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Breast cancer diagnosis and treatment wait times in specialized diagnostic units compared with usual care: a population-based study

C. Webber PhD,* M. Whitehead MSc,† A. Eisen MD,‡ C.M.B. Holloway MD PhD,‡§ and P.A. Groome PhD†||

ABSTRACT

Background Breast assessment sites (BASs) were developed to provide expedited and coordinated care for patients being evaluated for breast cancer (BCa) in Ontario. We compared the diagnostic and treatment intervals for patients diagnosed at a BAS and for those diagnosed through a usual care (UC) route.

Methods This population-based, cross-sectional study of patients diagnosed with BCa in Ontario during 2007–2015 used linked administrative data. "Diagnostic interval" was the time from the earliest cancer-related health care encounter before diagnosis to diagnosis; "treatment interval" was the time from diagnosis to treatment. Diagnosis at a BAS was determined from the patient's biopsy and mammography institutions. Interval lengths for the BAS and UC groups were compared using multivariable quantile regression, stratified by detection method.

Results The diagnostic interval was shorter for patients who were BAS-diagnosed than for those who were UC-diagnosed, with adjusted median differences of –4.0 days [95% confidence interval (CI): –3.2 days to –4.9 days] for symptomatic patients and –5.4 days (95% CI: –4.7 days to –6.1 days) for screen-detected patients. That association was modified by stage at diagnosis, with larger differences in patients with early-stage cancers. In contrast, the treatment interval was longer in patients who were BAS-diagnosed than in those who were UC-diagnosed, with adjusted median differences of 4.2 days (95% CI: 3.8 days to 4.7 days) for symptomatic patients and 4.2 days (95% CI: 3.7 days to 4.8 days) for screen-detected patients.

Conclusions Diagnosis of BCa through a BAS was associated with a shorter diagnostic interval, but a longer treatment interval. Although efficiencies in the diagnostic interval might help to reduce distress experienced by patients, the longer treatment intervals for patients who are BAS-diagnosed remain a cause for concern.

Key Words Breast neoplasms, organized breast assessment, early detection, diagnostic interval, treatment interval

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BACKGROUND

Timely diagnosis and treatment of breast cancer (BCa) can reduce patient anxiety and promote positive outcomes, including an earlier stage at diagnosis and improved survival[1–10]. In Ontario, breast assessment sites (BASs) were developed by the Ontario Breast Screening Program to provide expedited diagnostic assessment for women with abnormal BCa screens. Motivated by the efficiency and popularity of the BASs, many regions in Ontario established more inclusive diagnostic programs to accommodate patients presenting with symptoms of BCa and to expand the scope beyond diagnosis to include staging and treatment planning. These programs offer a single access point for all BCa diagnostic and staging services, streamlined coordination of imaging and specialist consultations, and patient navigation. Although the original BASs are connected to the population-based Ontario Breast Screening Program and

Correspondence to: Patti A. Groome, 10 Stuart Street, Level 2, Kingston, Ontario K7L 3N6.
E-mail: groomep@queensu.ca **DOI:** https://doi.org/10.3747/co.27.6115
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therefore have provincial oversight, the regional programs do not. As of 2017, Ontario had 70 BASs, with coverage in all regions of the province[11].

Despite the development of BASs in Ontario, a significant proportion of women still receive their BCa diagnosis through usual care (UC)[11–13]—that is, care directed by individual health care providers, which might lack standardization, coordination, and psychosocial support[14]. We would expect that patients with BCa diagnosed through a BAS would experience improved outcomes, including shorter diagnostic and treatment intervals (respectively defined as the time from a patient's first contact with the health care system for a breast-related complaint to diagnosis, and from diagnosis to treatment initiation). However, little research has compared those intervals for patients whose BCa was diagnosed at a BAS or through UC, particularly studies that include symptomatic patients found to have BCa[15,16]. Further, previous studies examining this question have likely underestimated the diagnostic interval length, because the interval definition excluded relevant encounters, particularly those occurring before a patient's referral for a diagnostic procedure[12,13,17].

The purpose of the present study was to evaluate differences in the lengths of the BCa diagnostic, treatment, and total intervals, and the amount of diagnostic activity that occurred within the diagnostic interval, stratified by whether patients were diagnosed at a BAS or through UC. We used an empirical approach to measure the entire diagnostic interval, wherein the interval start date reflects the patient's first BCa-related health care encounter before diagnosis[17].

METHODS

Study Population

This population-based cross-sectional study considered all Ontario patients with BCa *(International Classification of Diseases for Oncology,* 3rd edition, code C50) identified in the Ontario Cancer Registry (OCR) and diagnosed from 1 January 2007 to 31 December 2015. Excluded patients were those who were diagnosed on death certificate only, who were less than 18 or more than 105 years of age at diagnosis, whose sex was recorded as male, who were not resident in Ontario at diagnosis, who had less than 6 months of OHIP (Ontario Health Insurance Plan) coverage before diagnosis, who had a previous or concurrent cancer (within 6 months of the BCa diagnosis), who had stage 0 cancer, or who could not be linked across datasets.

Data Sources

This study used population-based administrative databases from ICES (https://www.ices.on.ca/, previously known as the Institute for Clinical Evaluative Sciences), an independent nonprofit research institute funded by the Ontario Ministry of Health. Patient-level data are linked across ICES databases using deterministic linkage and unique encoded identifiers that are based on encrypted Ontario health card numbers and are analyzed at ICES. Supplementary Table 1 describes the ICES data sources used in the present study. A list of BAS institutions, including their institution numbers and opening dates, was provided by Ontario Health (Cancer Care Ontario) and transferred to ICES under the terms of a data-sharing request.

Study Variables

Supplementary Table 2 provides details about the definitions, databases, and variable formats used in the measurement of all study variables. The primary outcome was the duration of the diagnostic interval, defined as days from the earliest BCa-related encounter, called the "index contact," to the diagnosis date[2].

Methods to determine the index contact have been described previously[17]. Briefly, to define the index contact, we first identified all BCa symptom- or procedure-related encounters that were more common in the 3 months preceding compared with the 12–15 months preceding the diagnosis. Next, we used statistical control charts to define lookback periods for each category of BCa-related encounter, keeping only the encounters that had a lookback period signal strength of at least 80%, where "signal strength" represents the proportion of encounters in the lookback period that exceeded the expected number based on the background rate in the 12–15 months before diagnosis. We used the encounter-specific lookback period to identify a patient's earliest BCa-related encounter preceding diagnosis, using the referring physician visit if the earliest encounter was a non-screening procedure. The identified encounter defined the patient's index contact date. The diagnostic interval end date was the OCR diagnosis date.

Secondary outcomes were the duration of the treatment interval (defined as days from the OCR diagnosis date to initial BCa treatment) and the duration of the total interval, defined as days from the index contact to diagnosis or initial treatment, whichever occurred later. "Initial treatment" was the earliest of curative surgery (occurring in the 2 weeks before, to 9 months after diagnosis) or chemotherapy or radiotherapy that occurred in the 9 months after diagnosis. The treatment interval was undefined if initial treatment occurred before the OCR diagnosis date or if no treatment was received.

Patients were defined as being diagnosed at a BAS if they underwent at least 1 biopsy procedure performed in an institution that housed a BAS, or through UC if they underwent biopsies only in institutions that did not house a BAS. If institution data were missing from a patient's OHIP biopsy claims or if there were no OHIP biopsy claims, the patient was defined as being diagnosed at a BAS if mammography was performed at least once in a BAS institution, or through UC if all mammography encounters occurred in non-BAS institutions. Institution numbers on OHIP biopsy and mammography claims were cross-referenced with the BAS institution list to determine whether the institution housed a BAS on the procedure date. The assessment process was defined as "unknown" if a patient's OHIP biopsy and mammography claims had no institution data or if the patient had no OHIP biopsy or mammography claims.

Covariates included the following patient characteristics, measured at the index contact:

- Age, categorized to distinguish between those eligible for population-based BCa screening (ages 50–59, 60–69,

and 70–74 years) and those ineligible for such screening (ages <40, 40–49, ≥75)
- Comorbidity, based on health care encounters in the 2 years before the diagnostic interval index contact and the Aggregated Diagnosis Groups of the Johns Hopkins (Baltimore, MD, U.S.A.) ACG System, version 10
- Neighbourhood income quintile
- Rurality, based on Statistics Canada's census metropolitan-influenced zones and defined as urban [any census metropolitan area (CMA) or census agglomeration (CAG)], rural (any non-CMA or non-CAG with strong metropolitan influence), rural–remote (any non-CMA or non-CAG with moderate metropolitan influence), rural–very remote (any non-CMA or non-CAG with weak or no metropolitan influence), or rural–unknown (any non-CMA or non-CAG with unknown metropolitan influence)[18]
- Recent immigrant status, measured by the number of years in Canada at index contact
- Residence in a long-term care facility

Disease presentation characteristics included TNM stage at diagnosis[19]; first presentation to an emergency department; and detection method, defined as "screen-detected" if the index contact included screening mammography and otherwise as "symptomatic."

Usual health care utilization characteristics measured in the 24 months preceding the index contact included number of health care encounters, including office-based visits, emergency department visits, and hospital admissions; and continuity of primary care based on the Continuity of Care Index[20].

Analysis

We determined whether patients who received care at a BAS differed from those who received UC by using chi-square tests to compare the distributions of patient characteristics, disease presentation characteristics, and usual health care utilization. The diagnostic, treatment, and total intervals were positively skewed, and so quantile regression was used to model their association with the assessment process (BAS or UC)[21]. In quantile regression, the relationship between independent variables and a specified percentile of the outcome variable is modelled. This method is appropriate for use with skewed data when the mean that would be estimated in a linear regression model is not a good measure of the central tendency.

We computed fully adjusted quantile regression models for the 25th, median, 75th, and 90th percentiles of the diagnostic, treatment, and total intervals, with Markov chain marginal bootstrapping to compute the 95% confidence intervals (CIs) for the parameter estimates[22]. The parameter estimates from the quantile regression models indicate the difference in days between BAS-assessed and UC-assessed patients in the percentile of the interval being modelled, with negative estimates denoting shorter intervals for BAS assessment compared with UC assessment. We evaluated whether the relationship between assessment process and interval length was modified by stage at diagnosis, reporting stage-specific parameter estimates for the association between assessment process and interval length when the effect modification was statistically significant ($p < 0.05$).

Sensitivity analyses were performed using a more stringent assessment process definition: BAS categorization if all biopsies and mammography encounters occurred in a BAS institution, UC categorization if all biopsies and mammography encounters occurred in non-BAS institutions, and otherwise unknown. We used chi-square tests to examine variations in the number of health care encounters during the diagnostic interval by assessment process. All analyses were stratified by detection method and performed using the SAS software application (version 9.3: SAS Institute, Cary, NC, U.S.A.).

The use of data in this project was authorized under section 45 of Ontario's Personal Health Information Protection Act, which does not require review by a Research Ethics Board.

RESULTS

We identified 62,333 patients with BCa who met our study population inclusion criteria (Figure 1). Two thirds (n = 41,564, 66.7%) presented with symptoms. Compared with patients in the UC group, those in the BAS group were younger, more likely to live in rural–remote areas, to be non-immigrants, to have lower continuity of care before their index contact date, to have earlier-stage disease, and to be less likely to have unknown-stage disease (Table I). Compared with symptomatic patients receiving UC, symptomatic patients assessed at a BAS were more likely to reside in areas with a higher neighbourhood income.

Across all quantiles of symptomatic and screen-detected BCa cases, with the exception of the 90th percentile in symptomatic cases, the diagnostic interval was shorter for patients

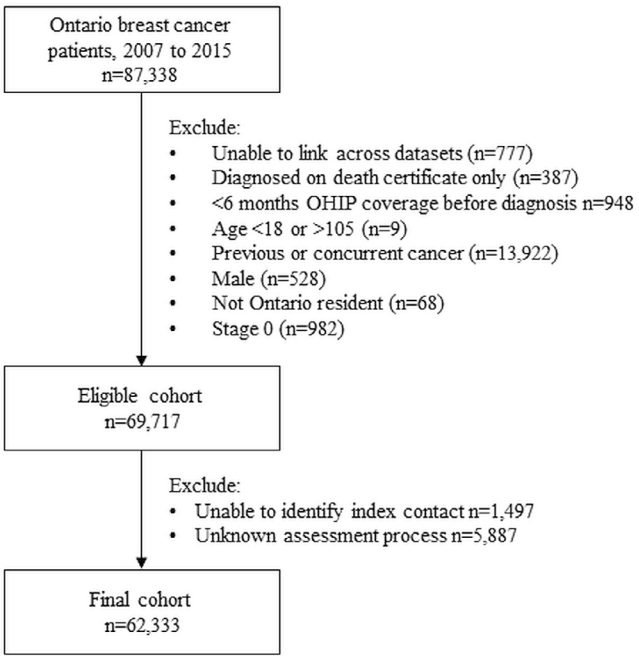

FIGURE 1 Flow diagram of study cohort creation. OHIP = Ontario Health Insurance Plan.

TABLE I Characteristics of the study population by assessment process, stratified by detection method

Characteristic	Symptomatic [% (*n*=41,564)]		Chi-square *p* value	Screen-detected [% (*n*=20,769)]		Chi-square *p* value
	Breast assessment site (*n*=22,009)	Usual care (*n*=19,555)		Breast assessment site (*n*=12,948)	Usual care (*n*=7,821)	
Stage at Dx						
I	32.7	32.7	<0.001	60.0	58.1	0.003
II	42.0	40.1		29.1	29.8	
III	16.4	16.5		7.0	7.3	
IV	5.1	5.5		1.1	1.2	
Unknown	3.8	5.1		2.8	3.7	
First presentation in ED	3.6	3.9	0.1	0.1	0.2	0.02
Age group						
<40 Years	7.1	6.6	<0.001	0.5	0.6	<0.001
40–49 Years	24.0	21.9		4.0	5.7	
50–59 Years	21.7	21.9		33.5	32.8	
60–69 Years	19.0	19.0		39.6	38.2	
70–74 Years	7.5	7.9		14.6	13.4	
≥75 Years	20.7	22.7		7.7	9.4	
Major ADGs						
0	50.3	50.9	0.4	49.7	50.7	0.03
1	29.5	29.3		32.3	31.8	
2	12.4	12.2		12.0	11.9	
3	4.7	4.5		4.2	3.6	
4	1.6	1.7		1.1	1.1	
≥5	0.8	0.7		0.4	0.3	
Unknown	0.5	0.7		0.3	0.6	
Minor ADGs						
0–2	20.1	19.9	0.1	17.7	17.6	0.03
3–5	38.2	37.5		41.0	40.1	
6–10	37.6	38.3		37.7	38.3	
≥11	3.4	3.7		3.3	3.5	
Unknown	0.5	0.7		0.3	0.6	
Neighbourhood income quintile						
1 (lowest)	17.1	17.8	0.03	15.7	16.3	0.8
2	19.3	19.4		19.0	18.8	
3	19.9	19.7		20.1	19.8	
4	21.2	21.9		21.7	22.2	
5 (highest)	22.1	21.0		23.1	22.6	
Unknown	0.3	0.3		0.3	0.3	
Residence						
Urban	88.1	88.5	<0.001	84.1	87.0	<0.001
Rural	4.3	5.9		4.9	6.4	
Rural–remote	5.7	3.0		7.8	3.5	
Rural–very remote, or rural–unknown[a]	1.9	2.5		3.2	3.1	
Immigrant status						
Non-immigrant	86.7	85.7	<0.001	91.8	89.1	<0.001
≥10 Years	9.5	9.4		6.1	8.1	
<10 Years	3.8	4.9		2.0	2.8	
Living in long-term care	1.5	1.7	0.03	0.2	0.3	0.1
Health care encounters 12–36 months before Dx						
0	2.9	3.0	0.04	1.9	2.0	0.05
1	3.5	3.8		2.9	3.0	
2	4.1	3.7		3.6	3.5	
≥3	88.9	88.8		91.3	90.9	
Undefined	0.5	0.7		0.3	0.6	

TABLE I Continued

Characteristic	Symptomatic [% (*n*=41,564)]		Chi-square *p* value	Screen-detected [% (*n*=20,769)]		Chi-square *p* value
	Breast assessment site (*n*=22,009)	Usual care (*n*=19,555)		Breast assessment site (*n*=12,948)	Usual care (*n*=7,821)	
Continuity of Care Index						
>0.75 (high)	49.5	54.0	<0.001	53.8	57.4	<0.001
≤0.75 (low)	43.6	39.2		40.0	37.2	
Undefined	6.9	6.8		6.1	5.4	

[a] Categories combined because of ICES reporting restrictions for small cells (*n*<6).
Dx = diagnosis; ED = emergency department; ADGs =Aggregated Diagnosis Groups (Johns Hopkins, Baltimore, MD, U.S.A.).

in the BAS group than in the UC group (Table II). For patients who were symptomatic, statistically significant adjusted differences were 1.5 to 5.5 days shorter for those assessed at a BAS. For patients whose BCa was screen-detected, statistically significant adjusted differences were 2.8 to 10.9 days shorter for those assessed at a BAS. Stage-specific effect estimates indicated that the assessment process had little effect on the diagnostic interval in patients subsequently diagnosed with stage IV disease. In patients with early-stage disease, particularly those with screen-detected cancer, diagnostic intervals were shorter for patients in the BAS group than for those in the UC group, with adjusted differences of up to 11 days (supplementary Table 3). The association between assessment process and diagnostic interval did not differ substantially in the sensitivity analyses (results not shown).

The treatment interval was longer for patients in the BAS group than for those in the UC group (Table III). Comparing treatment intervals, the adjusted differences (BAS group to UC group) for both symptomatic and screen-detected cases were similar at each percentile. Stage-specific effect estimates indicated that the assessment process had a similar association with the treatment interval across all stage groups (supplementary Table 4). The association between assessment process and treatment interval did not differ substantially in the sensitivity analyses (results not shown).

Differences in the total interval for the BAS and UC groups were small, with maximum adjusted differences of less than 2 days. The exception was at the 90th percentile, in which the total interval for symptomatic cases was 4.1 days longer (95% CI: 0.2 days to 8.0 days) in the BAS group than in the UC group and, for screen-detected cases, 4.0 days shorter (95% CI: –6.6 days to –1.3 days) in the BAS group than i the UC group.

The frequency of encounter types in the diagnostic interval differed by assessment process (Table IV). Compared with patients in the UC group, those in the BAS group had fewer encounters (including primary care encounters), saw fewer providers (including primary care providers and surgeons), and had fewer breast ultrasound encounters and biopsies. In contrast, patients in the BAS group had more encounters with radiologists and more breast magnetic resonance imaging; and symptomatic patients in the BAS group had more diagnostic mammography.

DISCUSSION AND CONCLUSIONS

Ontario's BASs were developed to improve the efficiency of BCa diagnostic care. In the present population-based study, patients assessed at a BAS, compared with those assessed through UC, had shorter diagnostic intervals, but longer

TABLE II Evaluation of the difference in diagnostic interval for patients attending a breast assessment site compared with those receiving usual care

Statistic	Diagnostic interval length (days)			
	Breast assessment site	Usual care	Adjusted difference[a]	95% CI
Symptomatic				
25th percentile	20	21	–1.5	–0.9 to –2.0
Median	39	44	–4.0	–3.2 to –4.9
75th percentile	88	97	–5.5	–3.3 to –7.8
90th percentile	174	173	–0.9	–4.8 to 2.9
Screen-detected				
25th percentile	17	20	–2.8	–2.3 to –3.4
Median	28	34	–5.4	–4.7 to –6.1
75th percentile	45	55	–8.4	–7.1 to –9.7
90th percentile	72	84	–10.9	–8.3 to –13.5

[a] Breast assessment site compared with usual care, adjusted for covariates in Table I.
CI = confidence interval.

TABLE III Evaluation of the difference in treatment interval for patients attending a breast assessment site compared with those receiving usual care

Statistic	Treatment interval length (days)			
	Breast assessment site	Usual care	Adjusted difference[a]	95% CI
Symptomatic				
25th percentile	23	19	4.3	3.9 to 4.7
Median	35	30	4.2	3.8 to 4.7
75th percentile	48	43	4.8	4.1 to 5.4
90th percentile	65	60	5.8	4.7 to 6.9
Screen-detected				
25th percentile	25	22	3.7	3.2 to 4.3
Median	36	31	4.2	3.7 to 4.8
75th percentile	49	44	4.7	3.9 to 5.5
90th percentile	64	58	5.6	4.4 to 6.9

* Breast assessment site compared with usual care, adjusted for covariates in Table I.
CI = confidence interval.

TABLE IV Frequency of health care encounters in the diagnostic interval, by assessment process

Variable	Symptomatic (%)		Chi-square *p* value	Screen-detected (%)		Chi-square *p* value
	Breast assessment site	Usual care		Breast assessment site	Usual care	
Breast-related encounters						
0–3	24.5	18.5	<0.001	19.0	17.9	<0.001
4–6	54.1	52.3		66.5	60.5	
≥7	21.5	29.2		14.6	21.6	
Providers						
0–2	20.0	17.0	<0.001	44.3	35.5	<0.001
3–4	59.0	57.2		44.6	48.9	
≥5	21.1	25.7		11.0	15.6	
Primary care providers						
0	8.4	7.4	<0.001	43.0	33.4	<0.001
1	81.6	81.2		54.4	62.0	
≥2	10.0	11.5		2.7	4.7	
Primary care provider encounters						
0	8.4	7.4	<0.001	43.0	33.4	<0.001
1–2	75.9	73.6		52.5	59.1	
≥3	15.7	19.0		4.6	7.5	
Surgeons						
0	62.7	41.0	<0.001	75.3	51.0	<0.001
1	33.6	54.4		22.8	46.8	
≥2	3.7	4.6		1.9	2.3	
Radiologists						
0	2.1	3.5	<0.001	2.5	3.6	<0.001
1	28.1	31.8		29.9	36.4	
≥2	69.8	64.8		67.6	60.0	
Diagnostic mammography						
0	19.1	21.1	<0.001	37.5	37.1	0.05
1	57.1	59.0		42.9	44.5	
≥2	23.8	19.9		19.5	18.4	
Breast ultrasonography						
0	7.2	9.9	<0.001	24.6	18.7	<0.001
1	42.6	37.9		44.2	39.8	
≥2	50.2	52.2		31.2	41.4	
Breast magnetic resonance imaging						
0	93.3	96.5	<0.001	95.5	97.3	<0.001
≥1	6.7	3.5		4.5	2.7	
Breast biopsy						
0	5.6	8.0	<0.001	10.3	9.5	<0.001
1	72.9	66.1		73.3	66.2	
≥2	21.5	25.9		16.4	24.3	

treatment intervals. Differences in the total interval by assessment process were small, likely because of the opposing effects of the assessment process on the diagnostic and treatment intervals that constituted the total interval. Diagnostic intervals were shorter for screen-detected cases than for symptomatic cases. That finding is largely a function of the different start times for the interval, which, for screen-detected cases, was the date of the abnormal screening mammogram and, for symptomatic cases, was a symptom-related encounter, thereby including in the interval length the time from the first symptom-related encounter to the first diagnostic mammogram.

Previous research supports our finding of a shortened BCa diagnostic interval for patients assessed at a BAS[12,13,15,16,23]. Initiatives similar to a BAS in other jurisdictions have also demonstrated a positive impact on diagnostic interval timeliness[24–26]. A Nova Scotia study demonstrated that patient navigation, which included

facilitating appointments and procedures, was associated with a 6-day decrease in the median BCa diagnostic interval[27]. British Columbia's Rapid Access Breast Clinic offers a structure similar to the Ontario BASs and has been shown to shorten the time from first presentation to surgical consultation by 23 days for patients ultimately diagnosed with BCa[28,29]. Internationally, fast-track referral pathways, such as the 2-week-wait referral in the United Kingdom and standardized cancer patient pathways in Denmark, support timely diagnostic evaluation through wait time targets and guidelines for expediting urgent referrals[30–33]. Those findings suggest that coordinated care and patient navigation can shorten the BCa diagnostic interval. The present study adds new knowledge to that literature by demonstrating that the shorter diagnostic intervals in patients assessed at a BAS might at least in part be achieved through greater efficiencies in diagnostic processes. Patients in the BAS group had fewer breast-related encounters overall and fewer breast ultrasound encounters and biopsies within the diagnostic interval, which might reflect greater adherence to provincial guidelines for the BCa diagnostic pathway, which promotes a streamlined approach to biopsy and diagnosis, even before surgical assessment[34].

In contrast to our hypotheses, diagnosis at a BAS was associated with a longer treatment interval. To our knowledge, no previous research has examined the association between assessment at a BAS and the length of the treatment interval. We hypothesize several mechanisms that might explain why treatment intervals were longer in the BAS group than in the UC group and that warrant investigation in future research. It is possible that the facilitated access to imaging and specialist consultation within the BASs might be resulting in greater use of staging investigations such as breast magnetic resonance imaging or multidisciplinary consultation for treatment planning before initiation of treatment, thereby lengthening treatment wait times. Another possibility is that rather than extra staging investigations being conducted in the BAS group, staging investigations are instead being shifted from the diagnostic interval to treatment interval for patients in the BAS group. Such a shift would explain the reduced activity observed in the diagnostic interval for the BAS group and the finding of no difference in the total interval for the BAS and UC groups. Further investigation is warranted to better understand the finding of longer treatment intervals in patients assessed at a BAS, because that observation is in contradiction with the objectives of such programs.

The maximum observed differences in the diagnostic, treatment, and total intervals were small and unlikely to contribute to differences in stage at diagnosis or in survival. However, the goal of a BAS is not only to provide timely care and to improve outcomes, but also to improve the patient experience. The waiting period for diagnosis and treatment is anxiety-provoking, and reducing that waiting period might help to improve the psychological well-being of patients[8,35–37]. The support provided through BASs, including patient navigation, can reduce anxiety even if not accompanied by shorter diagnostic or treatment intervals[38]. Future research should explore the effect of assessment at a BAS on patient-reported outcome and experience measures, including anxiety and satisfaction with care.

Our study had several strengths. First, it was population-based, thereby providing an assessment of BAS effectiveness in all patients and avoiding any selection bias that might result when selected (and possibly higher-performing) institutions report their findings. Second, our analyses were stratified by detection method in recognition of the differences in care organization for screen-detected compared with symptomatic BCa. Larger differences in the diagnostic interval were observed for patients with screen-detected compared with symptomatic cancer when the assessment occurred at a BAS, potentially indicating that BASs might be more effective when their care is delivered in conjunction with the structure of the formal screening program.

Our study also had several limitations. We assigned patients to assessment process groups based on the assumption that those who received care in an institution that housed a BAS received care at the BAS. Violations of that assumption could dilute the BAS effect. However, our sensitivity analyses used a more conservative definition for assigning patients to an assessment group and did not produce substantially different results. Patients with an unknown assessment process were excluded from the analysis; compared with the final study population, those patients had a shorter median diagnostic interval (29 days). Patients for whom we could not identify an index encounter were also excluded from the analysis. That group had overrepresentation of patients with late- and unknown-stage disease (40%), and therefore, compared with the final study population, they likely also had shorter diagnostic intervals. In the analysis of the treatment interval, patients with an undefined treatment interval were excluded ($n = 2469$, 4.0%). Those patients included individuals who either received no treatment ($n = 2393$, 3.8%) or whose initial treatment occurred before diagnosis ($n = 76$, 0.1%). The missing data that prevented the determination of an interval is expected to be independent of assessment process. Those exclusions are therefore not expected to have resulted in selection bias. Finally, we excluded male patients with BCa. We expect that diagnostic processes and diagnostic intervals would differ for male and female patients with BCa, and we did not have a sufficient number of male patients with BCa to conduct the analyses required to identify the BCa index encounter for male patients.

Diagnostic intervals were shorter and encounter frequencies within the interval were lower for patients with BCa diagnosed through a BAS. At the same time, diagnosis at a BAS was associated with a longer treatment interval. A more thorough understanding of the benefits of BASs can be gained through further study of the diagnostic and treatment intervals in patients diagnosed through these specialized programs, together with a consideration of other relevant outcomes, including the patient experience.

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Canadian Institute for Health Information (CIHI). However, the analyses, conclusions, opinions, and statements expressed in the material are those of the authors, and not necessarily those of CIHI. Parts of this material are based on data and information provided by Ontario Health (Cancer Care Ontario) [OH(CCO)]. The opinions, results, views, and conclusions reported in this paper are those of the authors and do not necessarily reflect those of OH(CCO). No endorsement by OH(CCO) is intended or should be inferred. Parts of this material are based on data or information compiled and provided by Immigration, Refugees and Citizenship Canada (IRCC). However, the analyses, conclusions, and opinions expressed herein are those of the authors and not necessarily those of IRCC.

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DATA SHARING

The dataset from this study is held securely in coded form at ICES. Although data-sharing agreements prohibit ICES from making the dataset publicly available, access may be granted to those who meet pre-specified criteria for confidential access, available at https://www.ices.on.ca/DAS. The full dataset creation plan and underlying analytic code are available from the authors upon request, understanding that the computer programs might rely on coding templates or macros that are unique to ICES and might therefore either be inaccessible or require modification.

CONFLICT OF INTEREST DISCLOSURES

We have read and understood *Current Oncology*'s policy on disclosing conflicts of interest, and we declare that we have none.

AUTHOR AFFILIATIONS

*The Ottawa Hospital Research Institute and Bruyère Research Institute, Ottawa, †ICES Queen's, Kingston, ‡Ontario Health (Cancer Care Ontario), Toronto, §Department of Surgery, University of Toronto, Toronto, and ||Division of Cancer Care and Epidemiology, Queen's Cancer Research Institute, and Department of Public Health Sciences, Queen's University, Kingston, ON.

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