 Central East	7.71 (-7.56, 22.98)	22.43 (-33.25, 78.11)	0.47 (-4.06, 4.99)	0.30 (-13.15, 13.75)
	10 South East	38.28 (-10.25, 86.81)	3.35 (-408.10, 414.80)	0.01 (-24.36, 24.38)	-8.85 (-231.00, 213.31)
	11 Champlain	13.63 (-2.27, 29.53)	22.67 (-53.24, 98.57)	**9.90 (3.53, 16.26)**	1.80 (-14.84, 18.43)
	12 North Simcoe Muskoka	-	-	3.64 (-14.28, 21.55)	3.91 (-114.35, 122.17)
	13 North East	-98.21 (-352.42, 155.99)	-126.98 (-2,211.82, 1,957.86)	26.86 (-253.28, 306.99)	-17.91 (-1,827.40, 1,791.58)
	14 North West	-	-	-12.44 (-130.15, 105.27)	-27.26 (-694.67, 640.15)
Primary care enrolment model	Capitation	8.23 (-4.68, 21.15)	2.61 (-51.82, 57.05)	3.35 (-1.75, 8.46)	10.72 (-3.73, 25.18)
	Enhanced FFS	-6.79 (-18.05, 4.47)	-17.68 (-63.78, 28.41)	1.86 (-1.25, 4.97)	2.57 (-5.75, 10.89)
	Other	8.03 (-119.14, 135.20)	16.93 (-632.93, 666.79)	9.50 (-51.29, 70.29)	-7.88 (-388.47, 372.71)

	Team-based capitation	8.11 (-9.36, 25.57)	22.68 (-41.47, 86.82)	3.59 (-3.38, 10.56)	-8.06 (-24.35, 8.23)
	Straight FFS	Reference	Reference	Reference	Reference

Bolded values: p<0.05

Table J-5a. Median and 90th percentile contact to chemotherapy intervals - quantile regression multivariable adjusted model. Sensitivity analysis 5: immigrant characteristics with whole population

		Screened		Symptomatic	
Parameter	Group	Median	90th percentile	Median	90th percentile
Intercept		121.00 (116.75, 125.25)	184.00 (174.59, 193.41)	122.00 (118.66, 125.34)	223.00 (214.27, 231.73)
Age	<40 years	-13.00 (-33.46, 7.46)	7.00 (-116.32, 130.32)	**-16.00 (-19.81, -12.19)**	**-29.75 (-41.29, -18.21)**
	40-49 years	-8.00 (-16.06, 0.06)	-10.00 (-37.70, 17.70)	**-4.00 (-7.16, -0.84)**	-2.50 (-9.99, 4.99)
	50-59 years	Reference	Reference	Reference	Reference
	60-69 years	3.00 (-0.83, 6.83)	-1.00 (-7.77, 5.77)	0.50 (-3.34, 4.34)	-0.50 (-12.80, 11.80)
	70-74 years	1.00 (-6.95, 8.95)	2.00 (-19.78, 23.78)	6.00 (-1.19, 13.19)	-6.50 (-21.78, 8.78)
	>74 years	**13.00 (0.68, 25.32)**	2.00 (-15.37, 19.37)	6.00 (-3.84, 15.84)	-12.00 (-39.42, 15.42)
Country of birth	East Asia & Pacific	9.00 (-9.71, 27.71)	-2.00 (-48.57, 44.57)	**10.50 (2.77, 18.23)**	8.00 (-10.55, 26.55)
	Eastern Europe & Central Asia	2.00 (-16.36, 20.36)	3.00 (-33.55, 39.55)	-0.50 (-8.22, 7.22)	1.00 (-22.84, 24.84)
	Latin America & Caribbean	-1.00 (-14.12, 12.12)	65.00 (-43.23, 173.23)	**15.50 (2.18, 28.82)**	19.25 (-0.18, 38.68)
	Middle East & North Africa	1.00 (-13.86, 15.86)	9.00 (-40.11, 58.11)	6.00 (-6.27, 18.27)	2.25 (-31.61, 36.11)
	South Asia	0.00 (-20.74, 20.74)	-4.00 (-59.57, 51.57)	8.50 (-1.15, 18.15)	-3.25 (-35.46, 28.96)
	Sub-Saharan Africa	29.00 (-13.23, 71.23)	-28.00 (-263.52, 207.52)	9.00 (-8.29, 26.29)	14.50 (-20.33, 49.33)
	US/New Zealand/Australia	17.00 (-38.17, 72.17)	-52.00 (-376.65, 272.65)	1.00 (-21.82, 23.82)	18.50 (-35.43, 72.43)
	Western Europe	-1.00 (-39.18, 37.18)	9.00 (-287.90, 305.90)	**-12.50 (-22.88, -2.12)**	3.50 (-37.81, 44.81)
	Canadian	Reference	Reference	Reference	Reference
Time since immigration	<10 years	-6.00 (-21.10, 9.10)	11.00 (-43.21, 65.21)	-0.50 (-6.73, 5.73)	0.25 (-15.58, 16.08)
	>=10 years	Reference	Reference	Reference	Reference
Immigration class	Economic	Reference	Reference	Reference	Reference
	Family	10.00 (-5.02, 25.02)	18.00 (-25.81, 61.81)	-1.50 (-9.19, 6.19)	**-15.25 (-30.25, -0.25)**
	Refugee	0.00 (-24.50, 24.50)	15.00 (-65.11, 95.11)	6.50 (-4.38, 17.38)	-6.25 (-34.29, 21.79)
	Other	15.00 (-25.48, 55.48)	-31.00 (-274.25, 212.25)	7.50 (-30.00, 45.00)	-14.25 (-135.77, 107.27)
Income quintile	1 (low)	6.00 (-0.19, 12.19)	0.00 (-12.84, 12.84)	**4.00 (0.23, 7.77)**	-5.00 (-14.22, 4.22)
	2	2.00 (-3.65, 7.65)	-4.00 (-15.41, 7.41)	3.00 (-0.93, 6.93)	2.75 (-6.29, 11.79)
	3	2.00 (-2.84, 6.84)	-3.00 (-12.43, 6.43)	3.00 (-0.49, 6.49)	-3.75 (-12.66, 5.16)
	4	3.00 (-1.93, 7.93)	-2.00 (-12.39, 8.39)	1.50 (-2.08, 5.08)	-1.50 (-11.91, 8.91)
	5 (high)	Reference	Reference	Reference	Reference
Physical comorbidities	0-5 ADGs	Reference	Reference	Reference	Reference
	6-9 ADGs	1.00 (-2.77, 4.77)	1.00 (-6.56, 8.56)	**6.50 (3.43, 9.57)**	**19.25 (11.82, 26.68)**
	10+ ADGs	3.00 (-5.00, 11.00)	-5.00 (-18.00, 8.00)	**8.50 (2.46, 14.54)**	**27.75 (13.15, 42.35)**
History of mental health visits	Yes	-1.00 (-4.82, 2.82)	7.00 (-2.59, 16.59)	**5.00 (2.26, 7.74)**	4.75 (-2.57, 12.07)
	No	Reference	Reference	Reference	Reference

Bolded values: p<0.05

Table J-5b. Median and 90th percentile primary care intervals - quantile regression multivariable adjusted model. Sensitivity analysis 5: immigrant characteristics with whole population

		Screened		Symptomatic	
Parameter	Group	Median	90th percentile	Median	90th percentile
Intercept		34.00 (31.76, 36.24)	73.50 (66.63, 80.37)	33.57 (31.48, 35.66)	118.67 (107.14, 130.20)

Age	<40 years	**-14.00 (-22.55, -5.45)**	-25.50 (-152.72, 101.72)	**-4.57 (-7.08, -2.06)**	**-17.17 (-30.38, -3.96)**
	40-49 years	**-13.00 (-17.47, -8.53)**	2.44 (-30.05, 34.92)	0.43 (-1.38, 2.23)	0.67 (-9.61, 10.95)
	50-59 years	Reference	Reference	Reference	Reference
	60-69 years	1.00 (-0.81, 2.81)	-1.00 (-6.23, 4.23)	-0.29 (-2.87, 2.30)	-6.17 (-15.72, 3.38)
	70-74 years	0.00 (-4.08, 4.08)	-6.50 (-16.09, 3.09)	-0.71 (-4.14, 2.71)	**-15.83 (-30.61, -1.06)**
	>74 years	4.00 (-4.85, 12.85)	4.50 (-16.74, 25.74)	**-7.14 (-10.58, -3.71)**	**-31.17 (-50.18, -12.15)**
Country of birth	East Asia & Pacific	-2.00 (-14.55, 10.55)	-1.50 (-35.73, 32.73)	1.29 (-3.77, 6.34)	11.33 (-5.83, 28.50)
	Eastern Europe & Central Asia	-6.00 (-18.12, 6.12)	-18.00 (-36.67, 0.67)	0.71 (-4.26, 5.68)	10.50 (-17.11, 38.11)
	Latin America & Caribbean	4.00 (-7.20, 15.20)	-15.50 (-54.07, 23.07)	6.86 (-1.06, 14.78)	11.17 (-14.83, 37.16)
	Middle East & North Africa	13.00 (-2.95, 28.95)	2.50 (-46.10, 51.10)	**9.00 (1.19, 16.81)**	**25.50 (1.80, 49.20)**
	South Asia	-3.00 (-13.13, 7.13)	-8.00 (-30.55, 14.55)	-3.86 (-9.16, 1.44)	-10.50 (-40.14, 19.14)
	Sub-Saharan Africa	3.00 (-25.15, 31.15)	28.50 (-128.25, 185.25)	-1.29 (-14.69, 12.12)	-10.33 (-40.85, 20.19)
	US/New Zealand/Australia	5.00 (-44.10, 54.10)	6.44 (-157.87, 170.75)	5.86 (-13.50, 25.22)	8.33 (-125.72, 142.39)
	Western Europe	2.00 (-25.50, 29.50)	4.56 (-154.57, 163.70)	-3.29 (-10.48, 3.91)	-11.17 (-51.33, 29.00)
	Canadian	Reference	Reference	Reference	Reference
Time since immigration	<10 years	-2.00 (-10.92, 6.92)	-18.06 (-42.22, 6.09)	-2.29 (-7.00, 2.43)	-6.33 (-22.13, 9.47)
	>=10 years	Reference	Reference	Reference	Reference
Immigration class	Economic	Reference	Reference	Reference	Reference
	Family	3.00 (-7.48, 13.48)	**25.06 (1.59, 48.54)**	-1.86 (-6.25, 2.54)	-13.33 (-31.72, 5.06)
	Refugee	-3.00 (-15.12, 9.12)	-18.94 (-58.61, 20.74)	0.71 (-5.08, 6.51)	-5.83 (-35.78, 24.12)
	Other	5.00 (-31.05, 41.05)	-5.44 (-99.72, 88.85)	2.43 (-21.57, 26.43)	11.50 (-122.79, 145.79)
Income quintile	1 (low)	1.00 (-2.11, 4.11)	**27.00 (19.84, 34.16)**	-1.43 (-3.74, 0.88)	**-18.83 (-30.51, -7.16)**
	2	0.00 (-2.40, 2.40)	-0.50 (-7.08, 6.08)	-1.29 (-3.56, 0.98)	**-16.33 (-28.18, -4.49)**
	3	1.00 (-1.46, 3.46)	1.00 (-6.47, 8.47)	0.00 (-1.97, 1.97)	**-14.50 (-25.12, -3.88)**
	4	2.00 (-0.62, 4.62)	-3.44 (-10.79, 3.91)	-1.29 (-3.54, 0.97)	**-12.67 (-24.72, -0.61)**
	5 (high)	Reference	Reference	Reference	Reference
Physical comorbidities	0-5 ADGs	Reference	Reference	Reference	Reference
	6-9 ADGs	-1.00 (-3.09, 1.09)	-1.50 (-7.15, 4.15)	**3.43 (1.80, 5.05)**	**13.17 (5.45, 20.88)**
	10+ ADGs	-1.00 (-4.47, 2.47)	-0.50 (-7.81, 6.81)	1.71 (-0.55, 3.98)	**18.83 (2.81, 34.86)**
History of mental health visits	Yes	0.00 (-1.77, 1.77)	-2.00 (-7.56, 3.56)	1.43 (-0.25, 3.11)	3.33 (-4.58, 11.25)
	No	Reference	Reference	Reference	Reference

Bolded values: p<0.05

Table J-5c. Median and 90th percentile surgery to chemotherapy intervals - quantile regression multivariable adjusted model. Sensitivity analysis 5: immigrant characteristics with whole population

		Screened		Symptomatic	
Parameter	Group	Median	90th percentile	Median	90th percentile
Intercept		59.00 (56.46, 61.54)	90.25 (85.22, 95.28)	56.00 (54.66, 57.34)	89.00 (85.45, 92.55)
Age	<40 years	-9.00 (-21.49, 3.49)	11.25 (-104.07, 126.57)	**-6.00 (-7.85, -4.15)**	**-8.33 (-12.86, -3.80)**
	40-49 years	**-4.00 (-7.74, -0.26)**	**-16.75 (-26.37, -7.13)**	**-2.00 (-3.11, -0.89)**	**-4.00 (-7.44, -0.56)**
	50-59 years	Reference	Reference	Reference	Reference
	60-69 years	1.00 (-1.01, 3.01)	4.25 (-0.35, 8.85)	**2.00 (0.41, 3.59)**	1.00 (-2.25, 4.25)
	70-74 years	2.00 (-1.59, 5.59)	0.25 (-6.03, 6.53)	**4.00 (0.71, 7.30)**	**9.67 (2.51, 16.82)**
	>74 years	8.00 (-2.32, 18.32)	6.25 (-7.20, 19.70)	**8.00 (4.61, 11.39)**	**15.67 (1.15, 30.19)**
Country of birth	East Asia & Pacific	2.00 (-6.43, 10.43)	-6.25 (-28.59, 16.09)	0.00 (-2.24, 2.24)	3.67 (-4.08, 11.41)
	Eastern Europe & Central Asia	-2.00 (-11.86, 7.86)	3.50 (-30.58, 37.58)	-1.00 (-3.74, 1.74)	-5.33 (-11.93, 1.26)
	Latin America & Caribbean	0.00 (-10.09, 10.09)	-4.75 (-65.04, 55.54)	3.00 (-1.56, 7.56)	11.00 (-1.59, 23.59)
	Middle East & North Africa	-7.00 (-14.42, 0.42)	-5.50 (-62.94, 51.94)	**6.00 (1.51, 10.49)**	-3.33 (-14.14, 7.47)
	South Asia	0.00 (-14.84, 14.84)	22.25 (-14.06, 58.56)	1.00 (-3.32, 5.32)	1.00 (-9.55, 11.55)

	Sub-Saharan Africa	-4.00 (-17.93, 9.93)	-10.75 (-243.16, 221.66)	-5.00 (-10.97, 0.97)	15.00 (-10.27, 40.27)
	US/New Zealand/Australia	-16.00 (-40.91, 8.91)	-18.25 (-188.20, 151.70)	-1.00 (-17.77, 15.77)	0.00 (-28.22, 28.22)
	Western Europe	-6.00 (-16.61, 4.61)	-13.00 (-195.76, 169.76)	-3.00 (-8.90, 2.90)	-7.33 (-23.01, 8.35)
	Canadian	Reference	Reference	Reference	Reference
Time since immigration	<10 years	2.00 (-5.12, 9.12)	-10.25 (-43.55, 23.05)	1.00 (-1.68, 3.68)	3.00 (-4.34, 10.34)
	>=10 years	Reference	Reference	Reference	Reference
Immigration class	Economic	Reference	Reference	Reference	Reference
	Family	1.00 (-7.09, 9.09)	12.75 (-9.52, 35.02)	1.00 (-1.56, 3.56)	3.33 (-3.86, 10.53)
	Refugee	0.00 (-9.42, 9.42)	19.75 (-27.84, 67.34)	-1.00 (-4.34, 2.34)	4.00 (-5.07, 13.07)
	Other	7.00 (-17.89, 31.89)	23.25 (-150.48, 196.98)	6.00 (-2.29, 14.29)	19.00 (-21.84, 59.84)
Income quintile	1 (low)	2.00 (-1.25, 5.25)	0.00 (-5.75, 5.75)	1.00 (-0.49, 2.49)	2.67 (-2.01, 7.35)
	2	-1.00 (-4.25, 2.25)	1.50 (-4.04, 7.04)	**2.00 (0.26, 3.74)**	**5.33 (1.16, 9.51)**
	3	0.00 (-2.82, 2.82)	1.75 (-4.23, 7.73)	**2.00 (0.49, 3.51)**	**6.00 (1.61, 10.39)**
	4	1.00 (-1.75, 3.75)	4.00 (-2.01, 10.01)	**2.00 (0.78, 3.22)**	2.00 (-1.55, 5.55)
	5 (high)	Reference	Reference	Reference	Reference
Physical comorbidities	0-5 ADGs	Reference	Reference	Reference	Reference
	6-9 ADGs	0.00 (-2.26, 2.26)	-2.50 (-6.29, 1.29)	0.00 (-1.09, 1.09)	3.00 (-0.07, 6.07)
	10+ ADGs	-1.00 (-4.29, 2.29)	0.25 (-5.72, 6.22)	1.00 (-1.02, 3.02)	**6.33 (1.66, 11.01)**
History of mental health visits	Yes	1.00 (-1.11, 3.11)	2.25 (-2.24, 6.74)	1.00 (-0.01, 2.01)	1.00 (-2.05, 4.05)
	No	Reference	Reference	Reference	Reference

Bolded values: $p<0.05$