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Research

The effect of comorbidity on primary care use during breast cancer chemotherapy: a population-based retrospective cohort study using CanIMPACT data

Rachel L. Walsh MD MSc, Aisha K. Lofters MD PhD, Rahim Moineddin PhD, Monika K. Krzyzanowska MD MPH, Eva Grunfeld MD DPhil

Abstract

Background: Patients with breast cancer visit their primary care physicians (PCPs) more often during chemotherapy than before diagnosis, but the reasons are unclear. We assessed the association between physical comorbidities and mental health history (MHH) and the change in PCP use during adjuvant breast cancer chemotherapy.

Methods: We conducted a population-based, retrospective cohort study using data from the Canadian Team to Improve Community-Based Cancer Care along the Continuum (CanIMPACT) project. Participants were women 18 years of age and older, who had received a diagnosis of stage I–III breast cancer in Ontario between 2007 and 2011 and had received surgery and adjuvant chemotherapy. We used difference-in-difference analysis using negative binomial modelling to quantify the differences in the 6-month rate of PCP visits at baseline (the 24-month period between 6 and 30 months before diagnosis) and during treatment (the 6 months from start of chemotherapy) between physical comorbidity and MHH groups.

Results: Among 12 781 participants, the 6-month PCP visit rate increased during chemotherapy (mean 2.3 visits at baseline, 3.4 visits during chemotherapy). Patients with higher physical comorbidity levels or MHH visited their PCPs 4.2 or 1.7 more times, respectively, over 6 months compared to those with low physical comorbidity or no MHH at baseline and 2.5 or 1.1 more times, respectively, over 6 months during treatment. During treatment, the adjusted 6-month rate of PCP visits more than doubled in the group with the fewest physical comorbidities or no MHH compared with baseline (rate ratio 2.52, 95% confidence interval [CI] 2.43–2.61). This increase was lower in those with MHH (rate ratio 1.81, 95% CI 1.68–1.96) and in the highest physical comorbidity group (rate ratio 1.16, 95% CI 1.07–1.28).

Interpretation: Patients with breast cancer who have more physical comorbidities and MHH have a higher frequency of PCP visits during adjuvant chemotherapy but lower absolute and relative increases in visits compared with baseline. Therefore, PCPs can expect to see their patients with fewer physical comorbidities and no MHH more often during chemotherapy. Primary care physicians can plan for their patients with high physical comorbidity levels and MHH to continue having frequent appointments while they undergo chemotherapy, and they can expect their patients with low physical comorbidity levels and no MHH to increase the frequency of their visits during chemotherapy, and should be prepared to provide breast cancer–related care to these patients.

Breast cancer is the most commonly diagnosed cancer among women worldwide and the second most common cause of cancer-related death for women in developed regions of the world,[1] including Canada.[2] In 2018, just under 12 000 women received a diagnosis of breast cancer in Ontario alone.[3] Treatment for breast cancer often involves surgery and sometimes includes adjuvant chemotherapy (given after surgery) in order to reduce the risk of recurrence. From 2007 to 2012, 76.2% (n = 50 224) of Canadian women with stage I–III breast cancer received surgical treatment; the proportion of women who received adjuvant chemotherapy varied by province, from 35.3% to 40.7%.[4]

Patients with breast cancer frequently visit their primary care physicians (PCPs) during the course of their cancer journey.[5] A PCP can expect to see an average of 1 new case of breast cancer in any given year.[6] Although the role of PCPs during prevention, screening, diagnosis, survivorship

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Correspondence to: Rachel Walsh, rachel.walsh@sunnybrook.ca

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and end-of-life care has been relatively well established, the role of PCPs during breast cancer treatment is less clear.[6]

Despite the lack of a clear role for PCPs during breast cancer treatment, patients with breast cancer have been shown to visit their PCPs more often when they are receiving adjuvant chemotherapy than before their breast cancer diagnosis.[7–9] The reasons for this remain unclear. Previous qualitative work with providers suggests that PCPs' main roles in caring for patients with cancer are not to manage urgent issues during chemotherapy, but rather to coordinate care, manage comorbidities and provide psychosocial care.[10] It is possible, then, that PCPs see patients with breast cancer more often while they are undergoing chemotherapy because of increased concerns related to management of the patients' physical and mental comorbidities during this time.

In our study, we aimed to determine how baseline physical and mental comorbidities affect the increase in PCP use during adjuvant breast cancer chemotherapy. We hypothesized that patients with high levels of baseline physical and mental comorbidities would show the greatest increases in PCP use during adjuvant chemotherapy.

Methods

Study design

We performed a population-based, retrospective cohort study using linked provincial-level administrative health databases housed at ICES.[11] This study was performed using data from the Ontario cohort of a larger, nationwide cohort study (the Canadian Team to Improve Community-Based Cancer Care along the Continuum — CanIMPACT).[12] The CanIMPACT project began in 2013 with an aim to strengthen the capacity of PCPs to provide care to patients with cancer and to improve care coordination between PCPs and cancer specialists. The CanIMPACT quantitative subgroup uses administrative health data analyses to conduct inter- and intraprovincial comparisons of cancer care and includes cohorts of all patients with breast cancer diagnosed between 2007 and 2011 across 5 provinces (British Columbia, Alberta, Manitoba, Ontario and Nova Scotia).

Study population

We included women 18 years of age and older who received a diagnosis of stage I–III breast cancer between Jan. 1, 2007, and Dec. 31, 2011 (to allow for at least 5 full years of follow-up data used in other CanIMPACT studies[13,14]), who underwent potentially curative surgery (i.e., lumpectomy or mastectomy) and adjuvant chemotherapy (i.e., administered after surgery). Codes used to define our study population are included in Appendix 1A, available at www.cmajopen.ca/content/9/2/E331/suppl/DC1. We excluded patients who had a previous cancer diagnosis, were diagnosed with a new primary cancer within 14 months of breast cancer diagnosis, had received neoadjuvant chemotherapy (i.e., administered before surgery, often to reduce tumour size), had received radiation therapy before adjuvant chemotherapy or were living in a long-term care facility at diagnosis. Exclusions were applied to the analytic file before analysis.

Data sources

We used a variety of data sets housed at ICES, including the Ontario Cancer Registry; Ontario Health Insurance Plan; Registered Persons Database; 2006 Statistics Canada Census; Immigration, Refugees and Citizenship Canada; ICES Physician Database; Client Agency Program Enrollment; Corporate Provider Database; Canadian Institute for Health Information Discharge Abstract Database; Same Day Surgery database; and Canada Activity Level Reporting database. These data sets were linked using unique encoded identifiers and analyzed at ICES. A summary of the data sets used to obtain data elements is shown in Appendix 1B.

Data sets were deterministically linked at the individual patient level, with one exception. The Immigration, Refugees and Citizenship Canada data are linked using a combination of deterministic and probabilistic linkage, with an 86.4% linkage rate to Ontario health card records.[37]

Client Agency Program Enrollment and the Corporate Provider Database contain information on patient enrolment models in primary care, but do not contain information on Community Health Centre enrolment. Of note, in 2015, less than 1.0% of Ontario residents were Community Health Centre clients.[38]

Although the validity of Ontario Health Insurance Plan data has not been explicitly verified, a study of 2003 data from the Canadian Institute for Health Information Discharge Abstract Database found that demographic data and procedures were coded with high sensitivity and near-perfect specificity, whereas admission and discharge dates were nearly exact; however, diagnostic coding was much more variable.[39]

Variables

For our main outcome variable, we evaluated the difference in the 6-month rate of PCP visits during a 24-month baseline period (the 6–30 mo before diagnosis) and the 6-month treatment period (6 mo from the start of adjuvant chemotherapy). Visits that took place in the emergency department or inpatient locations were excluded. Diagnostic codes were noted. Visits were considered cancer-related if the diagnostic code was listed as female or male breast neoplasm, other malignant neoplasm, breast carcinoma in situ or adverse drug effect.

Our main predictor variables were baseline physical comorbidity and mental health history (MHH). We determined physical comorbidity level using the Johns Hopkins Aggregated Diagnosis Groups (ADGs),[15] which group similar conditions based on characteristics such as duration, severity and specialty care involvement.[16] Each of the roughly 25 000 possible *International Classification of Diseases, Ninth Revision* and *International Classification of Diseases, Tenth Revision* diagnosis codes associated with baseline visits were categorized into 1 of 32 ADGs (e.g., time limited: minor; likely to recur: progressive; chronic medical: stable).[17] We excluded psychosocial ADGs and categorized physical comorbidity into low (0–5 physical ADGs), medium (6–9 physical ADGs) and high

(≥10 physical ADGs) levels, similar to a previous CanIMPACT study.[18] We determined the presence of MHH based on whether a patient had any PCP visits during the baseline period associated with previously validated mental health diagnostic codes (Appendix 1A).[19]

Variables that we considered potential confounders, possibly affecting both physical comorbidity and MHH as well as PCP visits, were chosen a priori based on clinical insight and previously reviewed literature. These confounders included age at diagnosis,[20–24] immigration status (nonimmigrants were classified as Canadian-born citizens or immigrants arriving to Canada before 1985),[25–27] income quintile based on neighbourhood income,[20,24] rurality,[28,29] regional health district (1 of 14 Local Health Integration Networks in Ontario), primary care continuity[30–32] and primary care practice type.[33]

Primary care continuity was measured using the Usual Provider of Care index:[34] the proportion of visits to the most-often–visited PCP during the 24-month baseline interval 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 (usual provider of care index ≤ 0.75) and high continuity (usual provider of care index > 0.75). Primary care practice type was determined by enrolment in a particular funding model at the time of diagnosis ("team-based capitation" for interprofessional teams with physicians paid primarily by capitation, "enhanced fee-for-service [FFS]" for physicians paid primarily by FFS with some capitation, "capitation," "straight FFS" for physicians not enrolled in a primary care model, and "other").[35]

Statistical analysis

We used χ^2 tests to compare demographic characteristics across physical comorbidity and MHH groups. We used Wilcoxon rank sum tests and Kruskall–Wallis analysis of variance to compare mean ranks of participants' 6-month PCP visit rates in the baseline and treatment periods across patient characteristics. We used difference-in-difference methodology[40] to evaluate the difference in the change of PCP visit rates between baseline and treatment periods across physical comorbidity and MHH groups. We included potential confounders in a multivariable negative binomial regression analysis using generalized estimating equations with unstructured covariance to account for repeated measures. To account for participants who died during the 6-month follow-up period and for those who were not eligible for the Ontario Health Insurance Plan during the full 24-month baseline period, we included an offset term in our negative binomial model to account for differences in the exposure time of the baseline and treatment periods. Participants with missing values for at least 1 demographic characteristic were excluded from the multivariable modeling. All analyses were performed using SAS software, version 9.4.[41] A p value of less than 0.05 was considered statistically significant.

Ethics approval

Approval was received from the University of Toronto research ethics board.

Results

Our cohort consisted of 12 781 women (Table 1). Those in the higher physical comorbidity groups were more likely to be older, live in urban areas, be immigrants, have low continuity of care, be in an enhanced FFS model and have an MHH. Those with an MHH were more likely to be younger, live in urban areas, be nonimmigrants, be in an enhanced FFS model and have more physical comorbidities.

The mean number of PCP visits at baseline was 0.39 visits per month (2.34 visits over 6 mo; Figure 1). The median time from diagnosis to start of adjuvant chemotherapy was 91 days. The mean number of PCP visits during treatment was 0.56 visits per month (3.36 visits over 6 mo). Those with an MHH and in the highest physical comorbidity group had more PCP visits during all periods than those with no MHH and those in the lower physical comorbidity groups, respectively (Figure 2 and Figure 3).

There were 6.3% of patients (n = 800) who did not have any PCP visits during the baseline period. During the treatment period, this proportion increased to 15.0% (n = 1921). In total, 1.9% (n = 247) of patients had no PCP visits in either the baseline or treatment periods. Despite this, overall PCP visit rates increased from baseline to treatment periods across all groups of baseline characteristics (mean 6-mo PCP visit increase of 1.0; Table 2). The greatest increases in PCP visit rates from baseline to treatment occurred in those with fewer than 3 PCP visits at baseline and in those living in remote or very remote rural locations (mean 6-mo visit increase of 1.8–2.9).

Patients with higher physical comorbidity levels or MHH visited their PCPs 4.2 or 1.7 more times, respectively, over 6 months compared to those with low physical comorbidity or no MHH at baseline and 2.5 or 1.1 more times, respectively, over 6 months during treatment. However, patients with higher physical comorbidity levels or MHH had smaller absolute increases in 6-month PCP visit rates than those with low physical comorbidity levels or no MHH (mean increases lower by 1.6 and 0.6 visits per 6 mo, respectively; Table 2).

In our multivariable model (Figure 4 and Appendix 1C), we found that during treatment, the adjusted 6-month PCP visit rate more than doubled in the lowest physical comorbidity and no MHH group compared with the baseline (rate ratio 2.52, 95% confidence interval [CI] 2.43–2.61). Having an MHH was associated with a lower increase in PCP visits during the treatment period (rate ratio 1.81, 95% CI 1.68–1.96). Those in the highest physical comorbidity group showed an even lower increase in PCP visits (rate ratio 1.16, 95% CI 1.07–1.28).

Patients were seen by their PCPs during the baseline and treatment periods for various reasons (Table 3). Before their breast cancer diagnosis, patients most often saw their PCPs for hypertension, anxiety, annual health examinations, upper respiratory tract infections and diabetes. During adjuvant chemotherapy, patients most often saw their PCPs for breast cancer–related concerns, with other reasons remaining similar to their prediagnosis visits. Breast cancer–related concerns made up 39.9% (n = 17 054) of PCP visits overall during the treatment period (28.8% [n = 1639] in the highest physical

comorbidity group and 45.9% [n = 9315] in the lowest physical comorbidity group). Adding anxiety as a breast cancer–related concern increased this proportion to 46.2% (n = 19 740) of PCP visits overall (35.7% [n = 2037] in the highest physical comorbidity group and 51.6% [n = 10 465] in the lowest comorbidity group).

Table 1 (part 1 of 2): Physical and mental comorbidity levels stratified by cohort characteristics

Characteristic	Total, no. (%) n = 12 781	Physical comorbidity level, no. (%) 0–5 ADGs (low) n = 7287	6–9 ADGs (medium) n = 4425	≥ 10 ADGs (high) n = 1069	p value	Mental health history, no. (%) Yes n = 4127	No n = 8654	p value
Age at diagnosis, yr								
< 40	1102 (8.6)	639 (8.8)	374 (8.5)	89 (8.3)	< 0.001	349 (8.5)	753 (8.7)	0.008
40–49	3481 (27.2)	2177 (29.9)	1092 (24.7)	212 (19.8)		1134 (27.5)	2347 (27.1)	
50–59	4225 (33.1)	2500 (34.3)	1417 (32.0)	308 (28.8)		1404 (34.0)	2821 (32.6)	
60–69	3045 (23.8)	1581 (21.7)	1155 (26.1)	309 (28.9)		985 (23.9)	2060 (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 or rural residence								
Urban	11 189 (87.5)	6254 (85.8)	3957 (89.4)	978 (91.5)	< 0.001	3677 (89.1)	7512 (86.8)	0.06
Rural	699 (5.5)	450 (6.2)	213 (4.8)	36 (3.4)		199 (4.8)	500 (5.8)	
Remote	596 (4.7)	392 (5.4)	168 (3.8)	36 (3.4)		170 (4.1)	426 (4.9)	
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)	
Unknown	†	†	†	†		†	†	
Immigration status*								
Nonimmigrants	11 075 (86.7)	6384 (87.6)	3775 (85.3)	916 (85.7)	0.001	3636 (88.1)	7439 (86.0)	< 0.001
Immigrants	1706 (13.3)	903 (12.4)	650 (14.7)	153 (14.3)		491 (11.9)	1215 (14.0)	
Neighbourhood income quintile					0.073			0.09
1 (lowest)	2020 (15.8)	1121 (15.4)	705 (15.9)	194 (18.1)		685 (16.6)	1335 (15.4)	
2	2384 (18.7)	1376 (18.9)	792 (17.9)	216 (20.2)		786 (19.0)	1598 (18.5)	
3	2523 (19.7)	1433 (19.7)	879–883 (19.8–19.9)	207–211 (19.4–19.7)		839 (20.3)	1684 (19.5)	
4	2819 (22.1)	1598 (21.9)	980 (22.1)	241 (22.5)		867 (21.0)	1952 (22.6)	
5 (highest)	2994 (23.4)	1733 (23.8)	1051 (23.8)	210 (19.6)		934 (22.6)	2060 (23.8)	
Unknown	41 (0.3)	26 (0.4)	10–15 (0.2–0.3)	†		16 (0.4)	25 (0.3)	
Baseline continuity of care								
0 visit	800 (6.3)	788 (10.8)	7–12 (0.2–0.3)	†	< 0.001	18 (0.4)	782 (9.0)	< 0.001
1–2 visits	1536 (12.0)	1472 (20.2)	59–64 (1.3–1.4)	†		149 (3.6)	1387 (16.0)	
UPC ≤ 0.75 (low)	3914 (30.6)	1773 (24.3)	1661 (37.5)	480 (44.9)		1486 (36.0)	2428 (28.1)	
UPC > 0.75 (high)	6531 (51.1)	3254 (44.7)	2695 (60.9)	582 (54.4)		2474 (59.9)	4057 (46.9)	
Primary care practice model								
Straight FFS	1887 (14.8)	1193 (16.4)	568 (12.8)	126 (11.8)	< 0.001	562 (13.6)	1325 (15.3)	< 0.001
Enhanced FFS	6281 (49.1)	3212 (44.1)	2394 (54.1)	675 (63.1)		2213 (53.6)	4068 (47.0)	
Capitation	2235 (17.5)	1326 (18.2)	763 (17.2)	146 (13.7)		714 (17.3)	1521 (17.6)	
Team-based capitation	2206 (17.3)	1434 (19.7)	658 (14.9)	114 (10.7)		608 (14.7)	1598 (18.5)	
Other	172 (1.3)	122 (1.7)	42 (0.9)	8 (0.7)		30 (0.7)	142 (1.6)	
Regional health district (LHIN)					< 0.001			< 0.001
Erie St. Clair	713 (5.6)	396 (5.4)	256 (5.8)	61 (5.7)		259 (6.3)	454 (5.2)	
South West	992 (7.8)	623 (8.5)	302 (6.8)	67 (6.3)		312 (7.6)	680 (7.9)	
Waterloo Wellington	654 (5.1)	436 (6.0)	188 (4.2)	30 (2.8)		180 (4.4)	474 (5.5)	
Hamilton Niagara Haldimand Brant	1468 (11.5)	906 (12.4)	471 (10.6)	91 (8.5)		454 (11.0)	1014 (11.7)	

Table 1 (part 2 of 2): Physical and mental comorbidity levels stratified by cohort characteristics

Characteristic	Total, no. (%) *n* = 12 781	Physical comorbidity level, no. (%) 0–5 ADGs (low) *n* = 7287	6–9 ADGs (medium) *n* = 4425	≥ 10 ADGs (high) *n* = 1069	*p* value	Mental health history, no. (%) Yes *n* = 4127	No *n* = 8654	*p* value
Regional health district (LHIN) (cont'd)					< 0.001			< 0.001
Central West	543 (4.2)	248 (3.4)	226 (5.1)	69 (6.5)		180 (4.4)	363 (4.2)	
Mississauga Halton	750 (5.9)	393 (5.4)	273 (6.2)	84 (7.9)		226 (5.5)	524 (6.1)	
Toronto Central	1061 (8.3)	554 (7.6)	405 (9.2)	102 (9.5)		398 (9.6)	663 (7.7)	
Central	1784 (14.0)	886 (12.2)	712 (16.1)	186 (17.4)		550 (13.3)	1234 (14.3)	
Central East	1710 (13.4)	923 (12.7)	615 (13.9)	172 (16.1)		570 (13.8)	1140 (13.2)	
South East	520 (4.1)	349 (4.8)	137 (3.1)	34 (3.2)		139 (3.4)	381 (4.4)	
Champlain	1335 (10.4)	784 (10.8)	453 (10.2)	98 (9.2)		460 (11.1)	875 (10.1)	
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)	
North East	478 (3.7)	301 (4.1)	146 (3.3)	31 (2.9)		157 (3.8)	321 (3.7)	
North West	252 (2.0)	157 (2.2)	69 (1.6)	26 (2.4)		62 (1.5)	190 (2.2)	
Unknown	†	†	†	†		†	†	
Mental health history	4127 (32.3)	1,730 (23.7)	1810 (40.9)	587 (54.9)	< 0.001			
Physical ADGs								
0–5	7287 (57.01)					1730 (41.9)	5557 (64.2)	< 0.001
6–9	4425 (34.6)					1810 (43.9)	2615 (30.2)	
≥ 10	1069 (8.4)					587 (14.2)	482 (5.6)	

Note: ADGs = Aggregated Diagnosis Groups, FFS = fee for service, LHIN = local health integration network, UPC = usual provider of care index.
*Nonimmigrants includes Canadian-born citizens or immigrants arriving to Canada before 1985.
†Denotes too few cases to report. Ranges provided in associated rows or columns to prevent reidentification of small cells as per ICES policy.

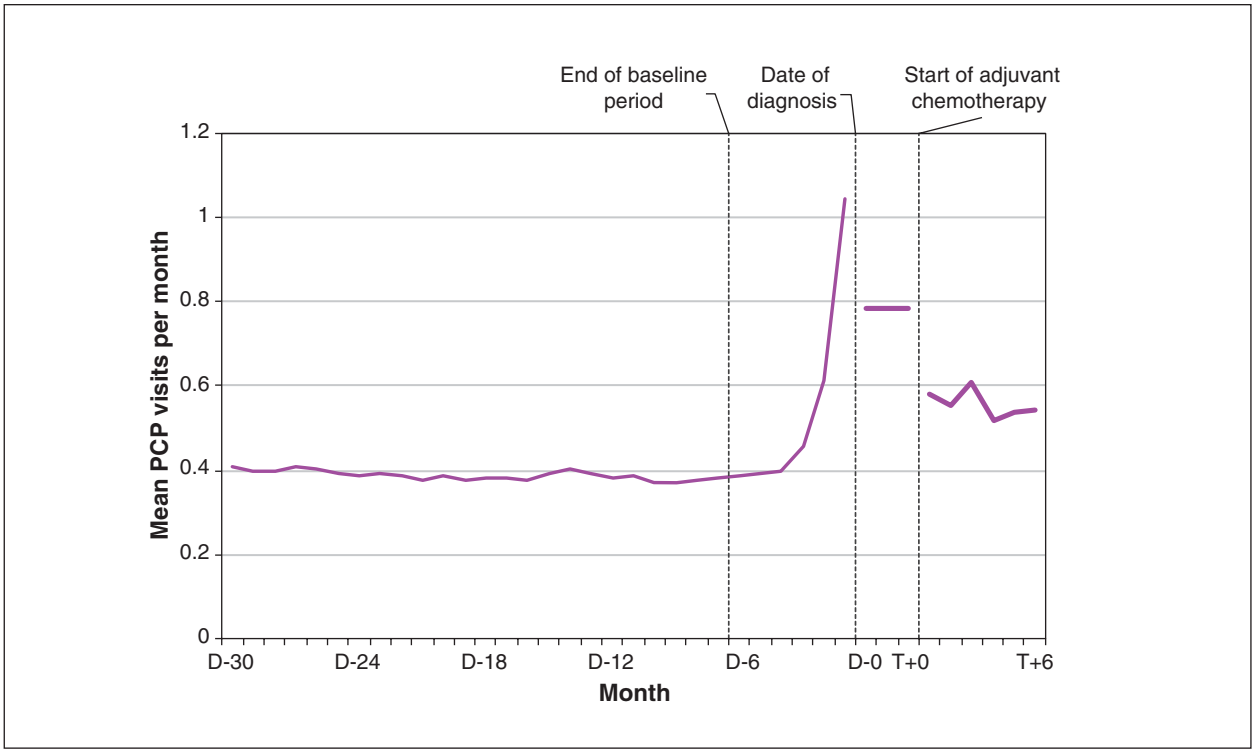

Figure 1: Mean primary care physician (PCP) visits per month before diagnosis and during adjuvant chemotherapy. D[n] is the number of months before diagnosis date and T[n] is the number of months from start of adjuvant chemotherapy. Note: Median number of days between date of diagnosis and start of adjuvant chemotherapy was 91 days.

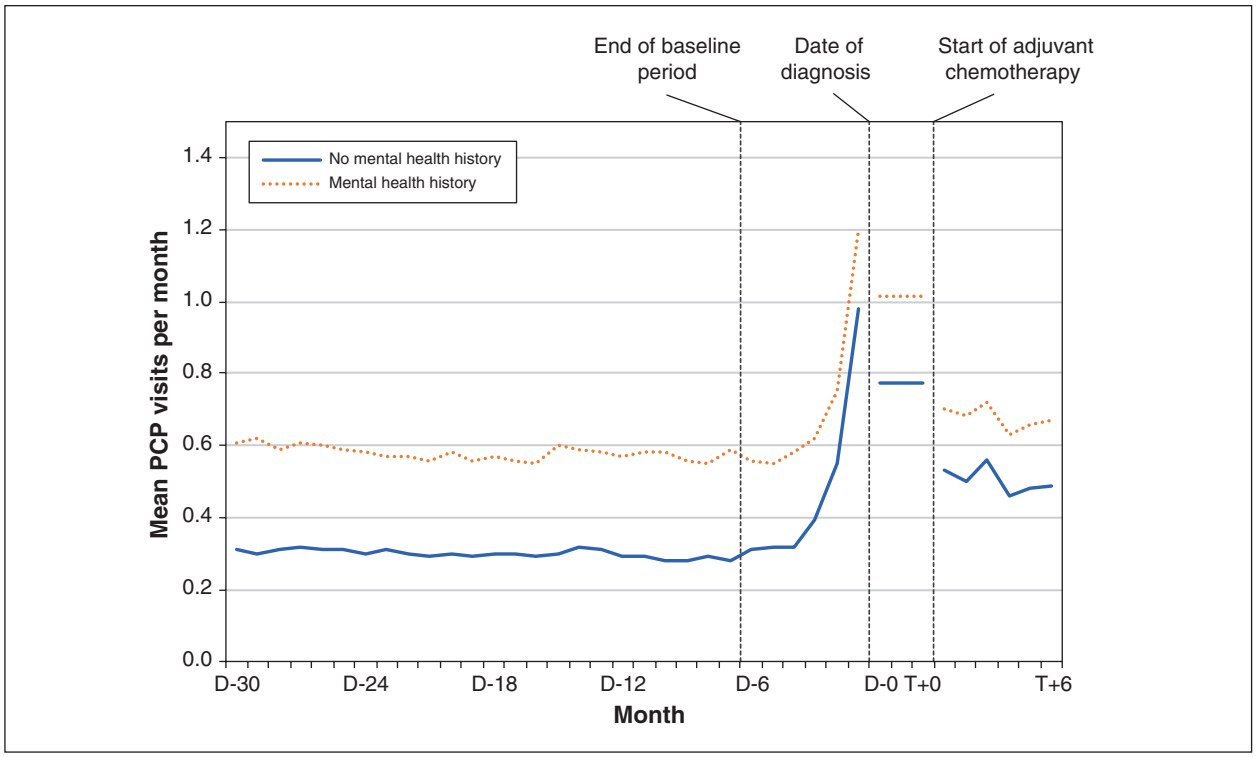

Figure 2: Mean primary care physician (PCP) visits per month before diagnosis and during adjuvant chemotherapy, by mental health history. D[n] is the number of months before diagnosis date and T[n] is the number of months from start of adjuvant chemotherapy. Note: Median number of days between date of diagnosis and start of adjuvant chemotherapy was 91 days.

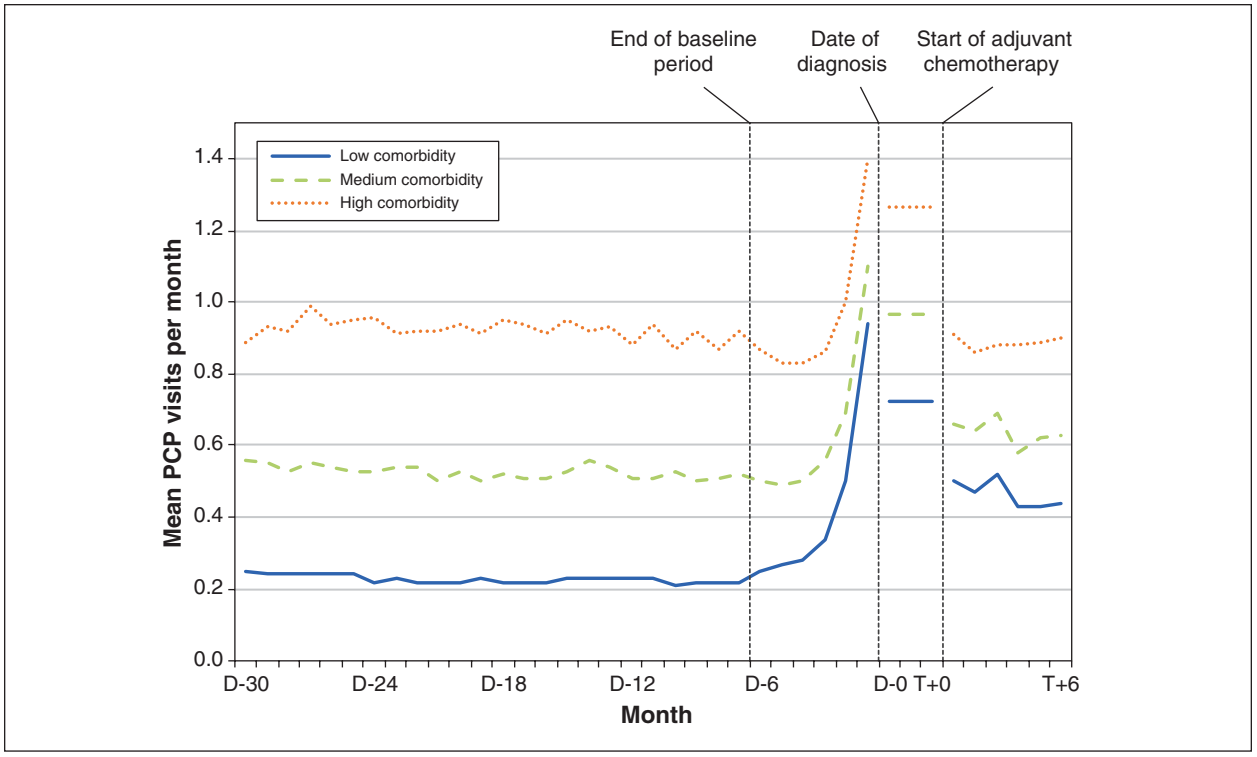

Figure 3: Mean primary care physician (PCP) visits per month before diagnosis and during adjuvant chemotherapy, by physical comorbidity group. D[n] is the number of months before diagnosis date and T[n] is the number of months from start of adjuvant chemotherapy. Note: low comorbidity = 0–5 Aggregated Diagnosis Groups (ADGs), medium comorbidity = 6–9 ADGs, high comorbidity = 10+ ADGs. Median number of days between date of diagnosis and start of adjuvant chemotherapy was 91 days.

Interpretation

Our study evaluated the effect of physical comorbidity and MHH on the change in PCP visit rates during breast cancer treatment. Similar to previous studies,[7–9] in this population-based cohort of women in Ontario with breast cancer, we found that the absolute number of PCP visits over 6 months increased from 2.3 at baseline to 3.4 during adjuvant chemotherapy. In our adjusted analyses, we found that although women with high physical comorbidity levels and MHH had more visits during the baseline and treatment periods, the increase in PCP visits from baseline to treatment periods was smaller than in those with low physical comorbidity levels and no MHH. It is therefore important for PCPs to be able to manage the increased demand for primary care that arises during

Table 2 (part 1 of 2): Mean PCP visits (per 6 mo) during baseline and treatment periods stratified by cohort characteristics

Characteristic	Total, no. (%) *n* = 12 781*	Baseline PCP visits, mean ± SD†	*p* value	Treatment PCP visits, mean ± SD	*p* value	Difference (treatment – baseline), mean ± SD	*p* value
Total		2.3 ± 2.5		3.4 ± 3.4		1.0 ± 3.3	
Age at diagnosis, yr			< 0.0001		< 0.0001		0.3662
< 40	1102 (8.6)	2.2 ± 2.2		3.0 ± 3.7		0.9 ± 3.6	
40–49	3481 (27.2)	2.1 ± 2.3		3.1 ± 3.1		1.0 ± 3.1	
50–59	4225 (33.1)	2.3 ± 2.6		3.3 ± 3.1		1.0 ± 3.2	
60–69	3045 (23.8)	2.5 ± 2.5		3.6 ± 3.4		1.0 ± 3.4	
70–74	607 (4.7)	3.1 ± 2.6		4.2 ± 3.8		1.0 ± 3.3	
> 74	321 (2.5)	3.0 ± 2.7		4.4 ± 4.9		1.3 ± 4.8	
Urban or rural residence			< 0.0001		< 0.0001		< 0.0001
Urban	11 189 (87.5)	2.4 ± 2.5		3.3 ± 3.3		0.9 ± 3.2	
Rural	699 (5.5)	2.0 ± 2.2		3.5 ± 3.6		1.5 ± 3.7	
Remote	596 (4.7)	1.7 ± 1.7		3.5 ± 3.8		1.8 ± 3.8	
Very remote	292–297 (2.3)	1.7 ± 1.9		4.7 ± 4.2		2.9 ± 4.3	
Unknown	≤ 5	§		§		§	
Unknown	≤ 5	§		§		§	
Immigration status‡			0.0439		0.2578		0.0079
Nonimmigrants	11 075 (86.7)	2.3 ± 2.5		3.4 ± 3.4		1.0 ± 3.3	
Immigrants	1706 (13.3)	2.5 ± 2.2		3.3 ± 3.1		0.8 ± 3.1	
Neighbourhood income quintile			0.0028		< 0.0001		0.2246
1 (lowest)	2020 (15.8)	2.4 ± 2.3		3.5 ± 3.6		1.1 ± 3.5	
2	2384 (18.7)	2.3 ± 2.4		3.5 ± 3.4		1.1 ± 3.3	
3	2523 (19.7)	2.4 ± 2.5		3.5 ± 3.3		1.0 ± 3.2	
4	2819 (22.1)	2.3 ± 2.4		3.4 ± 3.3		1.0 ± 3.3	
5 (highest)	2994 (23.4)	2.2 ± 2.7		3.1 ± 3.3		0.9 ± 3.3	
Unknown	41 (0.3)	2.2 ± 1.5		3.9 ± 3.5		1.7 ± 3.2	
Breast cancer stage			0.7891		0.8486		0.5796
I	2839 (22.2)	2.3 ± 2.2		3.4 ± 3.2		1.1 ± 3.2	
II	7311 (57.2)	2.4 ± 2.4		3.3 ± 3.3		1.0 ± 3.2	
III	2631 (20.6)	2.3 ± 2.9		3.4 ± 3.7		1.0 ± 3.7	
Baseline continuity of care			< 0.0001		< 0.0001		< 0.0001
0 visit	800 (6.3)	0.0 ± 0.0		2.1 ± 2.7		2.1 ± 2.7	
1–2 visits	1536 (12.0)	0.4 ± 0.1		2.1 ± 2.4		1.8 ± 2.4	
UPC ≤ 0.75 (low)	3914 (30.6)	2.8 ± 2.5		3.6 ± 3.5		0.7 ± 3.6	
UPC > 0.75 (high)	6531 (51.1)	2.8 ± 2.5		3.7 ± 3.4		0.9 ± 3.3	
Primary care practice model			< 0.0001		< 0.0001		< 0.0001
Straight FFS	1887 (14.8)	2.1 ± 2.7		3.2 ± 3.4		1.1 ± 3.4	
Enhanced FFS	6281 (49.1)	2.7 ± 2.7		3.6 ± 3.4		0.9 ± 3.3	
Capitation	2235 (17.5)	2.1 ± 2.1		3.0 ± 3.1		0.9 ± 3.1	
Team-based capitation	2206 (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 ± 3.0	

Table 2 (part 2 of 2): Mean PCP visits (per 6 mo) during baseline and treatment periods stratified by cohort characteristics

Characteristic	Total, no. (%) *n* = 12 781*	Baseline PCP visits, mean ± SD†	*p* value	Treatment PCP visits, mean ± SD	*p* value	Difference (treatment – baseline), mean ± SD	*p* value
Regional health district (LHIN)			< 0.0001		< 0.0001		< 0.0001
Erie St. Clair	713 (5.6)	2.4 ± 2.5		3.4 ± 3.7		1.1 ± 3.5	
South West	992 (7.8)	2.1 ± 2.0		3.8 ± 3.2		1.8 ± 3.2	
Waterloo Wellington	654 (5.1)	1.7 ± 1.8		2.7 ± 3.0		1.0 ± 2.7	
Hamilton Niagara Haldimand Brant	1468 (11.5)	2.1 ± 2.2		3.5 ± 3.1		1.4 ± 3.0	
Central West	543 (4.2)	3.0 ± 2.4		3.5 ± 3.1		0.5 ± 3.1	
Mississauga Halton	750 (5.9)	2.6 ± 2.4		2.8 ± 3.1		0.2 ± 3.0	
Toronto Central	1061 (8.3)	2.5 ± 3.2		3.0 ± 3.3		0.5 ± 3.2	
Central	1784 (14.0)	2.7 ± 2.7		3.2 ± 3.0		0.5 ± 3.3	
Central East	1710 (13.4)	2.6 ± 2.4		3.4 ± 3.5		0.9 ± 3.4	
South East	520 (4.1)	2.0 ± 2.1		3.1 ± 3.5		1.2 ± 3.5	
Champlain	1335 (10.4)	2.1 ± 2.6		3.9 ± 3.3		1.8 ± 2.9	
North Simcoe Muskoka	518–522 (4.1)	2.3 ± 2.9		3.0 ± 2.7		0.7 ± 3.5	
North East	478 (3.7)	2.0 ± 1.9		3.1 ± 3.9		1.1 ± 3.6	
North West	252 (2.0)	1.9 ± 1.8		4.4 ± 5.6		2.5 ± 5.6	
Unknown	≤ 5	§		§		§	
Physical comorbidities			< 0.0001		< 0.0001		< 0.0001
0–5 physical ADGs (low)	7287 (57.1)	1.4 ± 1.7		2.8 ± 3.0		1.4 ± 3.0	
6–9 physical ADGs (medium)	4425 (34.6)	3.2 ± 2.3		3.8 ± 3.4		0.7 ± 3.4	
≥ 10 physical ADGs (high)	1069 (8.4)	5.6 ± 3.4		5.3 ± 4.2		–0.2 ± 4.0	
Mental health history			< 0.0001		< 0.0001		< 0.0001
Yes	4127 (32.3)	3.5 ± 3.1		4.1 ± 3.8		0.6 ± 3.7	
No	8654 (67.7)	1.8 ± 1.9		3.0 ± 3.1		1.2 ± 3.1	

Note: ADGs = Aggregated Diagnosis Groups, FFS = fee for service, LHIN = local health integration network, PCP = primary care practitioner, SD = standard deviation, UPC = usual provider of care index.
*Some participants (*n* = 72) died during the 6-month treatment period and others (*n* = 319) were not eligible for Ontario Health Insurance Plan during the full 24-month baseline period. We included an offset term in our multivariable model to account for differences in the exposure time of the baseline and treatment periods.
†Mean baseline PCP visits divided by 4 to obtain 6-month visit rate.
‡Nonimmigrants includes Canadian-born citizens or immigrants arriving to Canada before 1985.
§Denotes too few cases to report.

chemotherapy, especially for patients with fewer comorbidities or no MHH at baseline.

Our findings could be explained by a "ceiling effect" — where those with high physical comorbidity levels and MHH already had a relatively saturated number of PCP visits at baseline, with little room for increasing visits during the treatment period. Alternatively, those with a small number of PCP visits at baseline, who are more likely to be those with low comorbidity levels, may be less familiar with the health care system and require more PCP visits during treatment for care coordination and navigation. Several studies have shown that physical and mental comorbidities increase after breast cancer diagnosis.[42–46] Therefore, another reason for this association could be that those with low physical comorbidity levels and no MHH at baseline develop more comorbidities and mental health issues or have more of these issues identified during chemotherapy, which would require additional primary care management. Future research should evaluate how increasing comorbidity after breast cancer diagnosis might influence PCP visits during treatment.

It is possible that all patients with breast cancer experience increasing care needs during chemotherapy; however, those with lower comorbidity levels may feel more comfortable having these issues addressed by their PCP, whereas those with higher comorbidity levels might present more readily to specialists or other settings. This possibility is supported by a study that looked at patients with early-stage breast cancer in Ontario from 2007 to 2009. It found that emergency department visits and hospital admissions were more likely to occur during chemotherapy and in those with higher comorbidity levels.[47] If we take this study into consideration with our results, we can see that PCP visits, emergency department visits and hospital admissions all increase during breast cancer chemotherapy. Those with fewer comorbidities increased their visits to their PCPs, and those with more comorbidities were more likely to increase their visits to the emergency department or hospital.

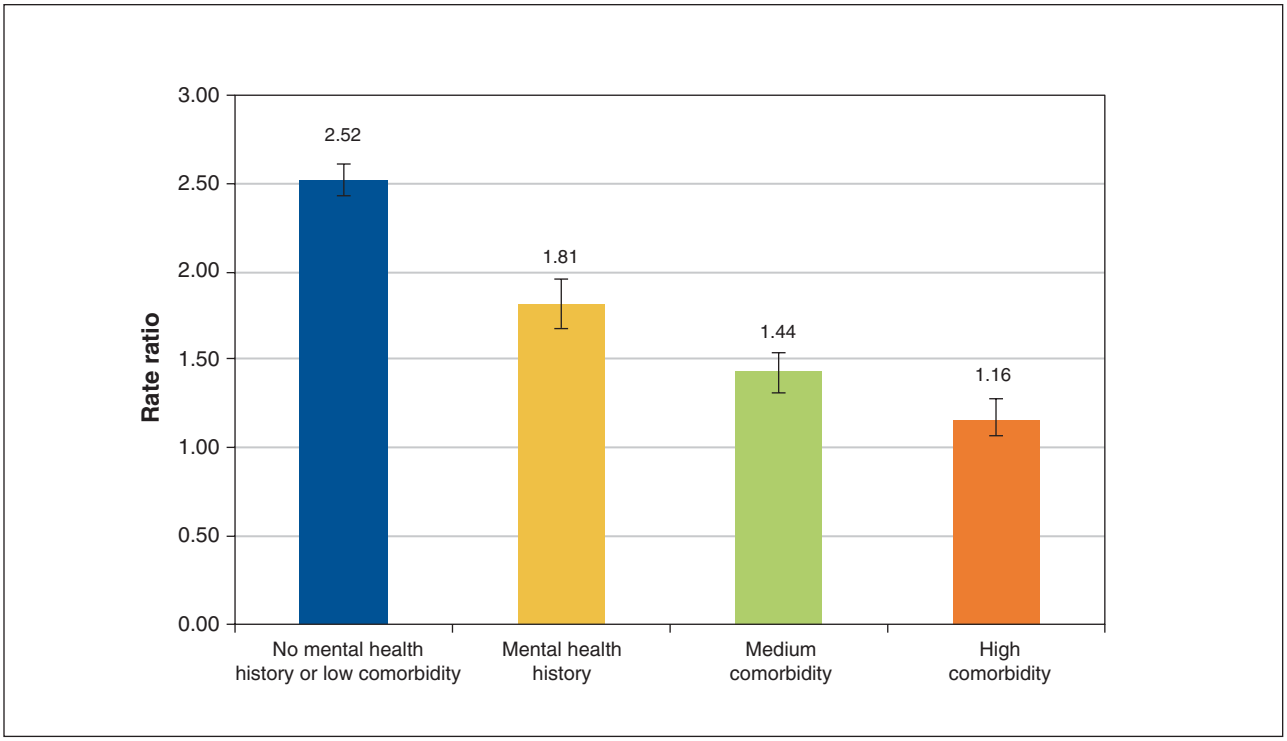

Figure 4: Relative increase in primary care physician visit rates from baseline to treatment periods (rate ratio), by mental health history and physical comorbidity groups and adjusted for age, immigration status, income, rurality, regional health district, continuity of primary care and primary care enrolment model. Note: low comorbidity = 0–5 Aggregated Diagnosis Groups (ADGs), medium comorbidity = 6–9 ADGs, high comorbidity = 10+ ADGs. 42 (0.3%) participants with missing values for at least 1 demographic characteristic were excluded from the multivariable modelling. Error bars represent 95% confidence intervals.

Table 3: Top 5 diagnostic codes for PCP visits during baseline and treatment periods

	Baseline period		Treatment period	
Rank	Diagnostic code	No. (%) *n* = 119 294	Diagnostic code	No. (%) *n* = 42 748
1	Hypertension	10 951 (9.18)	Breast cancer (female)	14 097 (32.98)
2	Anxiety	8533 (7.15)	Anxiety	2686 (6.28)
3	Annual health examination	5606 (4.70)	Hypertension	1757 (4.11)
4	URI	4844 (4.06)	Other ill-defined conditions, general symptoms	1429 (3.34)
5	Diabetes	4696 (3.94)	URI	1301 (3.04)

Note: PCP = primary care physician, URI = upper respiratory infection.

One way to help PCPs manage issues during chemotherapy is to implement shared care initiatives between primary care and oncology practices. For example, faxing chemotherapy information to PCPs was shown to increase PCP confidence in managing chemotherapy effects.[48] Another study showed that connecting patients with advanced practice nurses and psychiatric consultation-liaison nurses decreased the number of PCP visits for depressive symptoms during adjuvant chemotherapy for ovarian cancer.[49] In addition, CanIMPACT has launched a trial of eOncoNote, an asynchronous communications tool embedded within the larger eConsult platform,[50] aimed at improving communication between PCPs and oncologists.[51] Incorporating these or other interventions to improve shared care during chemotherapy can assist PCPs in managing the increased visits during the adjuvant chemotherapy period. Further research should continue to explore the effectiveness of shared care interventions during chemotherapy.

Limitations

Our results need to be interpreted in light of several possible limitations. Physician billings data do not provide detailed clinical information for PCP visits. Although we identified the

number of visits with a breast cancer diagnostic code, future research should evaluate the details of these visits (e.g., through surveying PCPs and patients) to identify the specific issues during chemotherapy that are being addressed by PCPs. Obtaining more detailed information on what occurs during these visits would help us further understand why the increase in visits primarily affects those with low baseline physical comorbidity levels and no MHH and whether there are reasons beyond that of a ceiling effect. The CanIMPACT cohort used in this study involved patients who received a diagnosis of breast cancer between 2007 and 2011. Although the principles of breast cancer treatment have not changed substantially since 2011,[52] and no major primary care reform has occurred in Ontario since then,[53] we need to consider that trends in PCP visits during chemotherapy may have shifted since these patients were treated.

Conclusion

In Ontario, PCPs can plan for their patients with high physical comorbidity levels and MHH to continue having frequent appointments while they undergo chemotherapy, and they can expect their patients with low physical comorbidity levels and no MHH to increase the frequency of their visits during chemotherapy, with 40% of these visits being related to their breast cancer diagnosis. It is therefore important for PCPs to be aware of and be able to provide management strategies for issues that may arise during chemotherapy.

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Affiliations: Department of Family and Community Medicine (Walsh), Sunnybrook Health Sciences Centre; Department of Family & Community Medicine (Walsh, Lofters, Grunfeld), University of Toronto; Department of Family & Community Medicine (Lofters), Women's College Hospital; Dalla Lana School of Public Health (Moineddin), University of Toronto; ICES Central (Moineddin); Department of Medical Oncology & Hematology (Krzyzanowska), Princess Margaret Cancer Centre, University Health Network; Institute of Health Policy, Management and Evaluation (Krzyzanowska), University of Toronto; Ontario Institute for Cancer Research (Grunfeld), Toronto, Ont.

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