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Examination of Health System Resources and Costs Associated With Transitioning Cancer Survivors to Primary Care: A Propensity-Score–Matched Cohort Study

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QUESTION ASKED: What is the effect on health system resources of transitioning low-risk cancer survivors back to their primary care provider?

SUMMARY ANSWER: Transitioned patients had significantly fewer hospitalizations, fewer cancer clinic visits, and fewer diagnostics but similar primary care visits compared with controls. The overall mean annual cost per patient was less expensive than controls.

WHAT WE DID: A Well Follow-Up Care Initiative was implemented in the publicly funded health system of Ontario, Canada, between 2010 and 2013. We propensity-score–matched nontransitioned breast cancer survivors (ie, controls) diagnosed in the same year, with similar disease profile and patient characteristics, using publicly funded administrative databases. Thereby, we linked 2,324 individuals who were transitioned to their primary care physician to our provincial administrative data to create a control group to compare health system resources and costs (CAD $2,014).

WHAT WE FOUND: A total of 2,324 breast cancer survivors from the Well Follow-Up Care Initiative intervention group were 1:1 matched to controls and observed over 25 months. Compared with controls, survivors in the intervention group incurred a similar number of primary care provider visits (6.9 *v* 7.5) and fewer oncologist visits (0.3 *v* 1.2) per person-year. Fewer survivors in the intervention group (20.1%) were hospitalized than in the control group (24.4%). There was a greater proportion having mammograms (82.6% *v* 73.1%) in the intervention group, but other diagnostic tests were less frequent. There was a 39.3% reduction in overall mean annual costs ($6,575 *v* $10,832) and a 22.1% reduction in overall median annual costs ($2,261 *v* $2,903).

BIAS, CONFOUNDING FACTOR(S), REAL-LIFE IMPLICATIONS: Given that we found a decreased health system resource use and cost savings to the publicly funded health system associated with transitioning women, our work suggests that this intervention represents a reasonable approach at the population level to delivering quality care for low-risk breast cancer survivors that seems to be cost effective. These results can be used in other jurisdictions to inform policy in the development and implementation of models of care that include transition to community providers at a system-wide level. JOP

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Abstract

Background

Transitioning low-risk cancer survivors back to their primary care provider (PCP) has been shown to be safe but the effect on health system resources and costs has not been examined.

Methods

A Well Follow-Up Care Initiative (WFCI) was implemented in the publicly funded health system. Low-risk breast cancer (BC) survivors in the WFCI intervention group were transitioned from oncologist-led cancer clinics to PCPs. We compared health system costs ($2,014 in Canadian dollars) and resource utilization in this intervention group with that in propensity-score–matched nontransitioned BC survivors (ie, controls) diagnosed in the same year, with similar disease profile and patient characteristics using publicly funded administrative databases.

Results

A total of 2,324 BC survivors from the WFCI intervention group were 1:1 matched to controls and observed for 25 months. Compared with controls, survivors in the intervention group incurred a similar number of PCP visits (6.9 *v* 7.5) and fewer oncologist visits (0.3 *v* 1.2) per person-year. Fewer survivors in the intervention group (20.1%) were hospitalized than in the control group (24.4%). There were no differences in emergency visits. More survivors in the intervention group had mammograms (82.6% *v* 73.1%), but other diagnostic tests were less frequent. There was a 39.3% reduction in overall mean annual costs ($6,575 *v* $10,832) and a 22.1% reduction in overall median annual costs ($2,261 *v* $2,903). Overall survival in the intervention group was not worse than controls.

Conclusion

Transitioning low-risk BC survivors to PCPs was associated with lower health system resource use and a lower annual cost per patient than matched controls. The WFCI model represents a reasonable approach at the population level to delivering quality care for low-risk BC survivors that seems to be cost effective.

ASSOCIATED CONTENT

Appendix available online

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INTRODUCTION

A number of breast cancer (BC) survivors who have finished their curative treatment are considered to be at low risk for cancer recurrence and continue to have regular follow-up visits with their oncologists despite not requiring this level of care.[1,2] Meanwhile, newly diagnosed patients with cancer are experiencing longer-than-expected waiting time to receive care from cancer specialists.[3] Randomized controlled trials have demonstrated, and guidelines recommend, that transitioning care for low-risk cancer survivors from oncologist-led cancer clinics to a primary care physician (PCP) is safe and does not result in differences in the time to diagnosis of recurrence or reporting of serious clinical events.[4-10] Transitioning follow-up care of survivors to primary care can potentially free up oncologist time to care for patients in need, improving the efficiency of oncology resources.

Ontario is Canada's largest province and home to over 13 million people. Approximately 90% of Ontarians have a PCP.[11,12] Between 2010 and 2013, Cancer Care Ontario, a publicly funded, provincial cancer agency in Ontario, Canada, initiated the Well Follow-up Care Initiative (WFCI). Cancer Care Ontario provided one-time funding ($100,000) for each of the 14 Regional Cancer Centres (RCC) to identify and transition eligible BC survivors, namely, those who had completed initial treatment and were at low risk for recurrence, from oncology-led care to primary care.[13] The RCCs received funding to develop structures and processes to support the transitions of such survivors, taking into account their unique environmental contexts such as geography and local primary care resources. Most regions developed survivorship care plans and patient education materials to identify appropriate survivors and support transition to PCPs.[13] WFCI intervention strategies included both direct transition to primary care and stepped transition using transition clinics, typically run by advanced practice nurses. Initial evaluation demonstrated that transitioning was both feasible and satisfactory to patients, where 85% of survivors indicated that they were prepared for transition.[13]

Understanding the health system resource implications and financial effect of this initiative can assist health system administrators make informed policy decisions about system-wide adoption. It is unclear whether survivors who are transitioned use more health system resources or whether the intervention would be associated with higher health system costs. The objective of our study was to compare both the publicly funded health system resources used and their associated costs among BC survivors enrolled in the WFCI with a comparable group of BC survivors who were not transitioned.

METHODS

Study Setting and Design

We conducted a propensity-score (PS)–matched, quasi-experimental study to compare the health system resource utilization and the health system costs of BC survivors in the WFCI intervention group (ie, those transitioned from oncology-led cancer clinics to their own PCPs, referred to as the intervention group) with those not transitioned (the control group). Ethics approval was granted by the research ethics board of Sunnybrook Health Sciences Centre, Toronto, Ontario, Canada.

Data Sources

All databases were housed and linked using unique encoded identifiers at the Institute for Clinical Evaluative Sciences in Toronto.[14] Diagnosis information came from the Ontario Cancer Registry. The Registered Persons Database included patient demographic information, as well as date of death. The Discharge Abstract Database included information on inpatient stays. The National Ambulatory Care Reporting System included emergency department visits, cancer clinic visits, and dialysis clinic visits. The Same-Day Surgery database included patient-level data on day surgeries. The Ontario Mental Health Reporting System included data on mental health stays. The Continuing Care Reporting System included information on long-term care services and complex continuing care. The National Rehabilitation Reporting System included information on inpatient rehabilitation. The Ontario Drug Benefit database included the cost of prescription medication (ie, oral chemotherapy) dispensed to those 65 years of age and older. The New Drug Funding Program included the cost of systemic treatment, which funds new and often expensive cancer drugs. The Ontario Health Insurance Plan (OHIP) included billing from all physician services and care by certain nonphysician providers (eg, physiotherapists, nurse practitioners, and midwives) that were paid by OHIP. OHIP also provided information on laboratory and diagnostic testing services.

Exposure Groups

In the WFCI intervention group, after completing their initial curative-intent treatment, 3,168 survivors were transitioned from RCCs to their PCPs after a thorough pretransition examination, as characterized in a previously published formative evaluation.[13] Universal health care coverage is available to all Ontario residents, and with this coverage comes a unique health card number. Survivors in the intervention group were linked to the provincial health system administrative data via their encoded health card number. Excluded were those whose date of transition was not recorded (n = 11), who were male (n = 15), whose initial cancer diagnosis or date of cancer diagnosis could not be identified (n = 210), who were transitioned out of the cancer clinics in years other than 2010 to 2013 (n = 78), who died or were lost to follow-up care before the transition date (n = 7), or who had a subsequent cancer after the initial BC diagnosis but before the transition date (n = 162). A total of 2,685 patients remained in the WFCI intervention group. Controls were women from the rest of the province who were diagnosed with BC and treated and who were alive on the transition date of their matched patients but did not participate in the WFCI intervention.

The date when a survivor in the WFCI intervention group was transitioned defined the index date for her matched pair. Survivors in the intervention group and their matched controls were each observed from the index date to the earliest of their date of death; date of last contact from administrative data; one day before the diagnosis of another cancer; or the study end date, which was March 31, 2015.

Study Outcomes

The primary study outcome was the overall publicly funded health system cost (mean, median), expressed in 2014 Canadian dollars (CAD $1 = USD $0.75[15]). For a BC survivor in either group, this overall cost represented all health system costs incurred during her follow-up period and was paid for by Ontario's single payer, the Ontario Ministry of Health and Long-Term Care. Data sources are provided in Data Sources, and the costing method for each resource is described elsewhere.[16] Secondary outcomes included disaggregated costs of each health system resource and health system resource utilization, the latter measured by percentage of survivors who used each resource.

One of the financial concerns with transitioning cancer survivors to PCPs was that the PCP might order additional diagnostic imaging tests to obtain an understanding of the patient's cancer history and health status. To address such concerns, we specifically conducted an analysis of the use of diagnostic imaging tests and visits to physicians of different clinical specialties.

Covariables

Factors that could potentially account for the difference in health system resource utilization and costs between the intervention and control groups and that were available from administrative databases were grouped into two categories. The first category included patient demographics: age at the index date, area of residence denoted by region, and neighborhood income quintile measured at the dissemination area (DA) level. A DA is a standardized small, relatively stable geographic unit comprising a population of 400 to 700 persons. In urban areas, people within the same DA are homogenous in terms of socioeconomic status (SES), whereas in rural areas, the SES of residents within the same DA can be heterogeneous. We therefore considered rural residents a separate category in the variable of neighborhood income quintile. The second category of covariables described disease characteristics and included year of BC diagnosis, cancer staging at the time of diagnosis, comorbid conditions denoted by the Johns Hopkins Aggregated Diagnosis Groups (ADGs), and health system utilization measured as the resource utilization band (RUB). Both ADG and RUB were derived using the Johns Hopkins University's Adjusted Clinical Group technique based on a patient's age, gender, and all diagnostic information from inpatient care, emergency department visits, and physician visits in the year before the index date. This technique captures the specific clustering of morbidities experienced by a patient over the specified time period.[17]

Analysis

The PS-matching method was used to select one control patient for each survivor in the intervention group (1:1 match). The PS was estimated using a logistic regression model in which being in the intervention group was regressed on patients' demographic characteristics (age, area of residence, SES), disease characteristics (cancer stage at diagnosis, year of diagnosis, and preexisting comorbidities denoted by the ADG scores), and previous resource utilization pattern denoted by RUB. Survivors in the intervention group and control group were matched on the logit of the PS with a caliper of 0.2 standard deviations of the logit of the PS.[18] To eliminate the potential difference in health care provision in different areas

or over different years, survivors in the intervention group and their matched controls were also required to have the exact year of diagnosis and area of residence. After matching, standardized differences were used to compare all covariables between the intervention group and the control group, with a value < 0.1 indicating good balance.[19]

The number and percentage of survivors who used each of the health system resources between the intervention group and the control group were compared with χ^2 tests. Costs associated with each health system resource were calculated with a case-costing algorithm that used administrative databases from Ontario.[20] Because BC survivors may have had different lengths of follow-up during the study period, we standardized health system costs for each survivor into cost per year and reported this standardized annual cost. The standardized annual cost was calculated as cost from a survivor during the follow-up divided by days of follow-up from the same survivor and multiplied by 365 days. Because costing data do not follow a normal distribution, both mean and median annual costs of each health system resource were calculated. Because the intervention group and the control group were closely matched, cost differences within a matched pair represent the effect of the WFCI on health system costs, after adjustment for all matched variables.[21,22] We used generalized estimating equations to estimate the differences in standardized annual costs between the two groups, along with their 95% CIs, with the standardized annual cost as the independent variable and being in the intervention group as the predicting variables, accounting for the cluster effect of matched pairs. Quantile regression was used to estimate the difference in median costs and their 95% CIs.

We reported the number of diagnostic scans per person-year for each exposure group, calculated as the total number of scans that survivors in the exposure group had, divided by total number of person days of follow-up from the same group, and multiplied by 365 days. We also reported the time to PCP by group. All *P* values were two-sided, at a significance level of .05. All statistical analyses were performed using SAS version 9.4 for UNIX (SAS Institute, Cary, NC).

RESULTS

Of the 2,685 BC survivors in the intervention group, 2,324 (86.6%) were matched to a control. After matching, the respective standardized differences between the intervention group and the control group were less than 0.1 for all covariables, indicating a good balance between the two groups (Table 1). The majority of women were diagnosed after 2006 and with stage I or II cancer at the time of diagnosis (Table 1). On average, survivors in both groups had 25 months of follow-up (Table 1). Three percent of the patients compared with 6.7% in the control group died during the 5-year period since diagnosis. The proportion of women dying of BC was similar between the two groups (20.3% *v* 18.6%; $P = .7$).

Health System Resource Utilization

During follow-up, the proportion of survivors who had a hospitalization (20.1% *v* 24.4%) or a cancer clinic visit (6.0% *v* 15.1%) were both lower in the intervention group; however, there were no differences in emergency department visits (49.1% *v* 51.8%). More survivors in the intervention group (38.5%) had a same-day surgery than in the control group (30.9%; Table 2).

The intervention and control groups had a similar number of PCP visits (6.88 *v* 7.50 per person-year) and internal medicine/hematology visits (0.66 *v* 0.92 per person-year). The cumulative probability of visiting PCPs was higher in the intervention group within 1 month of the intervention (43.2% *v* 38.8%) and within 3 months (70.2% *v* 67.4%) and 6 months (85.9% *v* 83.8%) after the index date. The intervention group had fewer visits to medical oncologists (0.26 *v* 1.23 per person-year) and radiation oncologists (0.13 *v* 0.35 per person-year). Per person-year visits to the emergency department were similar between the two groups (0.70 in the intervention group *v* 0.78 in the control group; Appendix Fig A1A, online only).

For diagnostic imaging, the proportion of survivors with a bone scan (11.6% *v* 14.6%), a computed tomography scan (29.0% *v* 33.8%), or a magnetic resonance imaging (11.3% *v* 13.6%) was all lower in the intervention group, compared with the control group (Table 2). Survivors in the intervention group were more likely to have a mammogram than those in the control group (82.6% *v* 73.1%; Table 2). The number of scans per person-year during follow-up was lower in the intervention group than that in the control group when considering a bone scan, computed tomography scan, magnetic resonance imaging scan, and x-ray, but not mammograms (Appendix Fig A1B).

Health System Costs

The mean annual total cost per survivor was CAD $6,575 (95% CI, $5,563 to $7,587) in the intervention group and $10,832 (95% CI, $9,947 to $11,717) in the control group, resulting in a $4,257 (95% CI, $2,928 to $5,587) lower annual cost per

Table 1. Characteristics of the WFCI Intervention Group and the Matched Control Group

Variable	WFCI Intervention Group (n = 2,324)	Control Group* (n = 2,324)	Standardized Difference (P)
Age at index date, years			
Mean ± SD	64.38 ± 11.30	64.89 ± 13.50	0.04 (.17)
Median (IQR)	64 (56-72)	65 (55-74)	0.02 (.42)
LHIN			
Erie St Clair	128 (5.5)	128 (5.5)	0 (1)
South West	389 (16.7)	389 (16.7)	0
Waterloo Wellington	24 (1)	24 (1)	0
Hamilton Niagara Haldimand Brant	208 (9.0)	208 (9.0)	0
Central West or Toronto Central	11 (1)	11 (1)	0
Mississauga Halton	36 (2)	36 (2)	0
Central	41 (2)	41 (2)	0
Central East	311 (13.4)	311 (13.4)	0
South East	19 (1)	19 (1)	0
Champlain	119 (5.1)	119 (5.1)	0
North Simcoe Muskoka	282 (12.1)	282 (12.1)	0
North East	634 (27.3)	634 (27.3)	0
North West	122 (5.2)	122 (5.2)	0
Income Q			
Urban Q1 (lowest)	319 (13.7)	328 (14.1)	0.01 (.83)
Urban Q2	309 (13.3)	332 (14.3)	0.03
Urban Q3	362 (15.6)	350 (15.1)	0.01
Urban Q4	386 (16.6)	360 (15.5)	0.03
Urban Q5 (highest)	387 (16.7)	385 (16.6)	0
Rural	561 (24.1)	569 (24.5)	0.01
Year of diagnosis			
Before 2007	627 (27.0)	627 (27.0)	0 (1.00)
2007	222 (9.6)	222 (9.6)	0
2008	238 (10.2)	238 (10.2)	0
2009	288 (12.4)	288 (12.4)	0
2010	337 (14.5)	337 (14.5)	0
2011	336 (14.5)	336 (14.5)	0
2012	243 (10.5)	243 (10.5)	0
2013	33 (1)	33 (1)	0
Time since diagnosis to index date, months			
Mean ± SD	59.42 ± 55.17	59.46 ± 55.09	0 (.98)
Median (IQR)	46 (21-76)	45 (21-78)	0 (.89)
ADG score group			
0-2	596 (25.6)	605 (26.0)	0.01 (.81)
3-4	650 (28.0)	669 (28.8)	0.02
5-6	519 (22.3)	517 (22.2)	0
≥ 7	559 (24.1)	533 (22.9)	0.03
ADG score†			
Mean ± SD	4.68 ± 2.96	4.63 ± 3.00	0.02 (.53)
Median (IQR)	4 (2-6)	4 (2-6)	0.03 (.36)

(continued on following page)

Table 1. Characteristics of the WFCI Intervention Group and the Matched Control Group (continued)

Variable	WFCI Intervention Group (n = 2,324)	Control Group* (n = 2,324)	Standardized Difference (P)
RUB			
0-2	67 (3)	85 (4)	0.04 (.18)
3	1,291 (55.6)	1,328 (57.1)	0.03
4	637 (27.4)	617 (26.5)	0.02
5	329 (14.2)	294 (12.7)	0.04
Stage of breast cancer			
0	≤ 5 (0)	7 (0)	0.05 (.28)
I	854 (36.7)	818 (35.2)	0.03
II	607 (26.1)	592 (25.5)	0.01
III	142 (6.1)	138 (5.9)	0.01
IV	≤ 5 (0)	6 (0)	0.03
Unknown	716 (30.8)	763 (32.8)	0.04
Months of follow-up‡			
Mean ± SD	26.21 ± 9.86	25.56 ± 9.32	0.07 (.02)
Median (IQR)	24 (21-28)	24 (21-27)	0.06 (.03)
Time since diagnosis to index, months			
Mean ± SD	59.42 ± 55.17	59.46 ± 55.09	0 (.98)
Median (IQR)	46 (21-76)	45 (21-78)	0 (.89)
Died during follow-up	69 (3.0)	156 (6.7)	0.18 (< .01)

NOTE. Data presented as No. (%) unless otherwise indicated.

Abbreviations: ADG, aggregated diagnosis group; IQR, interquartile range; Q, quintile; RUB, resource utilization band; SD, standard deviation; WFCI, Well Follow-Up Care Initiative.

*Hard matched on year of diagnosis and area of residence; propensity-score–matched on age, area of residence, income Q, ADG, RUB, year of diagnosis, and cancer stage at diagnosis.

†ADG and RUB were determined using Johns Hopkins Aggregated Diagnosis Groups system with diagnostic information from inpatient care, emergency department visits, and physician visits during 1 year before index.

‡End of follow-up is determined by date of death, date of last contact from administrative databases; March 31, 2015; or 1 day before a new cancer diagnosis.

survivor in the intervention group. Main cost drivers included hospitalization, physician visits, medications, and home care. The intervention group had significantly lower mean annual costs for same-day surgery, cancer clinic visits, physician visits, medications, long-term care, and home care (Table 3).

DISCUSSION

Our work builds on the accumulating evidence reporting that survivorship programs have been shown to be reasonable, safe, and acceptable to many survivors. Intervention group survivors had a comparable number of encounters with PCPs as those in the control cohort, indicating that despite the decreased specialist care, there did not seem to be an increase in primary care visits, but visits did happen sooner.

We showed an overall cost savings to the publicly funded health system in BC survivors who were transitioned. The cost savings is largely a result of decreases in utilization associated with cancer clinics and hospitalizations for transitioned survivors. Our results showed more use of an appropriate surveillance test (ie, mammogram) and less use of other imaging tests. This result is in alignment with best practices and initiatives, such as Choosing Wisely[23] and guidelines for managing low-risk BC survivors.[24] Our results also showed that from a safety perspective, survivors in the intervention group did not have worse survival outcomes, highlighting that transition did not compromise patient health outcomes.

In a publicly funded system, where 94% of the population has a PCP, transitioning follow-up care to primary care seems to be both viable and reasonable at the population level.[11] However, for transition models to be successful, there needs to be effective communication between PCPs and oncologists through strategies such as discharge visits or survivorship care plans to facilitate the patient's transition.[25]

Table 2. Use of Health System Resources Between the WFCI Intervention Group and the Matched Control Group During the Follow-Up Period

Variable	WFCI Intervention Group (n = 2,324)	Control Group (n = 2,324)	P
Hospitalization	467 (20.1)	566 (24.4)	< .001
Same-day surgery	894 (38.5)	719 (30.9)	< .001
Emergency department	1,140 (49.1)	1,203 (51.8)	.07
Cancer clinic	140 (6.0)	350 (15.1)	< .001
Oral medications*	1,719 (74.0)	1,720 (74.0)	.97
Long-term care	32 (1)	144 (6.2)	< .001
Home care	454 (19.5)	575 (24.7)	< .001
Laboratory tests	2,030 (87.3)	1,986 (85.5)	.06
Physician visits	2,323 (100.0)	2,323 (100.0)	1.00
Diagnostic radiology	2,247 (96.7)	2,199 (94.6)	< .001
General surgery	1,000 (43.0)	990 (42.6)	.77
Primary care	2,276 (97.9)	2,261 (97.3)	.15
Internal medicine/hematology	817 (35.2)	941 (40.5)	< .001
Medical oncology	418 (18.0)	926 (39.8)	< .001
Radiation oncology	257 (11.1)	491 (21.1)	< .001
Other physicians	2,067 (88.9)	2,050 (88.2)	.43
Nonphysician visits†	1,274 (54.8)	1,182 (50.9)	< .01
National Rehabilitation Reporting System	20 (1)	31 (1)	.12
Complex continuing care	15 (1)	37 (2)	< .01
Ontario Mental Health Reporting System	10 (0)	12 (1)	.67
New Drug Funding Program Medications	37 (2.0)	128 (5.5)	< .001
Used any resource	2,324 (100.0)	2,324 (100.0)	.32
Diagnostic tests			
Bone scan	270 (11.6)	340 (14.6)	< .01
CT scan	675 (29.0)	785 (33.8)	< .001
MRI	262 (11.3)	315 (13.6)	.02
Mammogram	1,920 (82.6)	1,698 (73.1)	< .001
PET	≤ 5 (0)	8 (0)	.25
Ultrasound	928 (39.9)	930 (40.0)	.95
X-ray	1,315 (56.6)	1,321 (56.8)	.86

NOTE. Data presented as No. (%).

Abbreviations: CT, computed tomography; MRI, magnetic resonance imaging; PET, positron emission tomography; WFCI, Well Follow-Up Care Initiative.

*Oral medications funded by Ontario Drug Benefit Formulary (> 64 years of age and receiving social assistance).

†Costs from nurse practitioners, physiotherapists, optometrists, alternate health professionals, dentists, chiropodists, chiropractors, and midwives that were covered by Ontario Health Insurance Plan.

Table 3. Mean and Median Standardized Annual Costs (in 2014 Canadian dollars) of Health System Resources per Patient Between the WFCI Intervention Group and the Matched Control Group During the Follow-Up Period

Value	WFCI Intervention Group, $ (n = 2,324)	Control Group, $ (n = 2,324)	Difference Between the Intervention and Control Group, $*	P
Hospitalization				
Mean (95% CI)*	2,384 (1,603 to 3,165)	2,510 (2,031 to 2,990)	−126 (−1,041 to 789)	.79
Median (IQR)†	0 (0)	0 (0)	0 (0)	.79
Same-day surgery				
Mean (95% CI)	287 (264 to 310)	273 (247 to 300)	13 (−22 to 49)	< .001
Median (IQR)	0 (0 to 360)	0 (0 to 266)	0 (0)	< .001
Emergency department				
Mean (95% CI)	243 (207 to 278)	278 (255 to 300)	−35 (−77 to 7)	.10
Median (IQR)	0 (0 to 244)	52 (0 to 316)	−52 (−90 to 15)	< .01
Cancer care clinic				
Mean (95% CI)	224 (151 to 296)	1,053 (844 to 1,262)	−829 (−1,049 to −609)	< .001
Median (IQR)	0 (0)	0 (0)	0 (0)	< .001
Oral medications				
Mean (95% CI)	897 (831 to 963)	1,281 (1,149 to 1,413)	−384 (−531 to −238)	< .001
Median (IQR)	269 (0 to 1,131)	310 (0 to 1,493)	−40 (−132 to 52)	.01
Long-term care				
Mean (95% CI)	214 (116 to 313)	1,808 (1,475 to 2,141)	−1,594 (−1,941 to −1,246)	< .001
Median (IQR)	0 (0)	0 (0)	0 (0)	< .001
Home care				
Mean (95% CI)	373 (299 to 447)	635 (529 to 740)	−262 (−390 to −133)	< .001
Median (IQR)	0 (0)	0 (0)	0 (0)	< .001
Laboratory tests				
Mean (95% CI)	108 (103 to 113)	120 (114 to 126)	−12 (−20 to −4)	< .01
Median (IQR)	78 (32 to 142)	81 (30 to 160)	−4 (−9 to 2)	.11
Physician visits				
Mean (95% CI)	1,513 (1,381 to 1,646)	1,974 (1,855 to 2,094)	−461 (−632 to −290)	< .001
Median (IQR)	1,015 (614 to 1,703)	1,171 (671 to 2,152)	−154 (−226 to −83)	< .001
Nonphysician visits				
Mean (95% CI)	33 (30 to 35)	47 (41 to 52)	−14 (−20 to −8)	< .001
Median (IQR)	21 (0 to 47)	12 (0 to 46)	9 (2 to 16)	.04
National Rehabilitation Reporting System				
Mean (95% CI)	64 (28 to 101)	153 (64 to 242)	−89 (−185 to 7)	.07
Median (IQR)	0 (0)	0 (0)	0 (0)	.12
Complex continuing care				
Mean (95% CI)	149 (50 to 248)	256 (146 to 367)	−107 (−256 to 41)	.16
Median (IQR)	0 (0)	0 (0)	0 (0)	< .01
Ontario Mental Health Reporting System				
Mean (95% CI)	41 (10 to 7)	78 (−9 to 164)	−37 (−129 to 55)	.43
Median (IQR)	0 (0)	0 (0)	0 (0)	.67
New Drug Funding Program Medications				
Mean (95% CI)	46 (13 to 79)	366 (236 to 497)	−321 (−456 to −186)	< .001
Median (IQR)	0 (0)	0 (0)	0 (0)	< .001

(continued on following page)

Table 3. Mean and Median Standardized Annual Costs (in 2014 Canadian dollars) of Health System Resources per Patient Between the WFCI Intervention Group and the Matched Control Group During the Follow-Up Period (continued)

Value	WFCI Intervention Group, $ (n = 2,324)	Control Group, $ (n = 2,324)	Difference Between the Intervention and Control Group, $*	P
Total cost				
Mean (95% CI)	6,575 (5,563 to 7,587)	10,832 (9,947 to 11,717)	−4,257 (−5,587 to −2,928)	< .001
Median (IQR)	2,261 (1,061 to 5,412)	2,903 (1,244 to 9,005)	−638 (−866 to −410)	< .001

Abbreviations: IQR, interquartile range; WFCI, Well Follow-Up Care Initiative.
*Difference in mean annual costs was estimated by generalized estimating equation, where each outcome was modeled separately, with controls as the referent group.
†Difference in median annual costs was estimated by quantile regression, where each outcome was modeled separately with controls as the referent group.

Our results are an accurate representation of real-world health system utilization and costs on the basis of our ability to leverage health system encounter data relating to our entire provincial population, derived from our universal health care system. The methods used here will help inform additional costing work for interventions initiated by public health systems.

There are limitations associated with this analysis. We recognize that these results are not based on a randomized controlled clinical trial. As such, the slightly higher percentage of survivors who died in the control group should be interpreted with caution. Intermediate outcomes, such as BC recurrence information, were not available from the administrative databases; thus, differences in cancer recurrence could not be analyzed between the two groups. The control group for this study was designed on the basis of demographic, disease status, baseline comorbidity, and location information available from our publicly funded databases, which may not contain all variables of interest regarding the medical management of survivors. For instance, we suspect that matching on medications may be important to the analysis; however we were unable to identify oral medications, such as endocrine therapy, for women under the age of 65 years. Also, we were not able to fully capture out-of-pocket costs not covered by the public insurer, which may have a significant effect on the overall societal costs but is beyond the scope of our health system. In addition, approximately one third of the patients had unknown BC stage. However, sensitivity analysis excluding those with missing staging information demonstrated similar cost savings in the intervention group (data available on request). Furthermore, we do not have data on patient satisfaction; however, previous research has shown that patients with cancer have some concerns about receiving cancer follow-up care from their PCPs in lieu of their oncologists.[26] Future research is needed to determine patient and physician buy-in and acceptability for a system-wide transition plan.

Our work suggests that transitioning low-risk BC survivors from oncologist-led care to PCPs was associated with fewer costs and similar or better outcomes. Our results provide additional evidence to inform policy in the development and implementation of models of care that include transition to community providers at a system-wide level. Implementation requires endorsement of results, a business case, and engagement with PCPs, specialist leaders, and patients. This includes the development of tools to support the identification of appropriate survivors for transition and ongoing monitoring of patterns of follow-up care to evaluate uptake and identify regional variations and targets for enhanced support. For what was a $1.4 million investment across RCCs, the health system will likely realize between $1.5 million (on the basis of median incremental value) and $9.9 million (on the basis of mean incremental value) savings per year for the cohort transitioned. If implemented at a provincial and population level, this may translate to a projected overall annual savings of between $9.6 million to $64.3 million in the province of Ontario. JOP

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Authors' Disclosures of Potential Conflicts of Interest

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References

1. 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 24:81-89, 2017

2. Urquhart R, Lethbridge L, Porter GA: Patterns of cancer centre follow-up care for survivors of breast, colorectal, gynecologic, and prostate cancer. Curr Oncol 24: 360-366, 2017

3. Barua B: Waiting your turn: Wait times for health care in Canada, 2017 Report. https://www.fraserinstitute.org/studies/waiting-your-turn-wait-times-for-health-care-in-canada-2017

4. Grunfeld E, Mant D, Yudkin P, et al: Routine follow up of breast cancer in primary care: Randomised trial. BMJ 313:665-669, 1996

5. Grunfeld E, Levine MN, Julian JA, et al: Randomized trial of long-term follow-up for early-stage breast cancer: A comparison of family physician versus specialist care. J Clin Oncol 24:848-855, 2006

6. Beaver K, Williamson S, Sutton C, et al: Comparing hospital and telephone follow-up for patients treated for stage-I endometrial cancer (ENDCAT trial): A randomised, multicentre, non-inferiority trial. BJOG 124:150-160, 2017

7. Kimman ML, Dirksen CD, Voogd AC, et al: Economic evaluation of four follow-up strategies after curative treatment for breast cancer: Results of an RCT. Eur J Cancer 47:1175-1185, 2011

8. Sussman J, Souter LH, Grunfeld E, et al: Guidelines & Advice: Models of care for cancer survivorship. https://www.cancercareontario.ca/en/guidelines-advice/types-of-cancer/246

9. Del Giudice ME, Grunfeld E, Harvey BJ, et al: Primary care physicians' views of routine follow-up care of cancer survivors. J Clin Oncol 27:3338-3345, 2009

10. Cheung WY, Neville BA, Cameron DB, et al: Comparisons of patient and physician expectations for cancer survivorship care. J Clin Oncol 27:2489-2495, 2009

11. Health Quality Ontario: Quality in primary care, setting a foundation for monitoring and reporting in Ontario. http://www.hqontario.ca/Portals/0/Documents/pr/theme-report-quality-in-primary-care-en.pdf

12. Ontario Ministry of Health and Long-Term Care: Health Care Experience Survey.

13. Grant M, De Rossi S, Sussman J: Supporting models to transition breast cancer survivors to primary care: Formative evaluation of a cancer care Ontario initiative. J Oncol Pract 11:e288-e295, 2015

14. ICES: Data dictionary. https://datadictionary.ices.on.ca/Applications/DataDictionary/Default.aspx

15. Bank of Canada: Currency converter. https://www bankofcanada ca/rates/exchange/currency-converter/

16. Mittmann N, Porter JM, Rangrej J, et al: Health system costs for stage-specific breast cancer: A population-based approach. Curr Oncol 21:281-293, 2014

17. The Johns Hopkins ACG System: Decades of impact on population health research and practice. https://www.hopkinsacg.org/

18. Austin PC: Optimal caliper widths for propensity-score matching when estimating differences in means and differences in proportions in observational studies. Pharm Stat 10:150-161, 2011

19. Austin PC: Balance diagnostics for comparing the distribution of baseline covariates between treatment groups in propensity-score matched samples. Stat Med 28:3083-3107, 2009

20. Wodchis W, Bushmeneva K, Nikitovic M, et al: Guidelines on person-level costing using administrative databases in Ontario. http://www.hsprn.ca/uploads/files/Guidelines_on_PersonLevel_Costing_May_2013.pdf

21. Krahn MD, Zagorski B, Laporte A, et al: Healthcare costs associated with prostate cancer: Estimates from a population-based study. BJU Int 105:338-346, 2010

22. Liu N, Mittmann N, Coyte PC, et al: Phase-specific healthcare costs of cervical cancer: Estimates from a population-based study. Am J Obstet Gynecol 214:615.e1-615.e11, 2016

23. Choosing Wisely Canada: Recommendations and resources, by specialty. https://choosingwiselycanada org/

24. Grunfeld E, Dhesy-Thind S, Levine M: Clinical practice guidelines for the care and treatment of breast cancer: Follow-up after treatment for breast cancer (summary of the 2005 update). CMAJ 172:1319-1320, 2005

25. The National Academies of Sciences, Engineering, Medicine: Implementing cancer survivorship care planning: Workshop summary (2007). https://www.nap.edu/read/11739/chapter/1.

26. Hudson SV, Miller SM, Hemler J, et al: Adult cancer survivors discuss follow-up in primary care: 'Not what I want, but maybe what I need.' Ann Fam Med 10:418-427, 2012

AUTHORS' DISCLOSURES OF POTENTIAL CONFLICTS OF INTEREST

Examination of Health System Resources and Costs Associated With Transitioning Cancer Survivors to Primary Care: A Propensity-Score–Matched Cohort Study

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Appendix

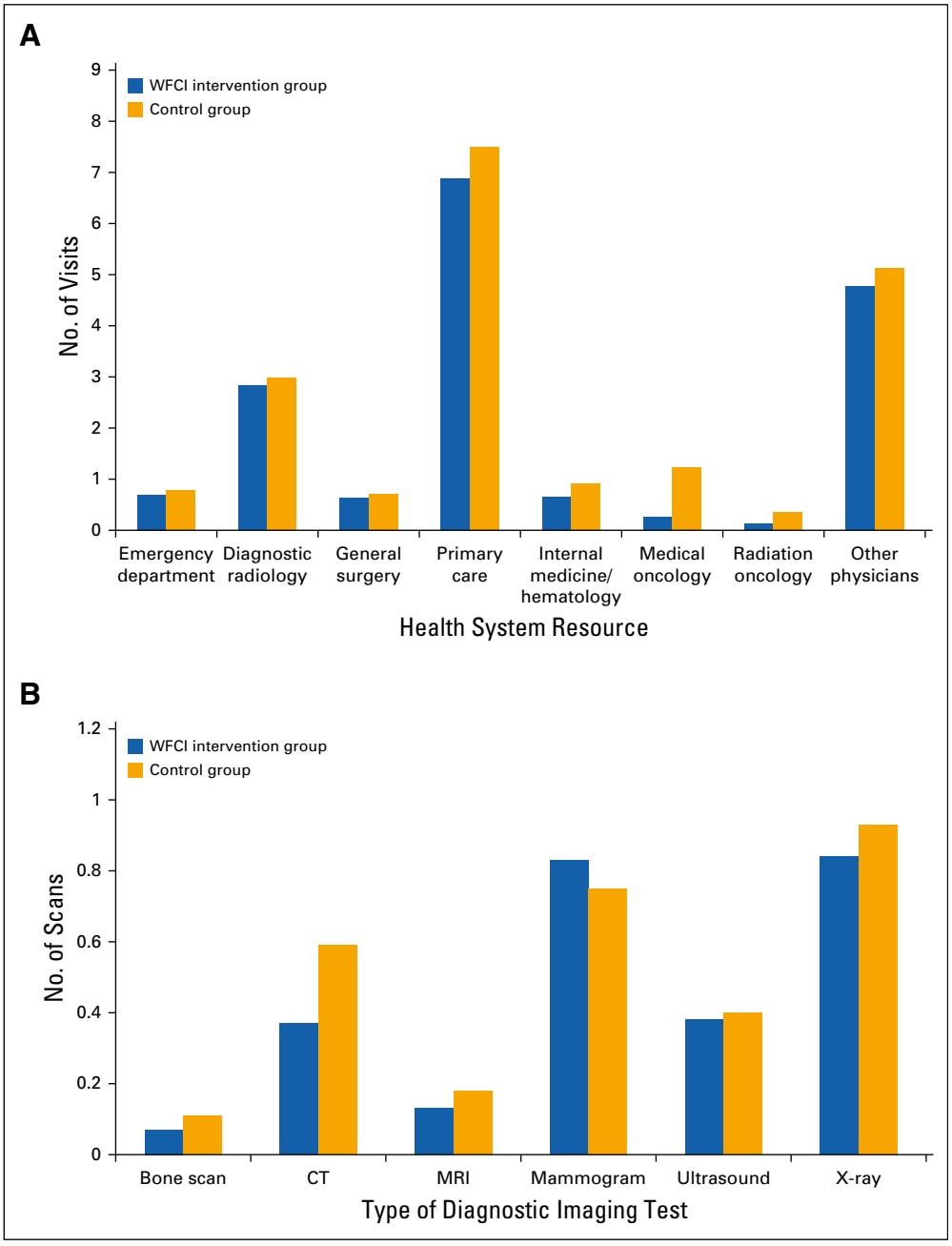

Fig. A1. Rate of resource utilization per person-year during the follow-up period: (A) emergency department visits and physician visits and (B) diagnostic imaging tests. CT, computed tomography; MRI, magnetic resonance imaging; WFCI, Well Follow-Up Care Initiative.