Screen *for* Life

Cancer screening sees what you can't

- Breast
- Cervical
- Colorectal

Ontario **Breast Screening Program**

2011 Report

Ontario

Cancer Care Ontario

Action Cancer Ontario

Contents

Ontario Breast Screening Program 2011 Report

Ontario
Cancer Care Ontario
Action Cancer Ontario

Acknowledgements

The *Ontario Breast Screening Program 2011 Report* was prepared by the Evaluation and Reporting Unit, Cancer Screening; Policy, Knowledge Translation and Exchange (KTE), and Primary Care Unit; and the Prevention and Surveillance Unit in the Prevention and Cancer Control Portfolio at Cancer Care Ontario.

The analysis for the report was led by **Anna M. Chiarelli PhD**, Scientific Lead for the Ontario Breast Screening Program (OBSP) and Senior Scientist, Prevention and Cancer Control. This report also benefited from the guidance of the OBSP's Radiologist-in-Chief, **Derek Muradali MD FRCPC.**

Core team members from the Evaluation and Reporting Unit, Cancer Screening included:
Jason Garay, Director
Joanne Hader, Senior Manager
Julia Gao, Manager, Analytics
Violet (Vicky) Majpruz, Senior Research Associate
Jenny Zhan, Project Coordinator

The core team members from the Prevention and Surveillance Unit were:
Beth Theis, Staff Scientist and Manager
Sandrene Chin Cheong, Junior Research Associate

The core team member from the Policy, Knowledge Translation and Exchange (KTE), and Primary Care Unit was **Meaghan Horgan**, Senior Lead, Policy and Guidelines.

For more information about the program or to find an OBSP site, call **1.800.668.9304** or visit **www.cancercare.on.ca/obsplocations.**

Message from Dr. Linda Rabeneck, Dr. Anna Chiarelli and Dr. Derek Muradali

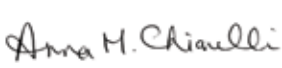
As the most frequently diagnosed cancer and the second leading cause of cancer deaths among Ontario women in 2012, breast cancer continues to have significant impact on Ontarians.

The key aim for the Ontario Breast Screening Program (OBSP) is the reduction of mortality from breast cancer through the delivery of evidence-based, high-quality screening. Regular breast cancer screening finds cancers when they are small and less likely to have spread. Therefore, early detection means that most women have more treatment options, a reduced chance of cancer recurrence and improved survival. From the time the program was launched in 1990 to March 2013, the OBSP provided more than 5.0 million mammograms to over 1.4 million women and detected more than 26,000 breast cancers, the majority in early stages.

The OBSP has undergone some significant changes since the release of the *Ontario Breast Screening Program 20th Anniversary Report 1990–2010*, which reported on program performance from 1990 to 2010. For example, performance data from the OBSP High Risk Screening Program are presented for the first time in this 2011 report. The results to date suggest that this new program is achieving the expected benefit of screening with annual MRI and digital mammography for high risk women in our target population. This report also highlights the OBSP's strengths and identifies areas of focus for future improvement.

The OBSP continues to monitor new evidence and review the results of our program evaluation in order to improve the quality, effectiveness and delivery of its breast cancer screening and assessment services to Ontario women. Together with our partners at the Ministry of Health and Long-Term Care, we are working to reduce the burden of breast cancer.

Linda Rabeneck MD MPH FRCPC
Vice-President, Prevention and Cancer Control, Cancer Care Ontario



Anna Chiarelli PhD
Scientific Lead, Ontario Breast Screening Program, Cancer Care Ontario

Derek Muradali MD FRCPC
Radiologist-in-Chief, Ontario Breast Screening Program, Cancer Care Ontario

Executive Summary

BURDEN OF DISEASE

Breast cancer was the most frequently diagnosed cancer in Ontario women in 2012, and ranked second only to lung cancer among causes of cancer deaths. Breast cancer risk increases with age and peaks at ages 70 to 74. Mortality is relatively low before age 60. From 1990 to 2009, breast cancer incidence has remained stable in Ontario and breast cancer mortality has decreased.

ONTARIO BREAST SCREENING PROGRAM

The Ontario Breast Screening Program (OBSP) is a province-wide, organized breast cancer screening program that provides high-quality breast cancer screening services for women at average risk for breast cancer aged 50 to 74 years and for women at high risk for breast cancer aged 30 to 69 years.

The OBSP was announced in 1990 and has developed into a provincial program that provides high-quality, regular breast cancer screening and assessment services. In 2010, the program celebrated its 20th anniversary. In 2011, the program expanded to provide women aged 30 to 69 years who are at high risk for breast cancer with annual screening using mammography and magnetic resonance imaging (MRI). To our knowledge, Ontario was the first jurisdiction in the world to incorporate a specific protocol for women at high risk for breast cancer in an organized screening program.

From the time the program was launched in 1990 to March 2013, the OBSP provided more than 5.0 million mammograms to over 1.4 million women and detected more than 26,000 breast cancers, the majority in early stages.

PROGRAM EVALUATION FRAMEWORK

Since its inception, the OBSP's evaluation framework and indicators have aligned with national and international frameworks. The indicator results in this report are grouped into five domains: coverage, follow-up, quality of screening, detection and disease extent at diagnosis. The evaluation framework has undergone continuous development as the program has matured.

PROGRAM RESULTS

OBSP Clients at Average Risk for Breast Cancer

Participation: The OBSP participation rate for women aged 50 to 74 increased from 40.1% in 2008–2009 to 43.2% in 2010–2011. In 2009, 74.5% of women receiving an initial program screen and 88.0% of women with subsequent program screens were rescreened within 30 months of their previous screen date. In 2010–2011, 71.1% of Ontario women aged 50 to 74 who underwent screening mammography had a mammogram through an OBSP site.

Follow-Up: Overall, the percentage of women who were diagnosed within the five week target and did not require a tissue biopsy increased from 83.7% in 2008 to 86.2% in 2011. The percentage of women who were diagnosed within the seven week target and did require a tissue biopsy increased from 57.0% in 2008 to 64.0% in 2011. OBSP diagnostic wait times decreased with increasing age for women not requiring a tissue biopsy. A greater proportion of women aged 70 to 74 received a timely diagnosis (88.6%) than women aged 50 to 54 (84.9%). For women requiring a tissue biopsy, the greatest proportion of them who received a timely diagnosis was those aged 65 to 69 (65.9%).

Quality of Screening: OBSP sensitivity remained relatively high over time and was 86.1% in 2009. Therefore, 13.9% of women diagnosed with breast cancer within one year after their OBSP screen date did not have their breast cancer detected by the program. The OBSP specificity also remained relatively high over time and was 93.1% for 2009. Therefore, 6.9% of women without breast cancer had an abnormal mammogram (false-positive) result.

Detection: The invasive cancer detection rate has decreased slightly for initial program screens (from 5.0 per 1,000 in 2008 to 4.6 per 1,000 in 2010), and has increased slightly for rescreens (from 3.6 per 1,000 in 2008 to 3.9 per 1,000 in 2010). The invasive breast cancer rate increased with age for both initial screens (from 3.5 per 1,000 for women aged 50 to 54 to 8.0 per 1,000 for women aged 70 to 74) and rescreens (from 2.1 per 1,000 for women aged 50 to 54 to 6.1 per 1,000 for women aged 70 to 74). Older women have a higher breast cancer incidence rate and therefore benefit more from screening.

Disease Extent at Diagnosis: The percentage of stage I invasive breast cancers remained relatively stable over time and was 62.2% in 2010. The proportion of women with early stage tumours is greater in older women than younger women, with 52.1% of stage I tumours being detected in women aged 50 to 54, compared with 67.3% in women aged 65 to 69 and 65.3% in women aged 70 to 74.

OBSP Clients at High Risk for Breast Cancer

Of the 2,359 screen-eligible women, 2,207 (93.6%) have been screened with at least an MRI (or ultrasound). Of those 2,207 women, 611 (27.7%) had an abnormal screen and 2,150 had a final result (97.4%). Thirty-five cancers were detected that resulted in a positive predictive value of 6.3% and a cancer detection rate of 16.3 per 1,000. Of the 35 cancers detected, eight were ductal carcinoma in situ (DCIS) (22.9%) and 27 were invasive (77.1%).

Of the 35 breast cancers detected, none were detected by a mammogram alone, 23 were detected by magnetic resonance imaging (MRI) alone (10.7 per 1,000) and 12 were detected by a combination of MRI and mammogram (5.8 per 1,000). These results may be explained by the higher sensitivity of MRI compared to mammography for women at high risk for breast cancer.

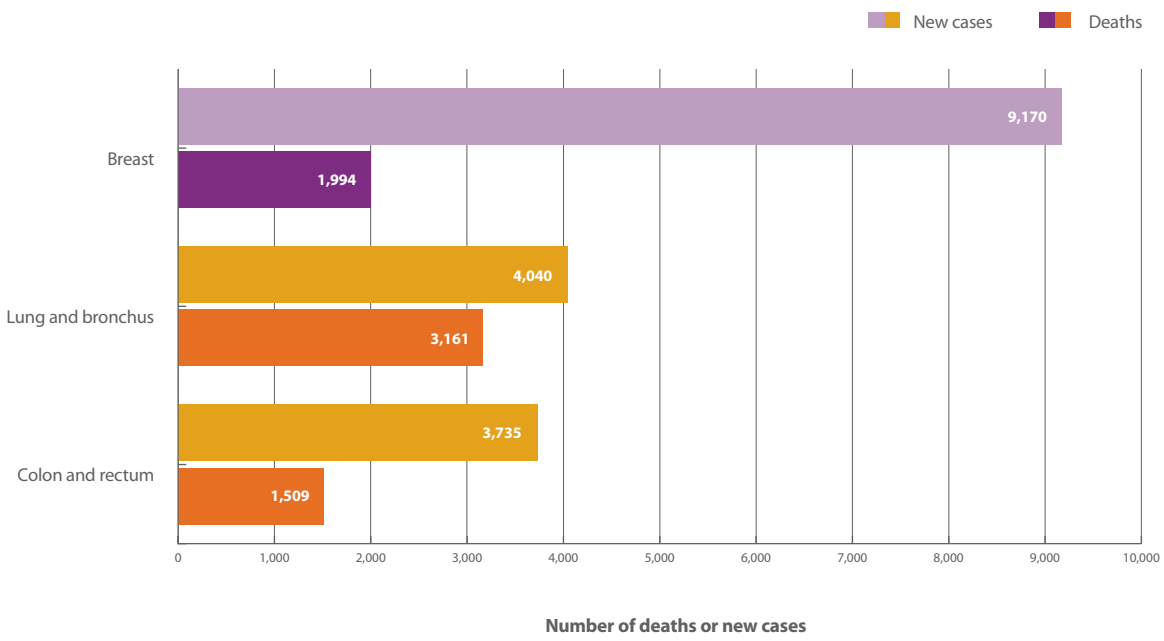
SUMMARY

The OBSP has celebrated many successes since its launch in 1990, including strong performance on key program indicators, the recent expansion of the program to include screening services for women at high risk for breast cancer, the continued development of its robust quality assurance program, and its ongoing recruitment of new screening and assessment sites.

Despite its successes, the OBSP recognizes that there are still challenges to overcome. The OBSP continues to work with Regional Cancer Programs, screening sites and assessment sites to improve OBSP performance and effectiveness. Additional areas of focus for the program include increasing screening participation, improving wait times from the time a woman receives an abnormal screen to diagnosis, continuing to improve the quality of breast cancer screening, and continuing to conduct research that will impact program design and delivery.

Burden of Disease

FIGURE 1 | Annual number of deaths and new cases for most common cancers in women, Ontario, 2012

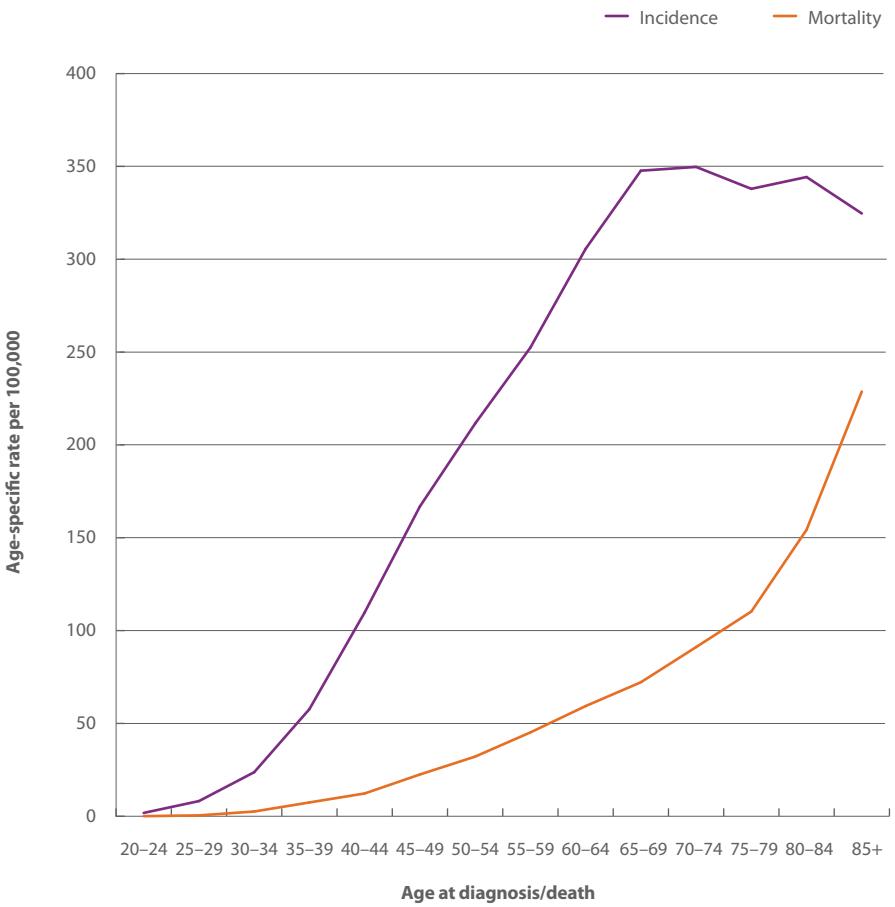


Data Source: Ontario Cancer Registry

Breast cancer was the most frequently diagnosed cancer in Ontario women in 2012, with an estimated 9,170 cases. Breast cancer ranked second only to lung cancer among causes of cancer deaths in women, with an estimated 1,994 deaths. (All incidence and mortality numbers and rates in this section refer to invasive cases of breast or other cancers.)

The prevalence of breast cancer is just under 1.0%. By the beginning of 2010, for example, approximately 63,000 Ontario women had been diagnosed with breast cancer in the preceding 10 years.

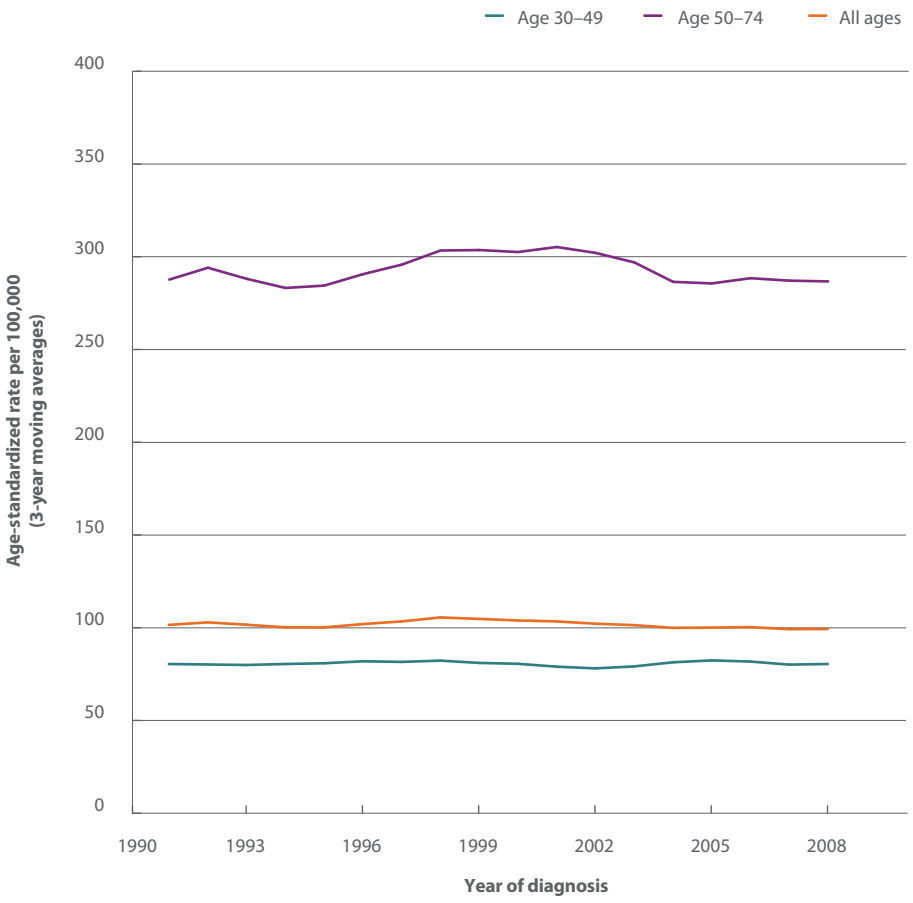
FIGURE 2 | Breast cancer incidence and mortality rates*, Ontario, 2005–2009, by age



Note: *Crude rates per 100,000.
Data Source: Ontario Cancer Registry

Breast cancer risk increases with age and peaks at ages 70 to 74. Mortality is relatively low before age 60. Median age at diagnosis was 60 and median age at death was 70 during the 2005 to 2009 period.

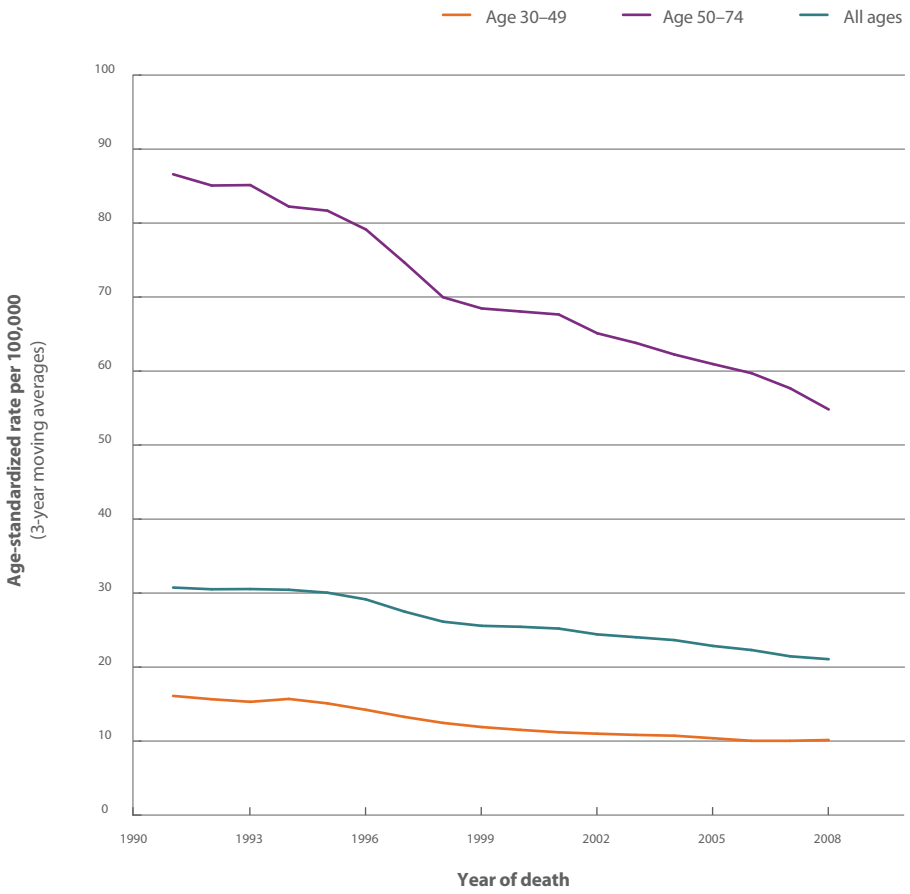
FIGURE 3 | Breast cancer incidence rates*, Ontario, 1990–2009



Note: *Rates are per 100,000 and standardized to the age distribution of the 1991 Canadian population.
Data Source: Ontario Cancer Registry

Breast cancer incidence rates were stable from 1990 to 2009 for women aged 50 to 74 (with 2009 incidence at 285.6 per 100,000), for younger women aged 30 to 49 (at 81.6 per 100,000 in 2009), and for women of all ages (with 2009 incidence at 99.8 per 100,000).

FIGURE 4 | Breast cancer mortality rates*, Ontario, 1990–2009

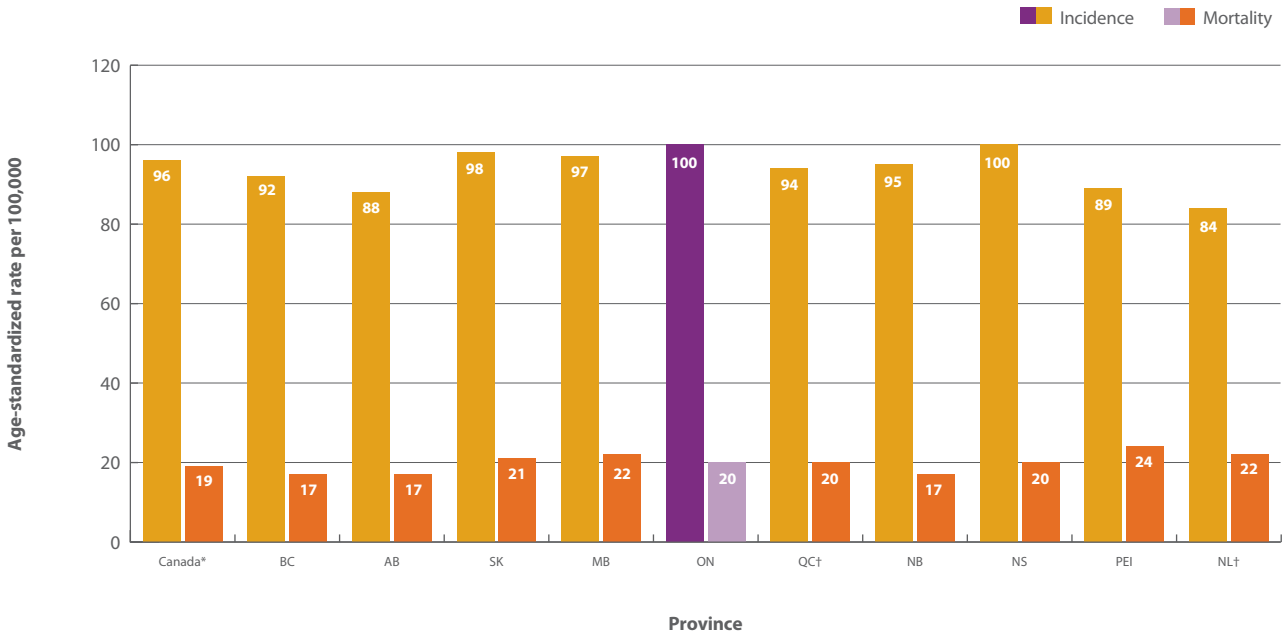


Note: *Rates are per 100,000 and standardized to the age distribution of the 1991 Canadian population.
Data Source: Ontario Cancer Registry

Between 1990 and 2009, breast cancer mortality declined by 36.7% for women aged 50 to 74, by 37.0% for younger women aged 30 to 49, and by 31.5% for women of all ages.

Stable incidence rates, especially among women aged 50 to 74 and older, may reflect relatively small increases in the proportion of Ontario women screened for breast cancer. The decline in mortality rates is likely due both to improved breast cancer treatment and to increased participation in breast cancer screening.

FIGURE 5 | Estimated breast cancer incidence and mortality rates across Canada by province, 2012



Note: *Canada totals include provincial and territorial estimates.
†The actual data used to calculate projected 2012 estimates were underestimated for some cancers for this province.
Data Source: Canadian Cancer Society's Steering Committee on Cancer Statistics. Canadian Cancer Statistics 2012. Toronto, ON: Canadian Cancer Society; 2012.

Female breast cancer incidence rates are fairly consistent across the country, with no discernible geographic pattern. Estimated 2012 rates for Ontario are among the highest compared with other provinces.

RISK FACTORS FOR BREAST CANCER

One in nine Canadian women will develop breast cancer in her lifetime[1]. As women age, the chance of developing breast cancer increases. In fact, age is the single most important risk factor for breast cancer, with age-specific incidence rising steeply with increasing age, peaking soon after age 70. In Ontario, 77.1% of breast cancers are found in women aged 50 and older, and over half of breast cancers occur in women aged 50 to 74.

A history of benign breast disease of a specific high risk type (e.g., atypical ductal hyperplasia, lobular carcinoma in situ) and/or having dense breasts on a mammogram, are associated with substantial increases in risk[2,3].

Most other known risk factors, while important at a population level, are modest in magnitude of risk. Many are hormone-related. Several reproductive factors are associated with modest elevations in risk: delayed childbearing, lower parity (fewer live births), early age at menarche (onset of menstrual periods) and late age at menopause[4]. Longer duration of breastfeeding reduces risk[5]. Exogenous hormones also increase risk: current or recent postmenopausal hormone replacement therapy and oral contraceptive use[6,7]. Reproductive and hormonal behaviours in particular may contribute to the observed higher risk for women of higher socioeconomic class and women born in more developed countries[8].

Several behavioural and nutritional factors modify risk. Alcohol consumption increases risk[5], as do body fatness and probably abdominal fatness and adult weight gain, which increase the risk specifically of postmenopausal breast cancer (while body fatness likely decreases the risk of premenopausal breast cancer)[5]. Greater adult height is associated with higher risk of postmenopausal and probably premenopausal breast cancer because it is a marker for genetic, environmental, hormonal and nutritional factors affecting growth[5]. High birth weight probably increases the risk of premenopausal breast cancer[5]. Physical activity probably decreases the risk of postmenopausal breast cancer[5]. Two major consensus panels have not concluded that smoking or second-hand smoke exposure are risk factors for breast cancer, although some consensus panels have drawn different conclusions[9,10,11,12].

Exposure to ionizing radiation early in life increases the risk of breast cancer, but is not a common risk factor[13]. Diabetes increases risk[14,15], and aspirin use is associated with a slightly reduced risk of breast cancer[16].

Breast cancer in first-degree relatives increases risk; familial breast cancer potentially involves multiple genes, multiple exposures and gene-environment interactions[17]. Known genetic mutations carry substantially increased risk, but appear to account for a small proportion of breast cancer cases[14].

THE EVIDENCE FOR BREAST CANCER SCREENING

Regular mammography continues to be the best screening approach for the early detection of breast cancer, and is recommended for women aged 50 to 74 by the Canadian Task Force on Preventive Health Care[18]. Breast cancer screening finds cancers when they are small and less likely to have spread. Early detection means that most women have more treatment options, a reduced chance of cancer recurrence and

improved survival. Both routine screen-film and digital mammography using direct radiography (DR) technology are effective in women aged 50 to 74 for the early detection of breast cancer[19,20]. Annual screening with MRI in addition to mammography is recommended for women aged 30 to 69 confirmed to be at high risk for breast cancer[21].

Between 1990 and 2009, breast cancer mortality declined by 36.7% for women aged 50 to 74, by 37.0% for younger women aged 30 to 49, and by 31.5% for women of all ages. This reduction may be the result of better treatments, increased screening with mammography and a decline in breast cancer incidence in the early 2000s.

In Ontario, five-year relative survival for breast cancer increased from 84.0% during the 1995–1999 time period to 87.3% during the 2005–2009 time period[22].

BALANCING THE BENEFITS AND HARMS OF BREAST CANCER SCREENING

The Ontario Breast Screening Program (OBSP) is an evidence-based organized breast cancer screening program. Processes and outcomes are continually evaluated against national and international benchmarks. Based on this evaluation, program changes may be required to improve overall program effectiveness and to maximize the benefits of screening while minimizing harm.

It has been clearly demonstrated that mammography is the best method for the early detection of breast cancer and that there is a mortality benefit from routine mammography screening in women over the age of 50.

However, mammography is not a perfect test. It may miss some breast cancers (false-negatives) and the false-positives (abnormal screens that result in benign diagnoses) that do occur may lead to additional (unnecessary) imaging and biopsies. Also, some cancers develop in the time between screens, which are called interval cancers. This is one of the reasons that regular screening is important. In addition, over-diagnosis can occur because current diagnostic tests cannot accurately distinguish breast cancers that will progress from those that will not. Consequently, some women may receive surgery and treatment for a breast cancer that would never have been life-threatening. A large proportion of dense breast tissue (≥ 75.0%) reduces the sensitivity of mammography, is associated with a higher rate of interval cancers and is one of the reasons for reduced screening efficacy in women younger than 50 years[23,24,25]. Finally, not all cancers found at screening can be cured.

In order to minimize the harms associated with screening, the OBSP has a robust quality assurance and performance monitoring framework. All OBSP sites are accredited by the Canadian Association of Radiologists' Mammography Accreditation Program (CAR-MAP). Developed in 1998, CAR-MAP guidelines are national in scope and specific to screening and diagnostic mammography services. The guidelines cover radiologist and medical radiation technologist (MRT) qualifications, equipment, quality control, quality assurance, image quality and radiation dose. CAR-MAP accreditation is renewed every three years and is available to any facility providing mammography services. Annual performance feedback, compared against national quality standards and targets, is also provided to all OBSP screening and assessment sites and to individual reading radiologists.

The Ontario Breast Screening Program

The Ontario Breast Screening Program (OBSP) is a province-wide, organized breast cancer screening program that provides high-quality breast cancer screening services.

The program screens two groups of women: women at average risk for breast cancer aged 50 to 74, for whom biennial mammography is recommended, and women at high risk for breast cancer aged 30 to 69, who are screened with mammography and magnetic resonance imaging (MRI) on an annual basis.

In July 2011, the OBSP expanded to include high risk screening services for eligible women aged 30 to 69. This expansion was supported by clinical practice guidelines that indicated that women at high risk for breast cancer would benefit from annual screening with mammography and MRI within the context of an organized screening program[21]. To our knowledge, Ontario was the first jurisdiction in the world to include women at high risk for breast cancer in an organized screening program. Women are eligible for high risk screening through the OBSP if they meet at least one of the following four criteria: 1) are known to be carriers of a deleterious gene mutation; 2) are the first-degree relative of a mutation carrier and have declined genetic testing; 3) have a family history that indicates a lifetime risk of breast cancer that is ≥ 25.0% confirmed through genetic assessment; 4) have received radiation therapy to the chest before age 30 and at least eight years previously.

As an organized cancer screening program, the OBSP recalls women when they are due for screening, notifies women of their screening results, and helps women with abnormal screens navigate as they move through the diagnostic phase. Screening services are delivered at hospitals and independent health facilities (IHFs) affiliated with the OBSP. As of May 2013, more than 71.0% of all breast cancer screening for women aged 50 to 74 occurred within the OBSP, at one of 165 OBSP screening sites (66 are IHFs and 99 are hospitals). Two of these centres are mobile screening coaches that provide screening services to women in remote locations. The coaches visit dozens of communities in Northwestern Ontario and in the Hamilton Niagara Haldimand Brant Local Health Integration Network (LHIN). Twenty-eight of the OBSP screening sites offer high risk screening services to eligible women; at least one OBSP high risk screening centre is located in each region across the province.

In addition to OBSP screening sites, OBSP breast assessment sites ensure a timely, coordinated approach to the assessment of breast abnormalities for women with abnormal screen results, through the use of navigators and streamlined referrals.

Program Evaluation

PROGRAM EVALUATION FRAMEWORK

Initial program evaluation work included a review of existing frameworks and indicators from other jurisdictions. The decision was made to align the program evaluation with national and international frameworks and indicators to facilitate comparison. This report presents program mammography indicators for the target population of women aged 50 to 74, with outcomes for women aged 50 to 69 reported in all figures by age group and in *Table 2* to facilitate comparison with national targets.

The Ontario Breast Screening Program (OBSP) adapted the Canadian Partnership Against Cancer's (CPAC) quality determinants framework for program evaluation[26]. The evaluation framework groups indicators into five domains: coverage, follow-up, quality of screening, detection and disease extent at diagnosis.

Appendix B provides methodology details, and *Appendix E* provides additional results by Ontario health regions (Local Health Integration Networks or LHINs) that also align with Regional Cancer Program boundaries.

In this program report, results for the following indicators are included:

Coverage:

- Participation Rate
- Retention Rate

Follow-Up:

- Abnormal Call Rate
- Diagnostic Interval

Quality of Screening:

- Positive Predictive Value
- One-Year Sensitivity and Specificity

Detection:

- Ductal Carcinoma In Situ (DCIS) Breast Cancer Detection Rate
- Invasive Breast Cancer Detection Rate

Disease Extent at Diagnosis:

- Early Stage Invasive Breast Cancer Detection Rate

Note: numbers represented in tables, figures and text have been rounded to one decimal place. As a result some numbers may not add up.

CHARACTERISTICS OF WOMEN/SCREENING VOLUMES/SCREENING OUTCOMES — FOR OBSP CLIENTS AT AVERAGE RISK FOR BREAST CANCER

TABLE 1 | Client profile, 2008–2011, ages 50–74, by calendar year

Total number of women screened	401,725	436,536	467,531	488,716
CALENDAR SCREEN YEAR	**2008**	**2009**	**2010**	**2011**
	N (%)	**N (%)**	**N (%)**	**N (%)**
Family history of breast cancer[1]				
Yes (%)	66,435 (16.5)	72,898 (16.7)	78,834 (16.9)	84,293 (17.2)
No (%)	335,290 (83.5)	363,638 (83.3)	388,697 (83.1)	404,423 (82.8)
Mammographic breast density[2]				
≥ 75% (%)	39,779 (9.9)	42,721 (9.8)	45,961 (9.8)	47,659 (9.8)
< 75% (%)	361,946 (90.1)	393,815 (90.2)	421,570 (90.2)	441,057 (90.2)
Number of children (including stillborn)				
None (%)	53,334 (13.3)	59,097 (13.5)	64,669 (13.8)	68,716 (14.1)
≥ 1 (%)	348,066 (86.7)	377,087 (86.5)	402,385 (86.2)	419,387 (85.9)
# Unknown (N)	325	352	477	613
Age at first child birth (including stillborn)				
≥ 30 (%)	49,259 (14.2)	55,885 (14.9)	61,860 (15.4)	67,808 (16.2)
< 30 (%)	298,062 (85.8)	320,355 (85.1)	339,397 (84.6)	350,428 (83.8)
N/A (No children)	53,334	59,097	64,669	68,716
# Unknown (N)	1,070	1,198	1,605	1,764
Estrogen use				
Yes (%)	35,765 (9.0)	36,674 (8.5)	37,245 (8.0)	37,067 (7.7)
No (%)	362,088 (91.0)	395,516 (91.5)	425,867 (92.0)	446,530 (92.3)
# Unknown (N)	3,872	4,346	4,419	5,119

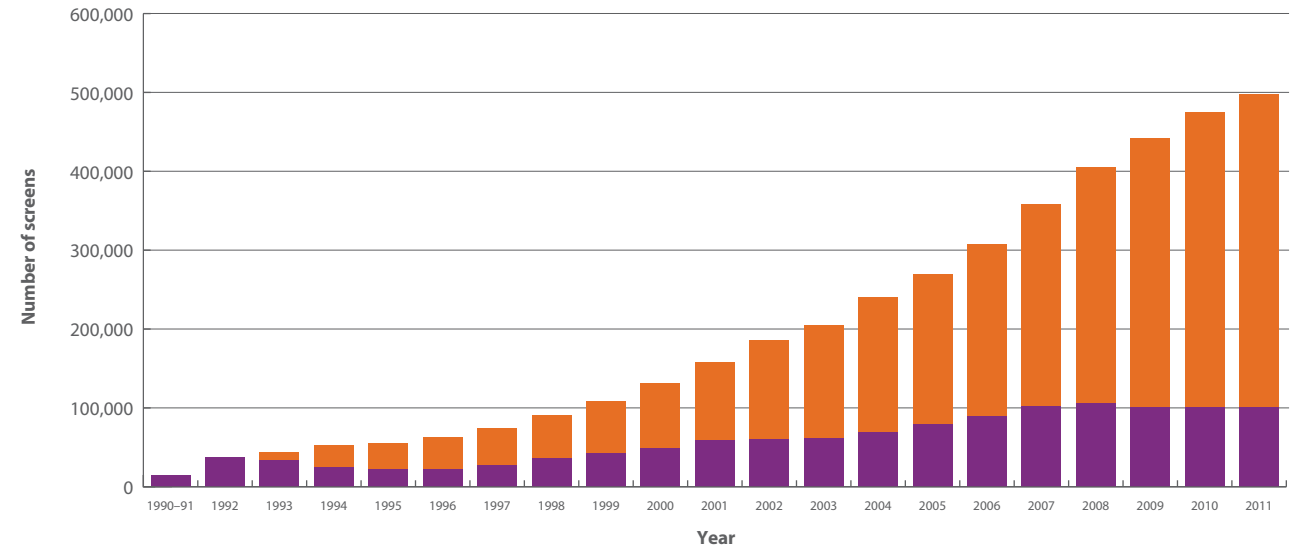
1. Family history of breast cancer includes breast cancer in first-degree relatives (mother, sister, daughter, father, brother, son who are blood relatives).
2. The proportion of connective tissue and epithelial tissue as opposed to fat.

Data Source: Integrated Client Management System

Table 1 shows the prevalence of breast cancer risk factors among OBSP clients at average risk for breast cancer. During the screening visit, relevant breast cancer risk factors and clinical information are obtained during a personal interview. Mammographic breast density is indicated by the reading radiologist when recording the findings from the screening mammogram.

The percentage of women with high mammographic breast density remained stable at around 10.0%. A slightly higher proportion of women reported a family history of breast cancer (17.2% in 2011), not having any children (14.1% in 2011) and having first children at age 30 or older (16.2% in 2011).

FIGURE 6 | Number of OBSP screens, 1990–2011, ages 50–74, by screen type and calendar year, for OBSP clients at average risk for breast cancer



	1990–91	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Rescreens		557	9,422	27,227	32,279	41,035	46,501	54,791	66,176	83,467	99,431	124,891	143,812	171,303	190,877	217,940	255,298	299,256	340,941	374,116	397,533
Initial screens	15,141	37,225	33,703	24,951	22,308	21,721	27,699	35,731	42,143	48,491	58,483	60,552	61,112	68,636	79,237	89,291	102,646	106,181	101,091	100,717	100,490

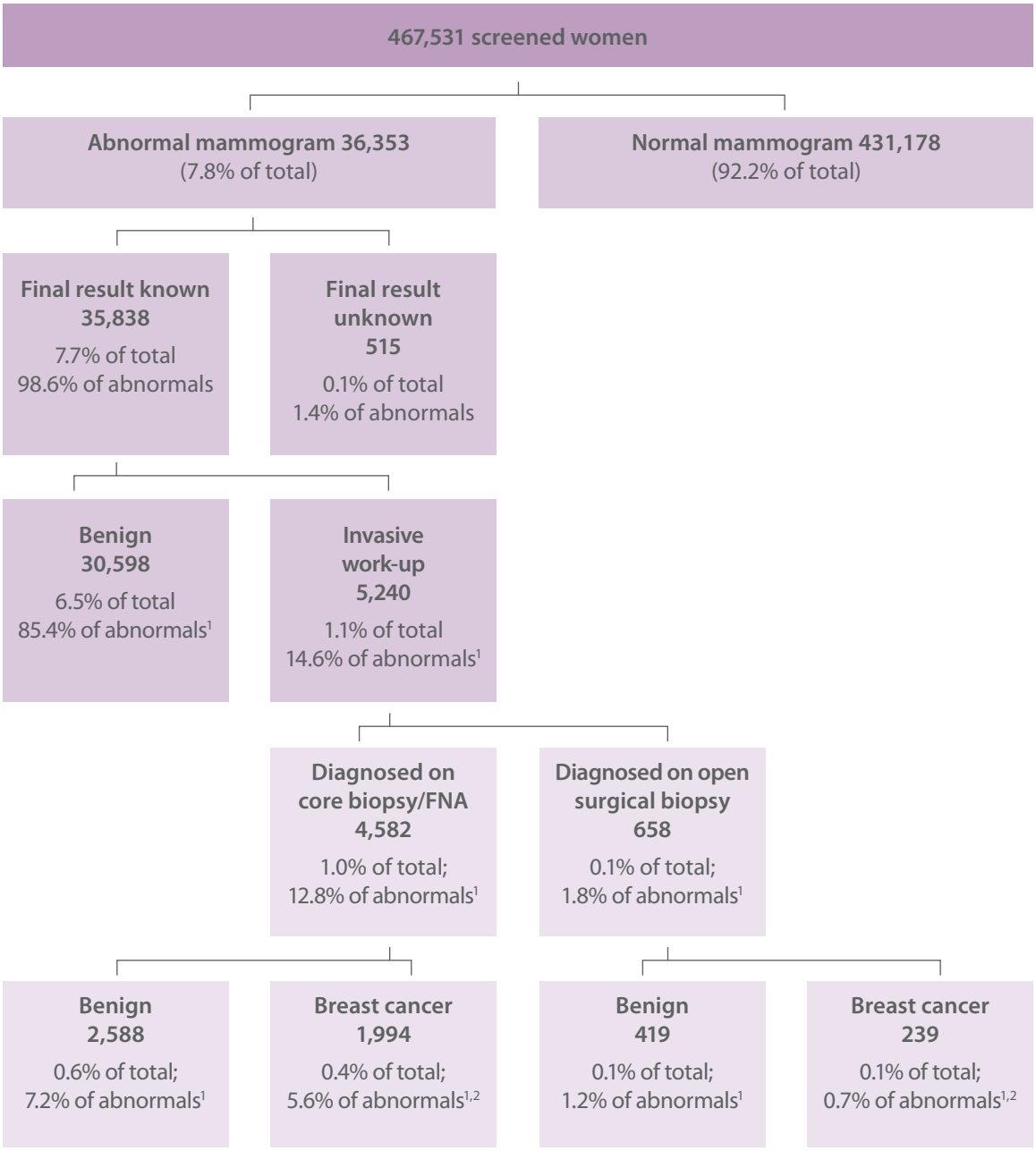
Data Source: Integrated Client Management System

From the time the program was launched in 1990 to March 2013, the OBSP provided more than 5.0 million mammograms to over 1.4 million women, and detected more than 26,000 breast cancers, the majority in early stages.

The annual number of screens among women aged 50 to 74 years increased from 15,141 in 1990–1991 to 498,023 in the 2011 calendar year. Initial program screens (first-time client visits) increased from 15,141 in 1990–1991 to 100,490 in 2011. In 2011, 20.2% of all client visits were initial or first-time screens in the program; this is the lowest percentage of initial screens since the inception of the program. Therefore, most screens (79.8%) represented returning clients.

The screening volumes reported in subsequent charts/tables will be slightly lower than the volumes reported in *Figure 6* since screen-ineligible women (those with a previous breast cancer diagnosis, mastectomy or mammogram exclusion fee code) are excluded.

FIGURE 7 | Screening outcome summary 2010, ages 50–74, for OBSP clients at average risk for breast cancer



1. The percentage was based on 35,838 (abnormal mammograms with known final result).
2. A total of 2,233 breast cancers (1,872 invasive and 361 ductal carcinoma in situ) were detected.

Data Source: Integrated Client Management System

Figure 7 illustrates the screening process and outcomes for women at average risk for breast cancer aged 50 to 74 who were screened by the OBSP in 2010, resulting in the diagnosis of 2,233 screen-detected breast cancers (1,872 invasive and 361 DCIS). Of those screened, 7.8% had an abnormal mammogram result. Therefore, for every 200 women screened, 16 were referred for further tests and one had breast cancer.

Of the abnormal mammograms, 85.4% were diagnosed as benign on non-invasive work-up (diagnostic imaging/healthcare provider consultation), 8.4% were diagnosed as benign on invasive work-up (7.2% on core/fine needle aspiration [FNA] biopsy and 1.2% on an open surgical biopsy), and 6.3% were diagnosed as breast cancer on invasive work-up (5.6% based on core/FNA biopsy and 0.7% on an open surgical biopsy). A total of 1.8% of abnormal screens required an open surgical biopsy to reach a definitive diagnosis.

The percentages noted above exclude abnormal screens (1.4%) where final diagnosis is unknown. Women were categorized as final diagnosis unknown if the client did not complete all recommended assessment procedures, if the client could not be traced (client moved/died during the assessment process) or if the client's assessment results could not be accessed (client did not provide consent for the OBSP to collect assessment information).

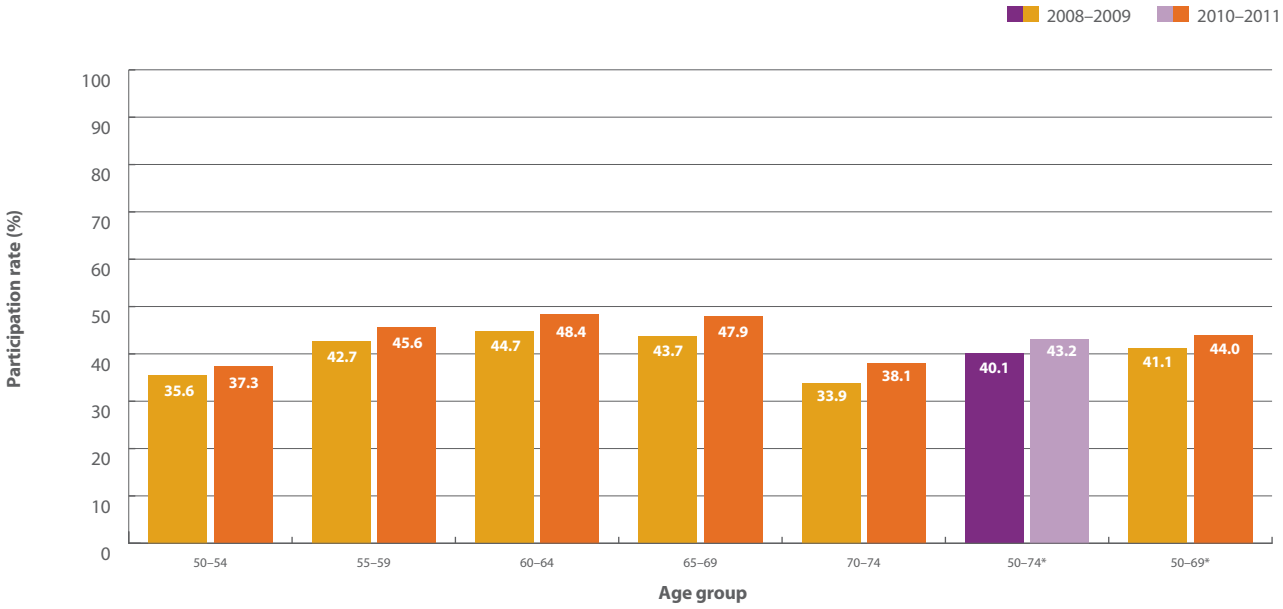
OBSP PROGRAM INDICATORS – WOMEN AT AVERAGE RISK FOR BREAST CANCER

I. COVERAGE

Participation Rate

Participation rate is the percentage of Ontario screen-eligible women, aged 50 to 74 who completed at least one OBSP screening mammogram in a two-year period.

FIGURE 8 | Age-standardized OBSP participation rate* (%) in Ontario women aged 50–74, 2008–2009 and 2010–2011, by five-year age group



Note: *Age-standardized to the 2006 Canadian population.
Data Sources: Ontario Health Insurance Plan, Integrated Client Management System

Figure 8 shows that the OBSP participation rate for women at average risk aged 50 to 74 increased from 40.1% in 2008–2009 to 43.2% in 2010–2011. This increase may be due to more screening site affiliations and health promotion efforts, and has kept up with continuing growth in the population eligible for breast cancer screening. Future health promotion efforts will include outreach strategies for targeted populations to increase awareness and screening participation among those who are under- or never-screened. Participation rates are also expected to improve as more mammography facilities affiliate with the program.

In 2010–2011, the OBSP participation rate was lowest for women aged 50 to 54 (37.3%) and 70 to 74 (38.1%). The lower percentage of women screened in the 50 to 54 and 70 to 74 age groups highlights the need for the identification and recruitment of women turning 50 years of age to the OBSP, as well as the retention of older women.

Please note that new guidelines published by the Canadian Task Force on Preventive Health Care in 2011 recommend screening for women aged 50 to 74[18]. As a result, all of the OBSP's indicators for breast cancer screening have been expanded to include women aged 70 to 74. However, results for women aged 50 to 69 have also been presented to allow for pan-Canadian comparisons.

FIGURE 9 | Age-standardized participation rate* (%) (OBSP and non-OBSP) in Ontario women aged 50–74, 2008–2009 and 2010–2011

Note: *Age-standardized to the 2006 Canadian population.
Data Sources: Ontario Health Insurance Plan, Integrated Client Management System

The overall percentage of women screened in the province (OBSP and non-OBSP) has remained stable, from 61.1% of all eligible women in 2008–2009 to 60.8% in 2010-2011. In 2010–2011, 71.1% (43.2/(43.2+17.6)) of Ontario women aged 50 to 74 screened had a mammogram through an OBSP site (*Figure 9*). This represents an increase from 65.7% in 2008–2009. With more women screened through the OBSP than outside of the program, more women were able to benefit from organized screening.

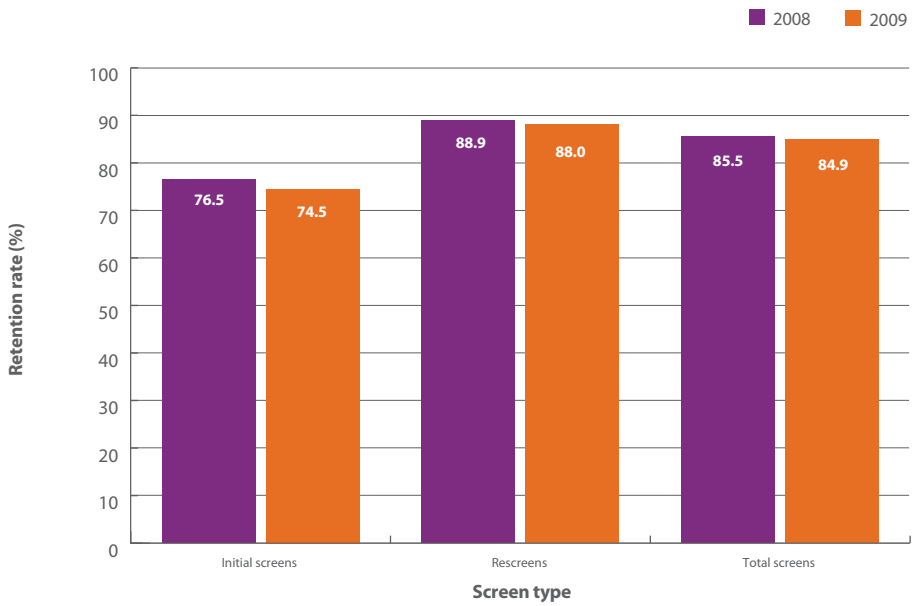
The non-OBSP results in *Figure 9* were achieved through opportunistic screening that occurs outside of the organized screening program.

Organized screening programs have the potential to achieve higher participation and retention rates and, through the monitoring of quality indicators and clinical outcomes, optimize the benefits of screening while minimizing harm.

Retention Rate

Retention rate is the percentage of screen-eligible women aged 50 to 72 who had a subsequent OBSP screening mammogram within 30 months of their previous program mammogram.

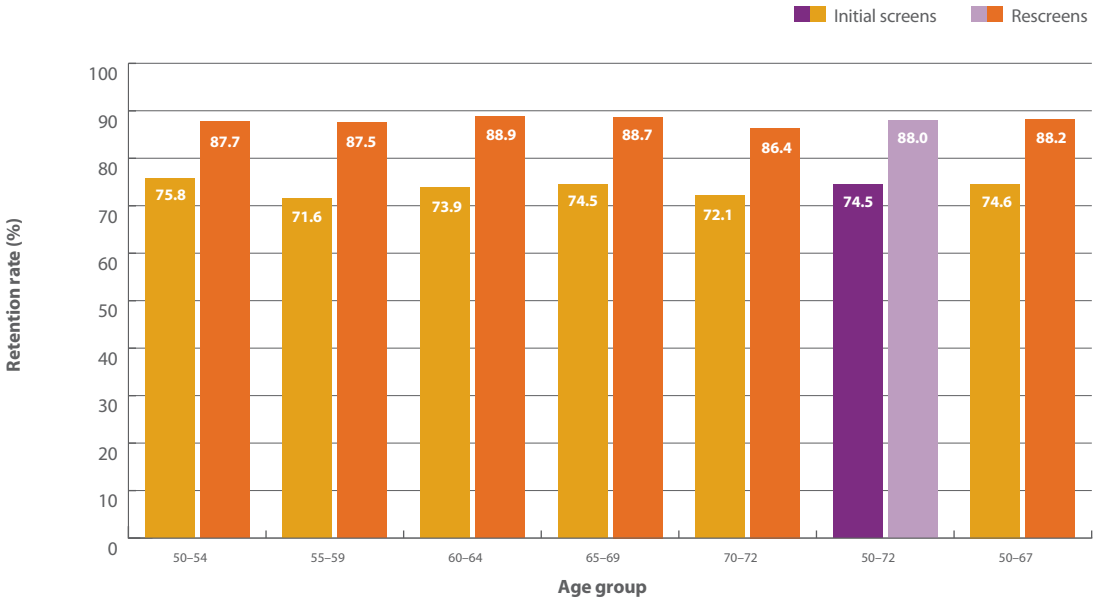
FIGURE 10 | Retention rate (%) in OBSP women aged 50–72, 2008–2009, by screen type and calendar year



Data Source: Integrated Client Management System

It is important to ensure that women return for regular screening at the recommended interval to realize the full benefit of an organized screening program in the reduction of breast cancer mortality. In 2009, 74.5% of women receiving an initial program screen and 88.0% of women with subsequent program screens were rescreened within 30 months of their previous screen date, a slight decline from 2008 (at 76.5% and 88.9%, respectively). Overall, 84.9% of women in 2009 returned to the program for repeat screening in the recommended time interval, a slight decline from 2008 (at 85.5%).

FIGURE 11 | Retention rate (%) in OBSP women aged 50–72, 2009, by screen type and five-year age group



Data Source: Integrated Client Management System

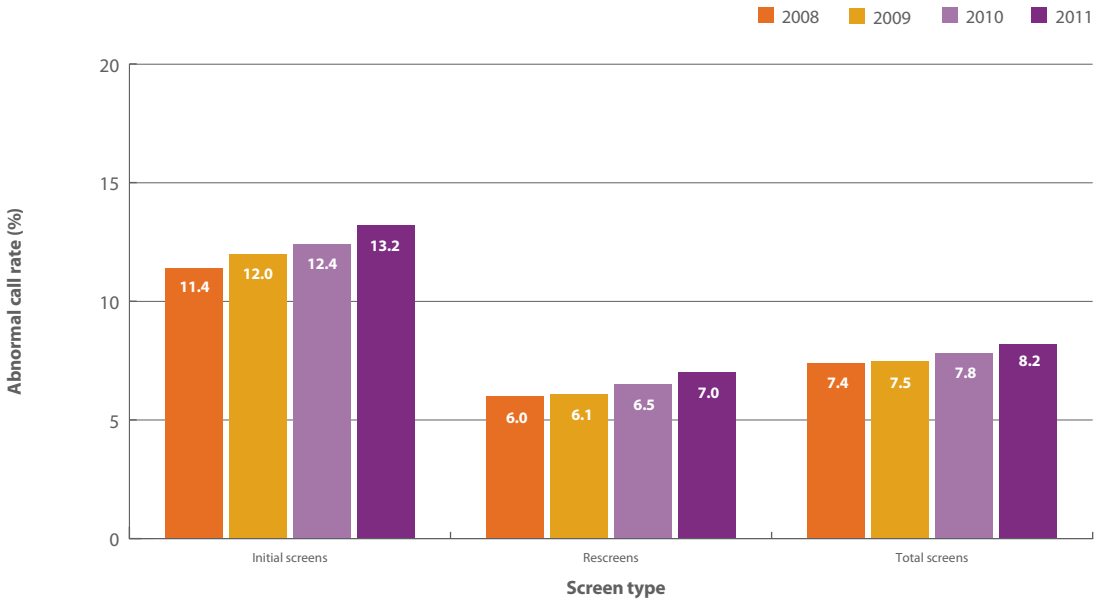
Figure 11 shows that the retention rate is high and similar across age groups, with between 71.6% and 75.8% of initial visit clients returning to screen within 30 months, as compared to between 86.4% and 88.9% of repeat visit clients.

II. FOLLOW-UP

Abnormal Call Rate

Abnormal call rate is the percentage of women who were referred for further testing because of an abnormal screening mammogram result.

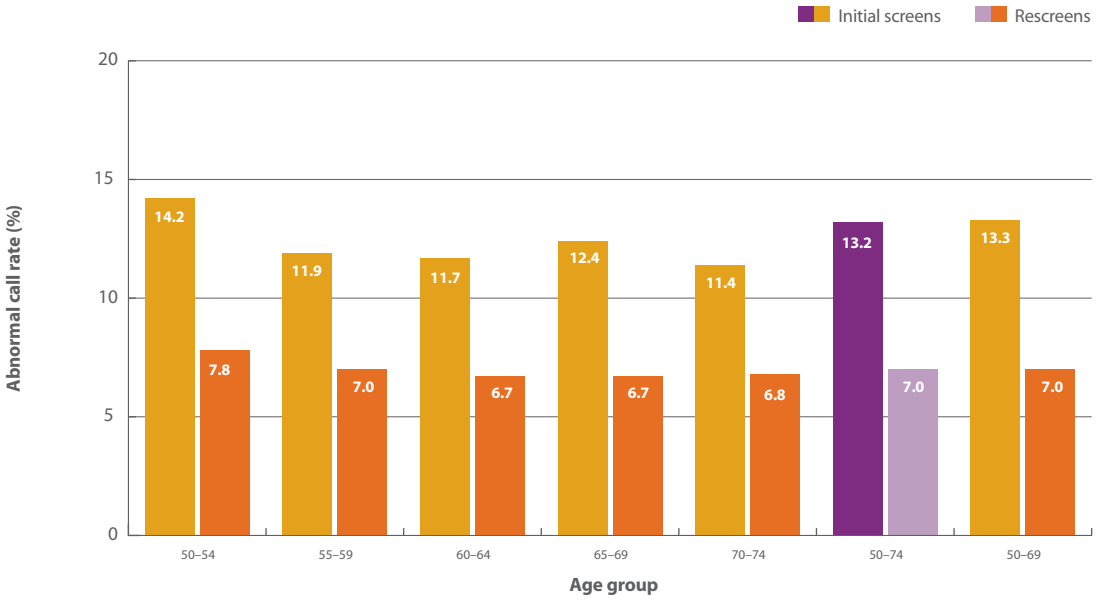
FIGURE 12 | Abnormal call rate (%) in OBSP women aged 50–74, 2008–2011, by screen type and calendar year



Data Source: Integrated Client Management System

In 2011, 13.2% of initial screens and 7.0% of rescreens had an abnormal mammogram result. As expected, abnormal call rates are higher for initial screens than for rescreens (for rescreens, the current mammogram findings can be compared with previous mammogram findings, resulting in fewer abnormal screening findings). Since 2008, abnormal call rates have increased for both initial screens and rescreens. Overall, 8.2% of women in 2011 had an abnormal mammogram result.

FIGURE 13 | Abnormal call rate (%) in OBSP women aged 50–74, 2011, by screen type and five-year age group



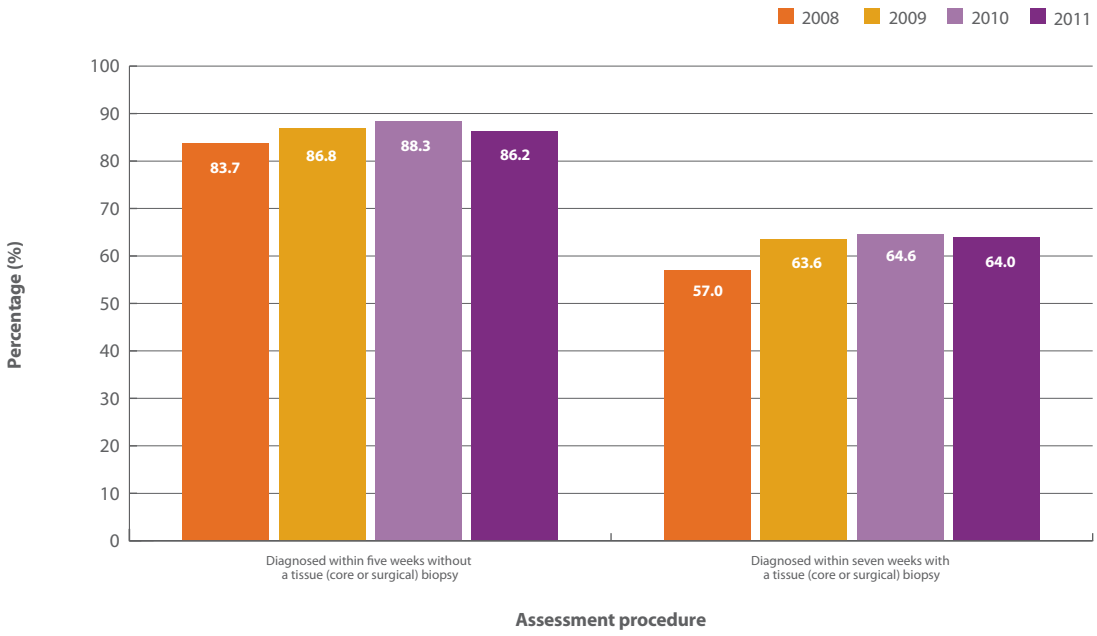
Data Source: Integrated Client Management System

Abnormal call rates generally decrease with age from 14.2% to 11.4% for initial screens and from 7.8% to 6.8% for rescreens. The abnormal call rate was lower for rescreens for older women because older women generally have a greater number of previous screens to which the most current screen can be compared.

Diagnostic Interval

Diagnostic interval is the percentage of women who had an abnormal mammogram result and received a diagnosis (either as benign or breast cancer) within the recommended interval.

FIGURE 14 | Diagnostic interval (%) in OBSP women aged 50–74, 2008–2011, by assessment procedure and calendar year

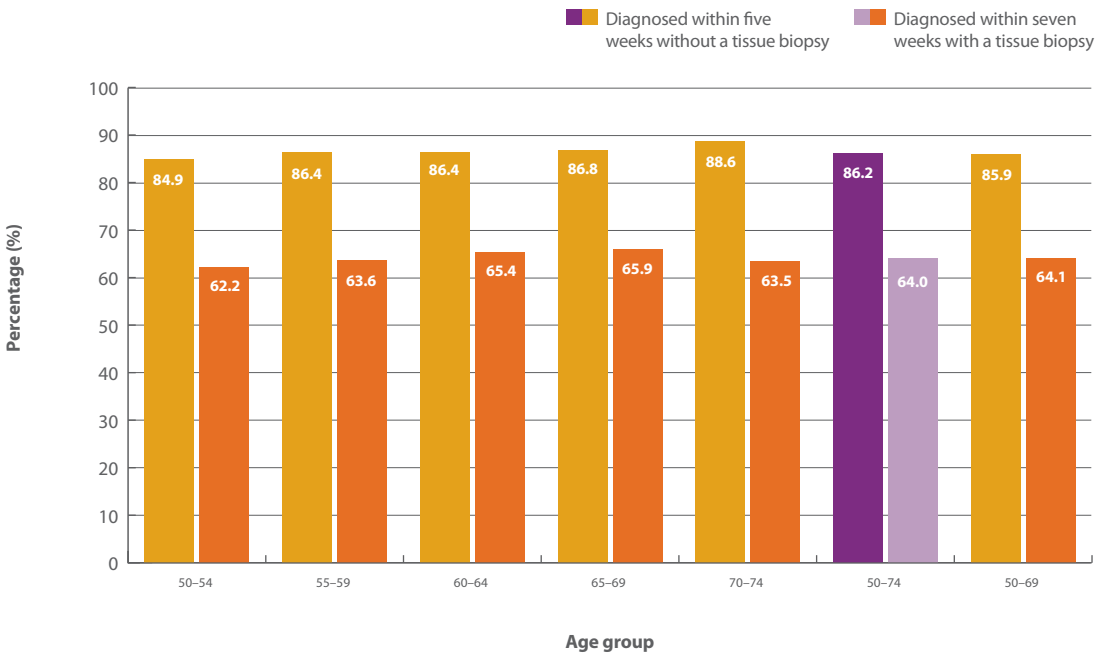


Data Source: Integrated Client Management System

Most women with abnormal mammogram results do not have breast cancer; however, additional assessment is required for a definitive diagnosis. Diagnostic assessment includes additional radiological or surgical assessment, such as diagnostic mammography, ultrasonography, fine needle aspiration, core and/or open surgical biopsy. Providing timely, well-coordinated follow-up with the appropriate interventions minimizes the fear and anxiety associated with abnormal results.

Overall, the percentage of women diagnosed within five weeks who did not require a tissue biopsy has increased from 83.7% in 2008 to 86.2% in 2011. The percentage of women diagnosed within seven weeks who did require a tissue biopsy has increased from 57.0% in 2008 to 64.0% in 2011. Wait times are affected by a number of factors that include resource shortages and access to surgical services. Cancer Care Ontario (CCO) continues to work with relevant partners to find solutions for improving these intervals.

FIGURE 15 | Diagnostic interval (%) in OBSP women aged 50–74, 2011, by assessment procedure and five-year age group



Data Source: Integrated Client Management System

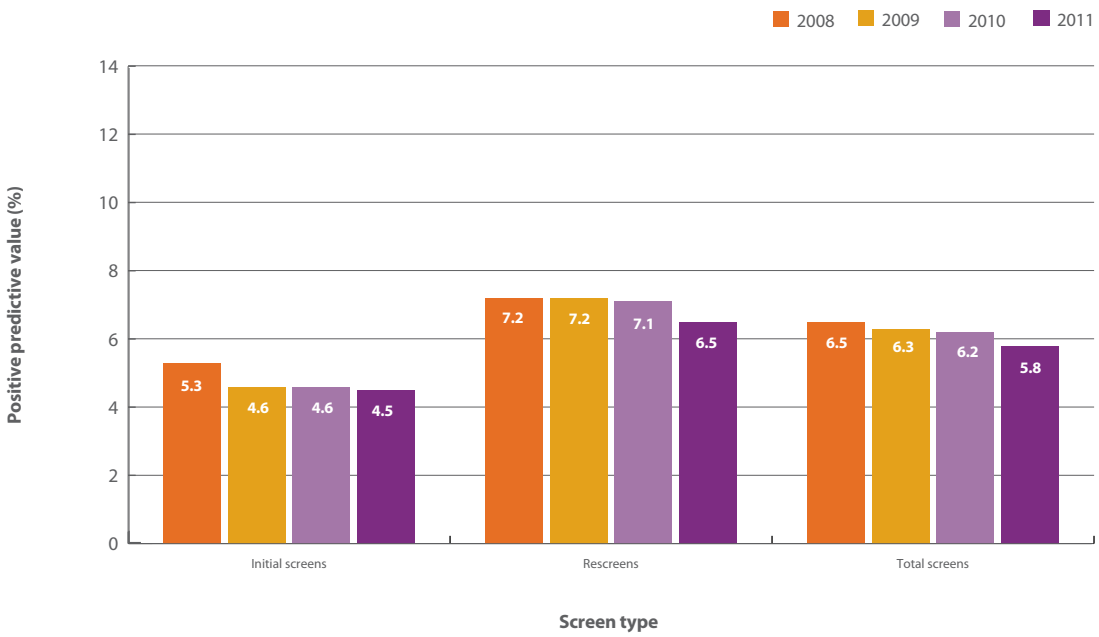
Figure 15 shows that diagnostic intervals decrease for women not requiring a tissue biopsy as their age increases. A greater proportion of women aged 70 to 74 received a timely diagnosis (88.6%) compared to 84.9% for women aged 50 to 54. As the age of women requiring a tissue biopsy increased, diagnostic intervals decreased up to ages 65 to 69, after which intervals increased. The greatest proportion of women requiring a tissue biopsy who received a timely diagnosis was in the 65 to 69 age group (65.9%).

III. QUALITY OF SCREENING

Positive Predictive Value

Positive predictive value is the percentage of women with an abnormal mammogram result who were diagnosed with breast cancer (DCIS or invasive) after completion of diagnostic work-up.

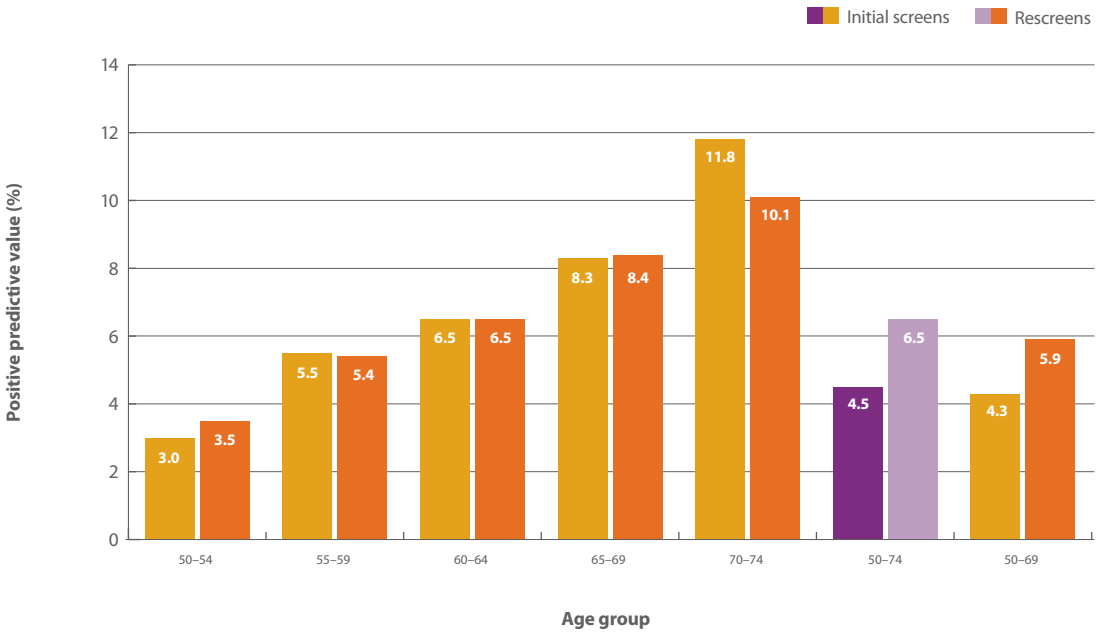
FIGURE 16 | Positive predictive value (%) in OBSP women aged 50–74, 2008–2011, by screen type and calendar year



Data Source: Integrated Client Management System

In 2011, 4.5% of women with an abnormal initial mammogram and 6.5% of women with an abnormal rescreen were diagnosed with screen-detected breast cancer after completion of diagnostic work-up. Although the positive predictive value for initial screens decreased over time (from 5.3% in 2008 to 4.5% in 2011), the rescreen values remained relatively stable (as 7.2% in 2008 and 7.1% in 2010), and decreased slightly in 2011 (6.5%), indicating the importance of having a previous screen in reducing the likelihood of a false-positive result. Overall, 5.8% of women with an abnormal mammogram in 2011 were diagnosed with screen-detected breast cancer after completing a diagnostic work-up.

FIGURE 17 | Positive predictive value (%) in OBSP women aged 50–74, 2011, by screen type and five-year age group



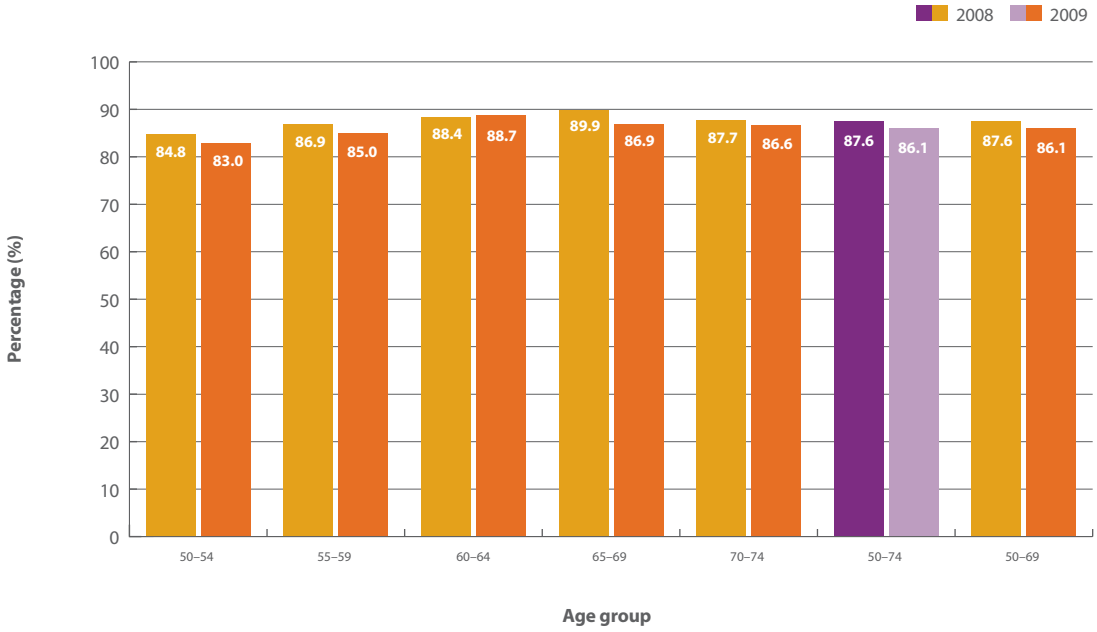
Data Source: Integrated Client Management System

Figure 17 shows that the positive predictive value is greater for women aged 70 to 74 for both initial screens and rescreens. Older women generally had a greater number of previous screens to which the most current screen could be compared; this improved the positive predictive value of the current screen. In addition, the incidence of breast cancer increases with age and older women tend to have less dense breasts than younger women, which improves the interpretation of mammographic findings.

Sensitivity and Specificity

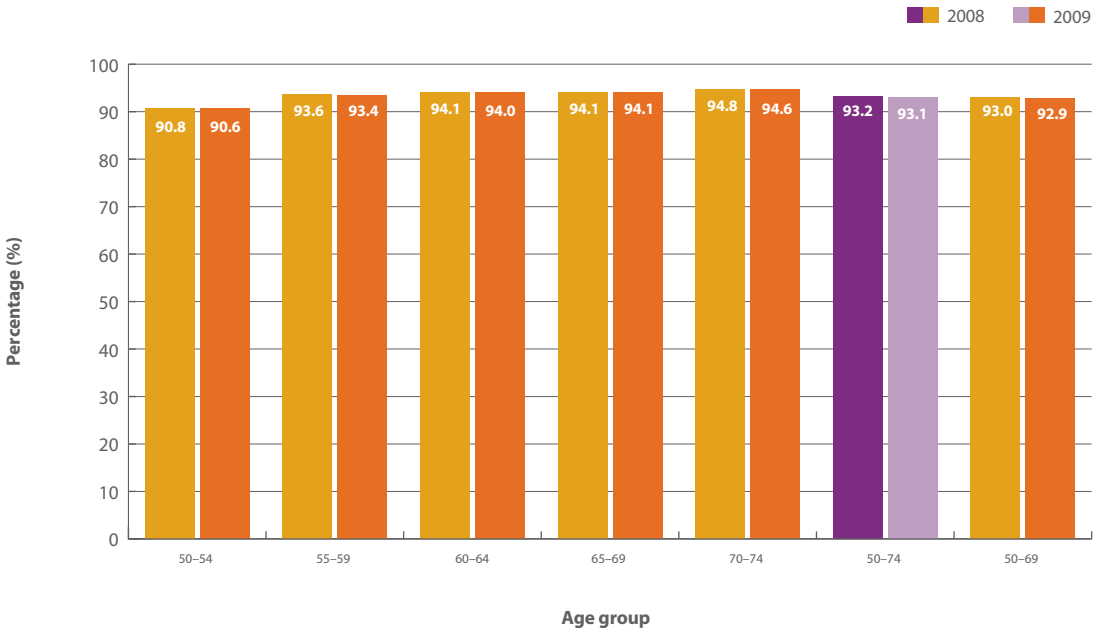
Sensitivity is the percentage of women diagnosed with breast cancer (DCIS or invasive) within a year of the mammogram date who had an abnormal OBSP screening mammogram result followed by a final diagnosis of breast cancer after completion of diagnostic assessment. Specificity is the percentage of women without a breast cancer diagnosis (DCIS and/or invasive) who had a normal screening mammogram result.

FIGURE 18 | One-year sensitivity (%) in OBSP women aged 50–74, 2008–2009, by five-year age group



Data Source: Integrated Client Management System

FIGURE 19 | One-year specificity (%) in OBSP women aged 50–74, 2008–2009, by five-year age group



Data Source: Integrated Client Management System

Sensitivity and specificity are affected by a number of factors, including the radiologist's level of experience, the number of previous screens, and the woman's age, breast density and hormone replacement therapy use.

Sensitivity has remained relatively high over time and was 86.1% in 2009. Therefore, 13.9% of women with breast cancer diagnosed within a year after the OBSP screen date did not have their breast cancer detected by the program. The slightly lower sensitivity in the most recent year may be the result of a decrease over time in the average age of initial program clients. The OBSP specificity has remained relatively high over time and is 93.1% for 2009. Therefore, 6.9% of women without breast cancer had an abnormal mammogram result (false-positive result).

In 2009, sensitivity was 83.0% in women aged 50 to 54, compared with 86.6% to 88.7% in women aged 60 and older. Sensitivity was greater in older women because their breasts are less dense and cancer detection rates are higher for this age group.

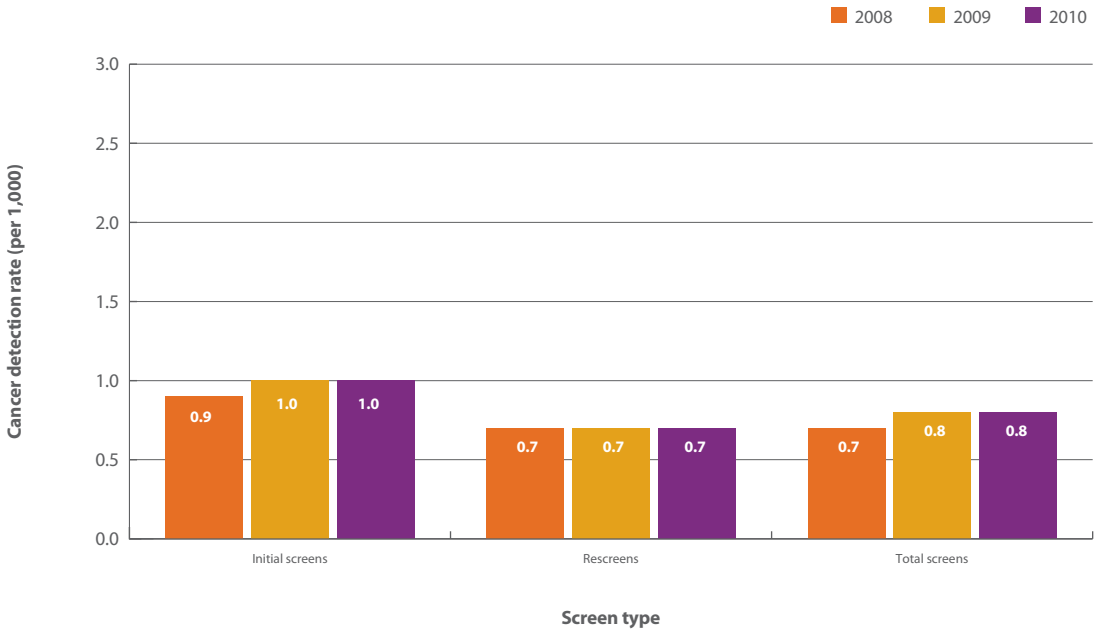
Specificity was 90.6% in women aged 50 to 54, compared with 94.6% in women aged 70 to 74 in 2009. The specificity of older women's current screens is improved because these women have more previous screens for comparison.

IV. DETECTION

DCIS Breast Cancer Detection Rate

Ductal carcinoma in situ (DCIS) breast cancer detection rate represents the number of women with a screen-detected DCIS breast cancer per 1,000 women who had a screening mammogram. DCIS is defined as a non-invasive tumour of the breast, arising from cells that involve only the lining of a breast duct. The cells have not spread outside the duct to other tissues in the breast.

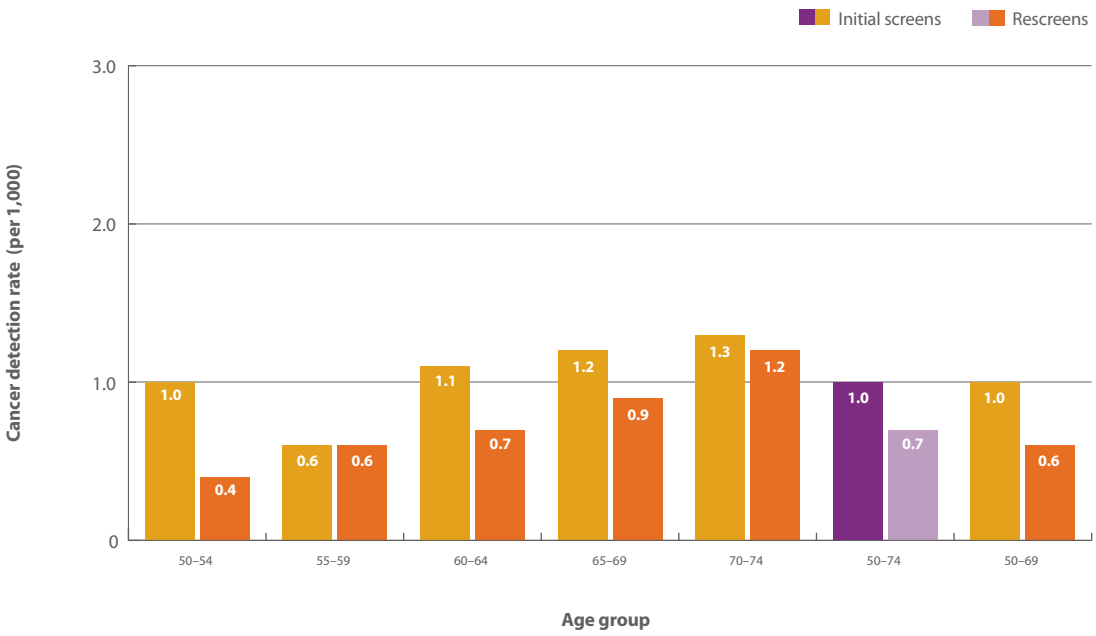
FIGURE 20 | DCIS breast cancer detection rate (per 1,000 screens) in OBSP women aged 50–74, 2008–2010, by screen type and calendar year



Data Source: Integrated Client Management System

The DCIS cancer detection rate has been stable at approximately 1.0 per 1,000 women who had initial screens and 0.7 per 1,000 women who had rescreens. Overall, the DCIS cancer detection rate increased slightly from 0.7 per 1,000 women screened in 2008 to 0.8 per 1,000 women screened in 2010.

FIGURE 21 | DCIS breast cancer detection rate (per 1,000 screens) in OBSP women aged 50–74, 2010, by screen type and five-year age group



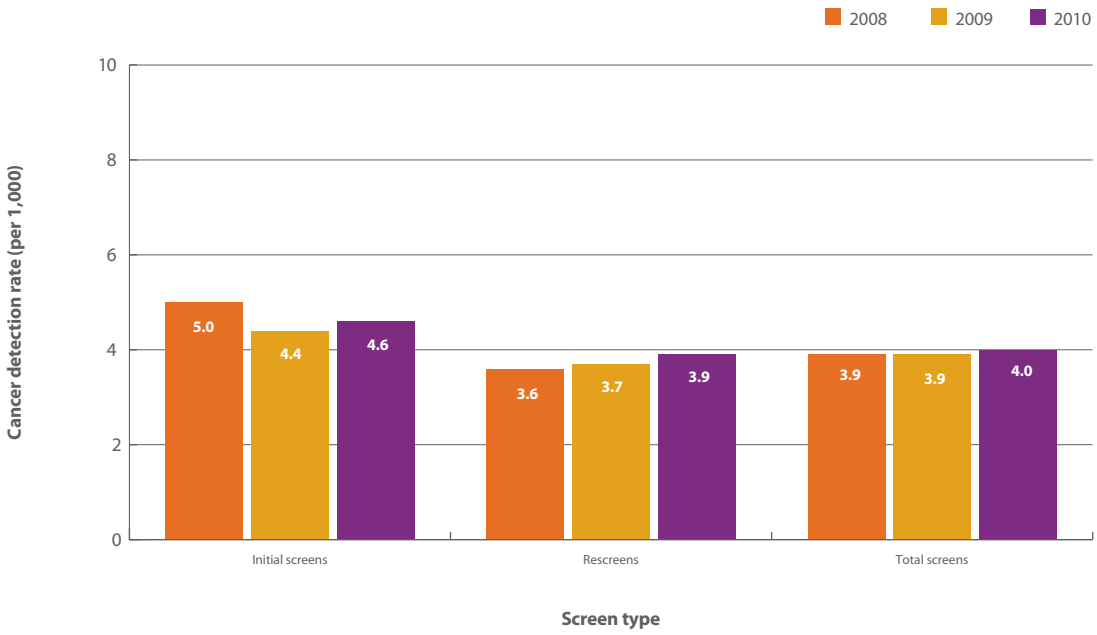
Data Source: Integrated Client Management System

The DCIS screen-detected breast cancer rate increased with age for rescreens (from 0.4 per 1,000 for women aged 50 to 54 to 1.2 per 1,000 for women aged 70 to 74) and for initial screens (from 1.0 per 1,000 for women aged 50 to 54 to 1.3 per 1,000 for women aged 70 to 74) except for women aged 55 to 59, whose DCIS cancer detection rate was the lowest at 0.6 per 1,000 women screened.

Invasive Breast Cancer Detection Rate

Invasive breast cancer detection rate is the number of women with a screen-detected invasive breast cancer per 1,000 women who had a screening mammogram. Invasive breast cancer is defined as cancer cells invading beyond the basement membrane of the milk duct or lobule. A DCIS component may also be present in cases of invasive cancer.

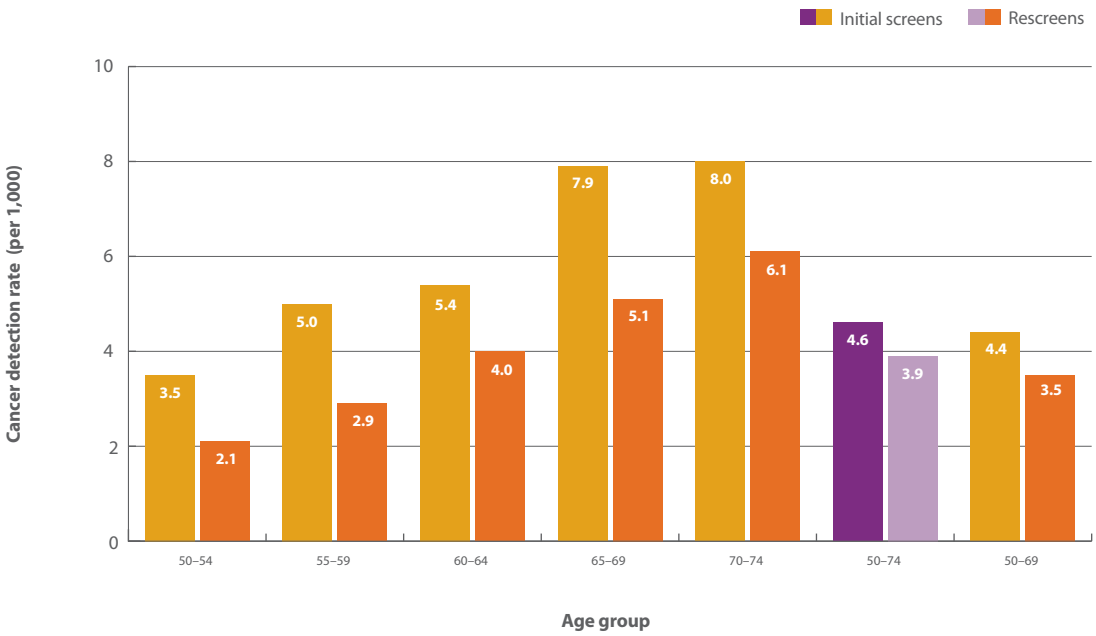
FIGURE 22 | Invasive breast cancer detection rate (per 1,000 screens) in OBSP women aged 50–74, 2008–2010, by screen type and calendar year



Data Source: Integrated Client Management System

The invasive cancer detection rate was generally higher for initial program screens (which detect prevalent cancers) than for rescreens (which detect incident cancers, or new cancer cases). The invasive cancer detection rate decreased slightly for initial program screens (from 5.0 per 1,000 in 2008 to 4.6 per 1,000 in 2010), but increased slightly for rescreens (from 3.6 per 1,000 in 2008 to 3.9 per 1,000 in 2010). Overall, the invasive cancer detection rate was similar across the time period with a slight increase in 2010 (4.0 per 1,000 women screened).

FIGURE 23 | Invasive breast cancer detection rate (per 1,000 screens) in OBSP women aged 50–74, 2010, by screen type and five-year age group



Data Source: Integrated Client Management System

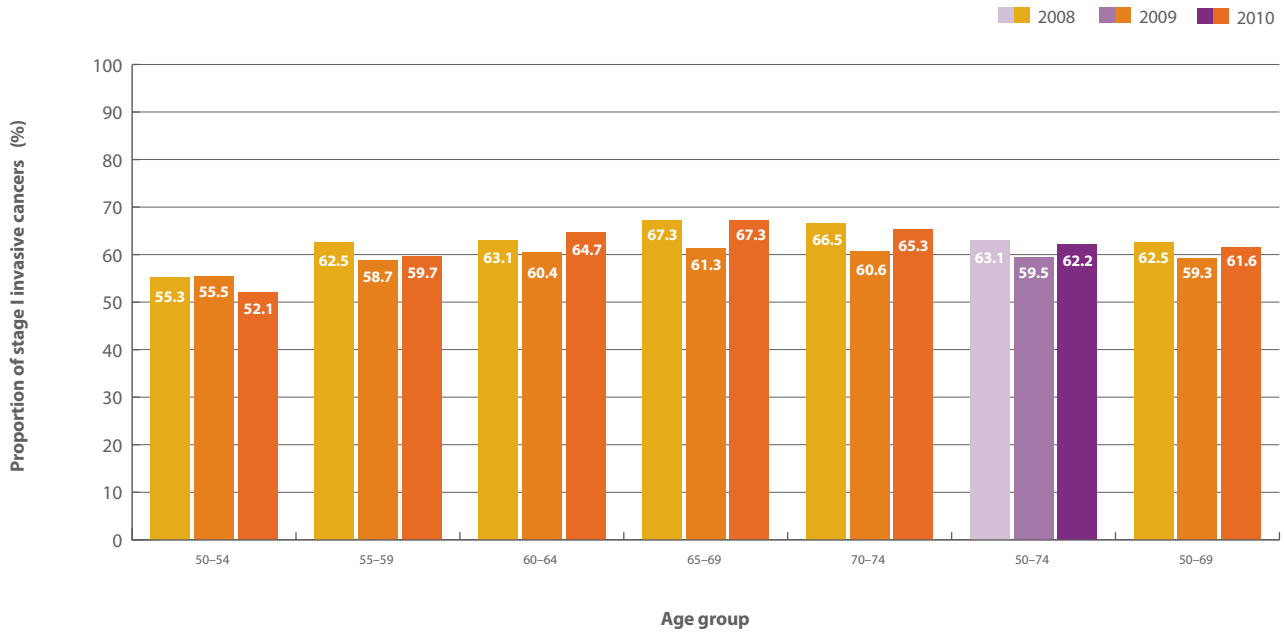
The invasive screen-detected breast cancer rate increased with age for both initial screens (from 3.5 per 1,000 for women aged 50 to 54, to 8.0 per 1,000 for women aged 70 to 74) and rescreens (from 2.1 per 1,000 for women aged 50 to 54, to 6.1 per 1,000 for women aged 70 to 74). Older women have a higher breast cancer incidence rate and therefore benefit more from screening.

V. DISEASE EXTENT AT DIAGNOSIS

Early Stage Invasive Cancer Detection Rate

Early stage invasive cancer detection rate is the percentage of women who had a screening mammogram and were diagnosed with an early stage (stage I) screen-detected invasive breast cancer.

FIGURE 24 | Proportion (%) of stage I invasive screen-detected breast cancers in OBSP women aged 50–74, 2008–2010, by five-year age group and calendar year



Data Source: Integrated Client Management System

The principal objective of cancer screening is to detect invasive cancers at early stages while they are associated with a good prognosis and when treatment is most effective. This involves detecting breast cancers at a small size and without lymph node involvement. These prognostic features are important in assessing program effectiveness because these measures will indicate if a reduction in breast cancer mortality is possible.

Stage is based on three prognostic factors: tumour size, presence/extent of axillary lymph node metastatic disease and presence of distant metastasis. Stage I tumours have a tumour size of < 2 cm with no axillary regional lymph node or distant metastases involvement. Stage data are available for over 88.9% of invasive cancers detected between 2008 and 2010.

The percentage of stage I invasive breast cancers detected has remained relatively stable over time and was 62.2% in 2010. Women with breast cancer detected at an early stage have more treatment options, reduced cancer recurrence and improved survival.

The proportion of women with early stage tumours is greater in older women than younger women, with 52.1% of stage I tumours being detected in women aged 50 to 54, compared with 67.3% in women aged 65 to 69 and 65.3% in women aged 70 to 74. Younger women may be more likely to be on hormone replacement therapy and have denser breasts, which makes it more difficult to detect early stage cancers. Breast cancer may also be more aggressive in younger women. For younger women, breast cancer may have been present for years and detected at first screen at a later stage. Also, older women would have a greater number of previous screens, allowing for detection of earlier-stage tumours.

OBSP OUTCOME INDICATORS COMPARED WITH CANADIAN INDICATOR TARGETS

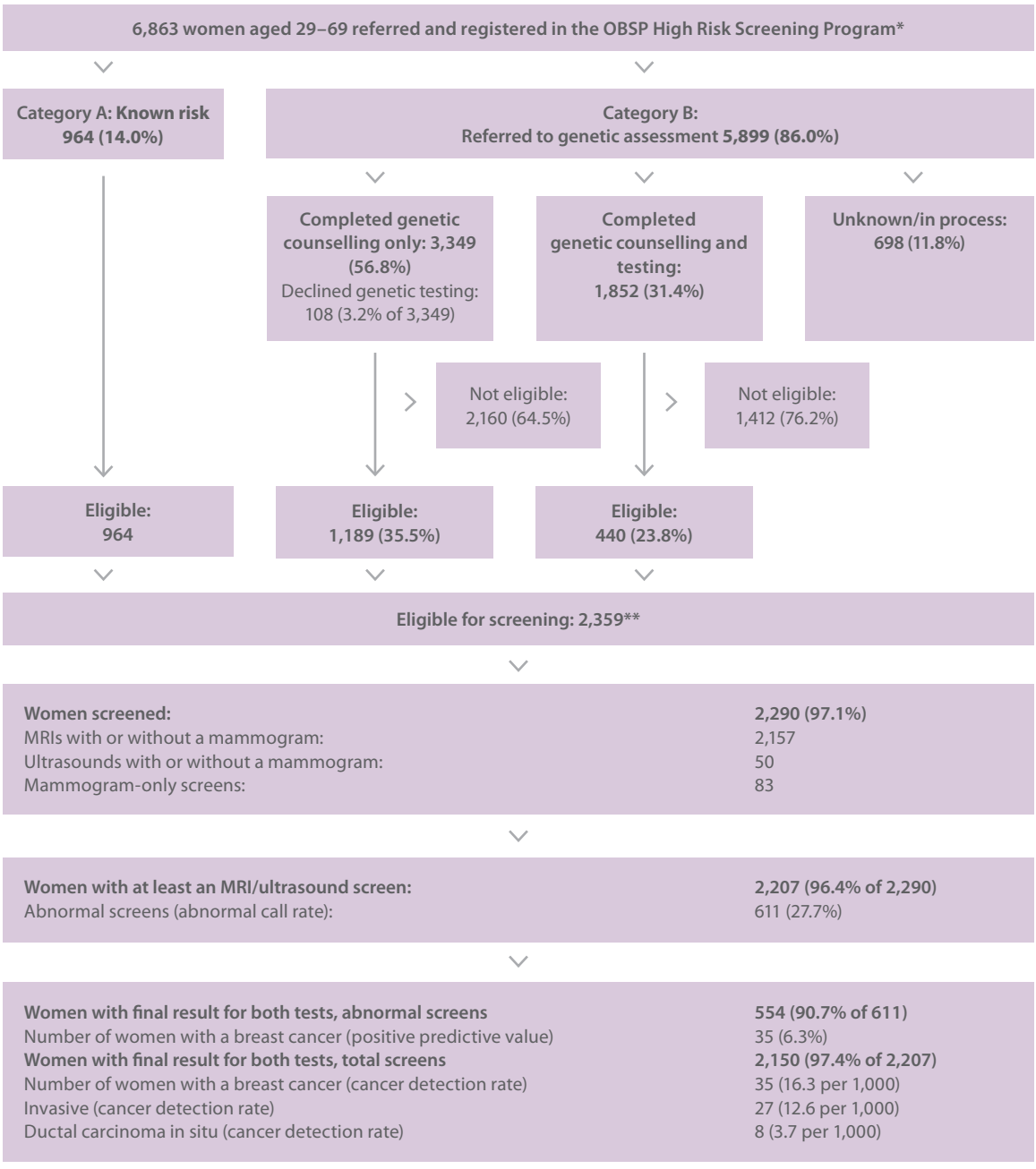
TABLE 2 | OBSP mammography average risk indicator results compared with Canadian targets

INDICATOR	DEFINITION	TARGET (AGES 50–69)	OBSP MAMMOGRAPHY INDICATOR (AGES 50–69)
I. Coverage			
Participation Rate (%) (2010–2011)	Percentage of women who have completed at least one OBSP screening mammogram in a two-year time period.	≥ 70% of the eligible population	44.0%
Retention Rate (%) (2009)	Percentage of women who were rescreened within 30 months of their previous screen.	≥ 75% (initial screens), ≥ 90% (rescreens)	74.6% (initial screens), 88.2% (rescreens)
II. Follow-Up			
Abnormal Call Rate (%) (2011)	Percentage of women screened who are referred for further testing because of abnormalities found with an OBSP screening mammogram.	< 10% (initial screens), < 5% (rescreens)	13.3% (initial screens), 7.0% (rescreens)
Diagnostic Interval (%) (2011)	Duration (in weeks) from abnormal screen to diagnosis (benign or cancer)	≥ 90% within five weeks if no tissue biopsy, ≥ 90% within seven weeks if tissue biopsy	85.9% (within five weeks if no tissue biopsy), 64.1% (within seven weeks if tissue biopsy)
III. Quality of Screening			
Positive Predictive Value (%) (2011)	Percentage of abnormal cases with completed follow-up found to have breast cancer (DCIS or invasive) after diagnostic workup.	≥ 5% (initial screens), ≥ 6% (rescreens)	4.3% (initial screens), 5.9% (rescreens)
VI. Detection			
In Situ Breast Cancer Detection Rate (per 1,000 Screens) (2010)	Number of women detected with DCIS breast cancer during a screening episode per 1,000 women screened.	Surveillance and monitoring purposes only	1.0 (initial screens), 0.6 (rescreens)
Invasive Breast Cancer Detection Rate (per 1,000 Screens) (2010)	The number of women detected with invasive breast cancer during a screening episode per 1,000 women screened.	> 5 per 1,000 (initial screens), > 3 per 1,000 (rescreens)	4.4 (initial screens), 3.5 (rescreens)

Table 2 compares the OBSP's mammography indicator results with national targets (using the *Canadian Partnership Against Cancer's Guidelines for Monitoring Breast Screening Program Performance, 3rd Edition*)[27]. Data presented here are based on OBSP sites only and do not reflect all breast cancer screening activity in Ontario because opportunistic screening takes place at non-OBSP mammography facilities. Performance against national targets should be evaluated within this context. The OBSP has met national targets for rescreens for invasive breast cancer detection rate and positive predictive value, and retention rate for initial screens; other indicators are close to meeting national targets, with the exception of participation rate and wait times to diagnosis for women requiring a tissue biopsy (see the *Summary and Future Directions* section of this report).

OBSP PROGRAM INDICATORS AND PROCESS MEASURES – WOMEN AT HIGH RISK FOR BREAST CANCER

FIGURE 25 | Screening outcome summary, July 2011–June 2012, ages 29–69, for OBSP clients at high risk for breast cancer*



Note: *Follow-up of women registered between July 2011 and June 2012 was through March 20, 2013. Unknown cases were excluded from all percentages.
**234 women were excluded (declined, deferred or died, planned bilateral mastectomy or had external (i.e., non-OBSP) MRI during first year of the program).
Data Sources: Integrated Client Management System, Ontario Cancer Registry, Pathology Information Management System

Program indicators and process measures were both used to evaluate the OBSP High Risk Screening Program. The program indicators align with those used to assess the average risk arm of the OBSP. The process measures were developed to allow detailed elements of the OBSP High Risk Screening Program's design to be reviewed to ensure that high-quality screening services are accessible to the high risk population of women.

There were 6,863 women aged 29 to 69 registered in the OBSP High Risk Screening Program from July 2011 to June 2012. Of these women, 964 (14.0%) were known to be at high risk for breast cancer and were referred to the OBSP High Risk Screening Program by their physician (Category A); 5,899 (86.0%) women were referred to genetic assessment to determine their eligibility (Category B). Of the 5,201 women who completed genetic assessment, 1,629 (31.3%) women were considered eligible for the OBSP High Risk Screening Program.

Of the 2,359 screen-eligible women, 2,207 (93.6%) have been screened with at least magnetic resonance imaging (MRI) (or ultrasound). Of those 2,207 women, 611 (27.7%) had an abnormal screen and 2,150 had a final result (97.4%). Thirty-five cancers were detected that resulted in a positive predictive value of 6.3% and a cancer detection rate of 16.3 per 1,000. Of the 35 cancers detected, eight were ductal carcinoma in situ (DCIS) (22.9%) and 27 were invasive (77.1%).

TABLE 3 | Characteristics of women eligible for screening by referral method, age, risk criteria and prior breast cancers for OBSP clients at high risk for breast cancer (July 2011–June 2012)*

CHARACTERISTIC	KNOWN RISK CATEGORY A (N=906) n (%)	GENETIC ASSESSMENT CATEGORY B (N=1,453) n (%)	TOTAL (N=2,359) n (%)
Age			
30–39	216 (23.8)	543 (37.4)	759 (32.2)
40–49	339 (37.4)	602 (41.4)	941 (39.9)
50–59	249 (27.5)	251 (17.3)	500 (21.2)
60–69	102 (11.3)	57 (3.9)	159 (6.7)
Risk criteria			
Known carrier	565 (62.4)	313 (21.5)	878 (37.3)
Family history ≥ 25% risk	185 (20.4)	1,108 (76.3)	1,293 (54.8)
First-degree relative	31 (3.4)	32 (2.2)	63 (2.7)
Chest radiation	125 (13.8)	0 (0.0)	125 (5.3)
Prior breast cancer			
No	780 (86.4)	1,281 (92.6)	2,061 (90.1)
Yes	123 (13.6)	103 (7.4)	226 (9.9)
# unknown	3	69	72
Time since prior breast cancer (years)**			
< 5	31 (26.1)	66 (66.0)	97 (44.3)
≥ 5 and < 10	43 (36.1)	15 (15.0)	58 (26.5)
≥ 10	45 (37.8)	19 (19.0)	64 (29.2)
# unknown (client not yet screened)	4	3	7

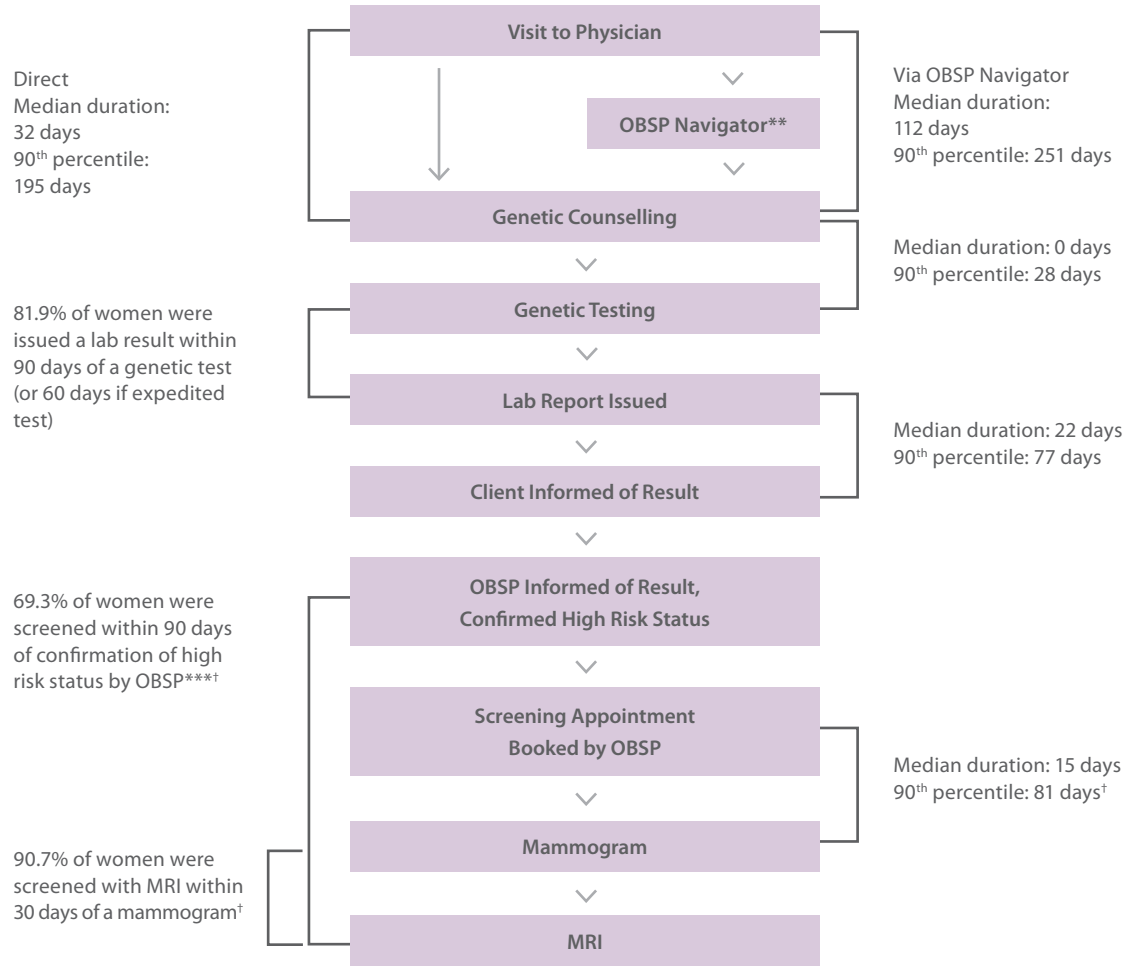
Note: *Follow-up of women registered between July 2011 and June 2012 was through March 20, 2013. Unknown cases were excluded from all percentages.
**Time from a prior diagnosis date to the first screen date in the OBSP High Risk Screening Program among women with a prior breast cancer.
Data Sources: Integrated Client Management System, Ontario Cancer Registry, Pathology Information Management System

Of the 2,359 women screen-eligible for the OBSP High Risk Screening Program, the majority were less than 50 years old (1,700, 72.1%), with the greatest proportion being aged 40 to 49 (941, 39.9%). There were proportionally more women aged 50 or older among those who were known to be at high risk for breast cancer at the time of their referral to the program (Category A, 351 out of 906, 38.8%), compared to those who were sent to genetic assessment to determine their eligibility (Category B, 308 of 1,453, 21.2%).

Among the 906 women referred directly to the OBSP High Risk Screening Program by their physician (i.e., those who were known to be at high risk at the time of their referral), 565 (62.4%) were known carriers of a gene mutation and 185 (20.4%) had a family history with an estimated lifetime cancer risk of ≥ 25.0%. Only a small proportion of women who were known to be at high risk at the time of their referral had a first-degree relative with a gene mutation, but had opted not to undergo genetic testing themselves (31 of 906, 3.4%) or had previously had radiation therapy to the chest (125 of 906, 13.8%). Among the 1,453 women who were referred to genetic assessment, 76.3% had a family history with an estimated lifetime cancer risk of ≥ 25.0%, and 21.5% were found to be known carriers of a gene mutation.

Overall, there were 226 (9.9%) screen-eligible women who had been diagnosed with breast cancer prior to their first screen in the OBSP High Risk Screening Program. Among the 103 women who had a prior breast cancer diagnosis and were referred to genetic assessment to confirm their program eligibility, 66.0% were diagnosed within five years of their first high risk screen in the program. In contrast, of the 123 women who had a prior breast cancer diagnosis and were referred directly to the high risk program by their physician (i.e., those who were known to be at high risk at the time of their referral), 37.8% had a prior breast cancer diagnosed 10 or more years following their first high risk screen.

FIGURE 26 | Median and 90th percentile durations (in days) and percent that meet program targets for OBSP clients at high risk for breast cancer (July 2011–June 2012)*



Note: *Follow-up of women registered between July 2011 and June 2012 was through March 20, 2013. Unknown cases were excluded from all percentages.
**27.7% of referrals were sent from the physician to the genetic clinic via the OBSP Navigator rather than directly from the physician to the genetic clinic.
***Date of confirmed high risk status refers to date when the data was entered into ICMS.
† Applies to both Category A and Category B women.
Data Sources: Integrated Client Management System, Ontario Cancer Registry, Pathology Information Management System

The majority of women (72.3%) were referred directly to genetic counselling by a physician; however, 27.7% of referrals were sent first to an OBSP Navigator and then to the genetic clinic. The duration for the latter pathway was much longer (112 days) compared to the former (32 days). Overall, most women had a genetic test the same day as genetic counselling and the majority (81.9%) of women were issued a lab result within 90 days of a genetic test (or 60 days if expedited).

It took approximately 22 days for most clients to find out their test result after the report was issued. Most women were screened approximately 15 days after being contacted by the OBSP high risk screening centre to book a mammogram appointment. The majority of women (69.3%) were screened within 90 days of confirmed high risk status and 90.7% of women were screened with an MRI within 30 days of their mammogram.

TABLE 4 | Abnormal call rates, positive predictive values and cancer detection rates by screening modality for OBSP clients at high risk for breast cancer (July 2011–June 2012)*

MODALITY	OVERALL	ABNORMAL MAMMOGRAM ALONE	ABNORMAL MRI (OR ULTRASOUND) ALONE	BOTH ABNORMAL MAMMOGRAM AND MRI (OR ULTRASOUND)
Number of screens with at least MRI (or ultrasound)	2,207	2,133**	2,207	2,133**
Number of abnormal screens	611	137	367	107
Number of screens with known final result	2,150	2,082	2,150	2,082
Number of abnormal screens with known final result	554	133	324	97
Number of cancers	35	0	23	12
Abnormal call rate % (N)	27.7 (611/2,207)	6.4 (137/2,133)	16.6 (367/2,207)	5.0 (107/2,133)
Positive predictive value % (N)	6.3 (35/554)	0.0 (0/133)	7.1 (23/324)	12.4 (12/97)
Cancer detection rate rate per 1,000 (N)	16.3 (35/2,150)	0.0 (0/2,082)	10.7 (23/2,150)	5.8 (12/2,082)

Note: *Follow-up of women registered between July 2011 and June 2012 was through March 20, 2013. Unknown cases were excluded from all percentages.
**Excludes MRI-only screens.
Data Sources: Integrated Client Management System, Ontario Cancer Registry, Pathology Information Management System

Of the 2,207 women screened with at least an MRI (or ultrasound), 2,150 had a final result for MRI (or ultrasound) and mammogram, 611 (27.7%) had an abnormal screen and 35 had breast cancer. The abnormal call rate was substantially higher among abnormalities referred by MRI (or ultrasound) alone (16.6%), compared to abnormalities referred by both mammogram and MRI (or ultrasound) (5.0%), and those referred by mammograms alone (6.4%).

There were 554 women with abnormal screens and a known final result (positive predictive value = 6.3%). The positive predictive value was higher for women who received both mammography and MRI (or ultrasound) (12.4%), compared to MRI (or ultrasound) alone (7.1%).

The overall cancer detection rate (16.3 per 1,000) is slightly lower than the expected cancer detection rate (17.0 per 1,000); a larger population of women may need to be screened for a longer period of time before this rate stabilizes. Of the 35 breast cancers detected, none were detected by a mammogram alone, 23 were detected by MRI (or ultrasound) alone (10.7 per 1,000) and 12 were detected by both modalities (5.8 per 1,000). These results may be explained by the higher sensitivity of MRI compared to mammography for women at high risk for breast cancer.

Program Successes and Future Directions

Designed to maximize screening benefits and minimize harms, organized screening programs have the potential to achieve higher participation and retention rates than opportunistic screening. It has been demonstrated that screening is most effective and cost-effective if delivered through an organized program with components that cover all aspects of the screening process[28]. These comprise comprehensive practice guidelines for screening and for follow-up of test results, initiatives to increase and maintain a high level of screening participation, procedures to ensure that women are regularly rescreened (following a normal test result) or followed up (when a test result suggests an abnormality) according to practice guidelines, and programs to ensure high standards of quality for all screening-related activities[29]. The Ontario Breast Screening Program (OBSP) currently includes all of these components with the exception of population-based invitation letters; however, the program plans to introduce these in the future.

The goal of every organized breast screening program is to decrease mortality due to breast cancer. It is important to measure a program's effectiveness over the course of its history. Between 1990 and 2009, breast cancer mortality declined by 36.7% for women aged 50 to 74, by 37.0% for younger women aged 30 to 49, and by 31.5% for women of all ages. This decrease in breast cancer mortality is attributed both to improved breast cancer treatments and to increased participation in breast cancer screening.

The OBSP has celebrated many successes over the years, including the recent expansion of the program to include screening services for women at high risk for breast cancer, the continued development of its robust quality assurance program, and its ongoing recruitment of new screening and assessment sites.

The program continues to perform well on key indicators. In 2009, 74.5% of women receiving an initial program screen and 88.0% of women with subsequent program screens were rescreened within 30 months of their previous screen date. These results demonstrate that the retention rate is high and women who have entered the OBSP are likely to return to the program for follow-up screening.

The program also ensures that women with abnormal screens are monitored for follow-up. This failsafe process has resulted in the achievement of very low rates of lost to follow-up in recent years. In 2010, the lost to follow-up rate was only 1.4%.

OBSP program sensitivity (percentage of women with breast cancer within a year of the mammogram date who had an abnormal OBSP screening mammogram result followed by a final diagnosis of breast cancer after completion of diagnostic assessment) has remained relatively high over time and was 86.1% for 2009. Therefore, 13.9% of women with breast cancer diagnosed within a year after the OBSP screen date did not have their breast cancer detected by the program. OBSP program specificity (proportion of women without breast cancer who had a negative screen result) has also remained relatively high over time and was 93.1% for 2009. Therefore, 6.9% of women without breast cancer had a false-positive result (abnormal mammogram result).

Despite its successes, the OBSP recognizes that there are still many challenges to overcome. The OBSP continues to work with individual screening and assessment sites, as well as Regional Cancer Programs, to improve OBSP performance and effectiveness. The following are highlights of the program's primary areas of focus for the future.

INITIATIVES TO INCREASE/MAINTAIN SCREENING PARTICIPATION

Mobile Coaches

Expanding on the success of the OBSP's mobile screening coach serving more than 30 communities in Northwestern Ontario, the OBSP expanded its reach by launching a second mobile screening coach in June 2013, which serves the Hamilton Niagara Haldimand Brant region.

Under- and Never-Screened Women

Cancer Care Ontario (CCO) and its regional partners continue to look at new and innovative approaches for recruiting women for screening, particularly those from marginalized groups. Examples of project work in this area include providing cultural awareness training to health service providers, and the recruitment of First Nations, Inuit and Métis peer ambassadors to lead educational focus groups.

PROCEDURES TO ENSURE FOLLOW-UP OF ABNORMAL MAMMOGRAM RESULTS AND FAILSAFE

Diagnostic Interval

The time interval from an abnormal screen to diagnosis, especially for women requiring a tissue (core or open surgical) biopsy to reach resolution, is below the national target and there is significant regional variation (see *Appendix E, Table 7*). Diagnostic intervals are affected by a number of factors, including human and other resource shortages, such as access to surgical services. CCO works closely with the Regional Cancer Programs and partners to identify opportunities for improvement, disseminate best practices and implement strategies to improve performance.

QUALITY ASSURANCE

Clinical Practice Guidelines

CCO and the Program in Evidence-Based Care (PEBC) will soon publish new breast cancer screening guidelines. CCO will consider the recommendations made in these new guidelines because they relate to program design and evaluation. In August 2012, PEBC updated its screening guideline document for women at high risk for breast cancer[21].

Ongoing Transition to Digital Mammography

Based on the latest scientific evidence[20], CCO and the Ministry of Health and Long-Term Care have committed to ensuring that the OBSP's screening technology is of the highest quality. As part of the program's ongoing endeavor to advance quality of care, all mammography using computed radiography (CR) digital technology is being converted to direct radiography (DR) digital technology. This investment provides Ontario women with access to the best screening services available.

OBSP HIGH RISK SCREENING PROGRAM

The OBSP's High Risk Screening Program launched in July 2011. An evaluation of the program's first year of operations identified several areas of focus where further development is needed. These include raising awareness about the program among the public and providers, increasing the volume of referrals into the program and reassessing the clinical pathway to improve wait times throughout the patient journey.

FUTURE DIRECTIONS FOR OBSP RESEARCH

The OBSP is evidence-based and relies heavily on new research findings to guide program design and delivery. Future OBSP research will examine several key areas.

Evaluation of Organized Breast Assessment within the OBSP

Evaluating factors associated with wait times in breast cancer diagnosis will ultimately improve the prognosis for women and the effectiveness of breast screening and assessment. A research study recently funded by the Canadian Institutes of Health Research will evaluate whether women diagnosed with breast cancer have shorter diagnosis and treatment wait times, are less likely to be diagnosed with breast cancer again and are more likely to live longer if they receive follow-up tests in established breast assessment centres.

Personalized Risk Stratification for Prevention and Early Detection of Breast Cancer

Currently, regular screening mammography is recommended for women at average risk for breast cancer aged 50 to 74. However, there is a need to identify younger women who are most at risk, based on a wide variety of risk factors. A recently funded grant from Genome Canada and Genome Quebec is allowing researchers to develop new tools for identifying women at increased and high risk for breast cancer.

Effectiveness of the OBSP High Risk Screening Program

Collecting data from OBSP high risk screening centres allows us to monitor key performance indicators and process measures, which supports the provision of high-quality care. Early results suggest a significant benefit associated with annual magnetic resonance imaging (MRI), with mammogram, for women at high risk for breast cancer. Future research will further evaluate the effectiveness of this program by examining the proportion of early cancers it detects and whether it leads to improved survival.

Appendices

Appendix A: Methodology for Burden of Disease Indicators

A) CANCER INCIDENCE

CANCER BURDEN INDICATOR	CANCER INCIDENCE
Definition	**Age-specific incidence rate:** the number of new cases of invasive cancer diagnosed in a given age group during a defined period of time, per 100,000 persons in that age group during that time period **Age-standardized incidence rate:** the number of new cases of invasive cancer that would occur in a specified population if it had the same age distribution as a given standard population, per 100,000 people, during a defined time period
Calculation	**Age-specific incidence rate:** $\frac{\text{Total number of new cases of cancer in a given age group}}{\text{Total population in that age group}} \times 100{,}000$ **Age-standardized incidence rate:** $\frac{\sum \text{Age-specific incidence rate in a given age group x standard population in that age group}}{\text{Total population in the standard population}} \times 100{,}000$
Denominator	See "Calculation"
Numerator	See "Calculation"
Data Availability and Limitations	Incidence was calculated for cancers diagnosed through 2009, the most recent year for which the Ontario Cancer Registry had received complete data at the time of analysis.
Other Jurisdictions	• Canadian Cancer Society's Steering Committee on Cancer Statistics: Canadian Cancer Statistics 2012. Toronto, ON: Canadian Cancer Society, 2012. • Jemal A, Simard EP, Dorell C, Noone A, Markowitz LE, Kohler B, et al. Annual report to the nation on the status of cancer, 1975–2009, featuring the burden and trends in human papillomavirus (HPV)-associated cancers and HPV vaccination coverage levels. J Natl Cancer Inst 2013; 105(3): 175–201. • Siegal R, Naishadham D, Jemal A. Cancer Statistics, 2012. CA Cancer J Clin 2012; 62:10–29. • Ferlay J, Parkin DM, Steliarova-Foucher E. Estimates of cancer incidence and mortality in Europe in 2008. Eur J Cancer 2010 Jan;46:765–781. • Ferlay J, Shin H-R, Bray F, Forman D, Mathers C, Parkin DM. Estimates of worldwide burden of cancer in 2008: GLOBOCAN 2008. Int J Cancer 127:2893–917. • Curado MP, Edwards B, Shin HR, Storm H, Ferlay J, Heanue M and Boyle P, eds (2007). Cancer Incidence in Five Continents, Vol. IX. IARC Scientific Publications No. 160, Lyon, IARC.
Analysis	**Age-specific incidence rates:** • For breast cancer (ICD-O-3 code: C50) by five-year age group (20–24, 25–29, 30–34,…85+), 2005–2009. **Age-standardized incidence rates:** • Age-standardized to the age distribution of the 1991 Canadian census population using the direct method. • For breast cancer (ICD-O-3 code: C50), 1990–2009, all ages and by age group (30–49, 50–74) • Trends analyzed with Joinpoint software from the US National Cancer Institute, available and described at *http://surveillance.cancer.gov/joinpoint/*. Joinpoint fits one to four lines connected at "joinpoints" to trend data and selects the simplest model that best fits the data. Monte Carlo methods are used for tests of significance. Trends are described as stable unless increases or decreases over time are statistically significant. Three-year moving averages are used for graphical presentation of time trends to smooth fluctuations caused by random variation from one year to another. • Incidence analyzed for Ontario as a whole and by LHIN, for the period 2005–2009. **Other incidence-based analyses:** • Most common cancers diagnosed in Ontario women, 2009 (numbers of cases). • Data analyzed using SEER*Stat, available from *http://www.seer.cancer.gov/seerstat*.
Data Sources	• Cancer incidence data: Ontario Cancer Registry, Cancer Care Ontario, 2012 (Surveillance extract May 2012). • Population data: Canadian Demographic Estimates, 2007/2008, Statistics Canada, released July 2009 (1981–2006); Ontario Ministry of Finance. Ontario Population Projections Update, 2010–2036. Spring 2011 release (2007–2009).

B) CANCER MORTALITY

CANCER BURDEN INDICATOR	CANCER MORTALITY
Definition	**Age-specific mortality rates:** the number of new deaths attributed to cancer in a given age group during a defined period of time, per 100,000 persons in that age group during that time period. **Age-standardized mortality rates:** the number of new deaths from cancer that would occur in a specified population if it had the same age-distribution as a given standard population, per 100,000 people, during a defined time period.
Calculation	**Age-specific mortality rate:** $\frac{\text{Total number of new cancer deaths in a given age group}}{\text{Total population in that age group}} \times 100{,}000$ **Age-standardized mortality rate:** $\frac{\sum\text{Age-specific mortality rate in a given age group x standard population in that age group}}{\text{Total population in the standard population}} \times 100{,}000$
Denominator	See "Calculation"
Numerator	See "Calculation"
Data Availability and Limitations	Mortality rates were calculated through 2009, the most recent year for which the Ontario Cancer Registry had received complete data at the time of analysis.
Other Jurisdictions	• Canadian Cancer Society's Steering Committee on Cancer Statistics: Canadian Cancer Statistics 2012. Toronto, ON: Canadian Cancer Society, 2012. • Jemal A, Simard EP, Dorell C, Noone A, Markowitz LE, Kohler B, et al. Annual report to the nation on the status of cancer, 1975–2009, featuring the burden and trends in human papillomavirus (HPV)-associated cancers and HPV vaccination coverage levels. J Natl Cancer Inst 2013; 105(3): 175–201. • Siegal R, Naishadham D, Jemal A. Cancer Statistics, 2012. CA Cancer J Clin 2012; 62:10–29. • Ferlay J, Parkin DM, Steliarova-Foucher E. Estimates of cancer incidence and mortality in Europe in 2008. Eur J Cancer. 2010 Jan;46:765–781. • International cancer mortality: World Health Organization (WHO) database, available at *http://www-dep.iarc.fr*.
Analysis	**Age-specific mortality rates:** • For breast cancer (ICD-10 code: C50) by five-year age group (20–24, 25–29, 30–34,…85+), 2005–2009. **Age-standardized mortality rates:** • Age-standardized to the age distribution of the 1991 Canadian census population using the direct method. • For breast cancer (ICD-10 code: C50), 1990–2009, all ages and by age group (30-49, 50-74). • Trends analyzed with Jointpoint software from the US National Cancer Institute, available and described at *http://surveillance.cancer.gov/joinpoint* . Joinpoint fits one to four lines connected at "joinpoints" to trend data and selects the simplest model that best fits the data. Monte Carlo methods are used for tests of significance. Trends are described as stable unless increases or decreases over time are statistically significant. Three-year moving averages are used for graphical presentation of time trends to smooth fluctuations caused by random variation from one year to another. • Mortality analyzed for Ontario as a whole and by LHIN, for the period 2005–2009. **Other mortality-based analyses:** • Deaths attributed to three most common causes of cancer death in Ontario women, 2009 (numbers of deaths). • Data analyzed using SEER*Stat, available from *http://www.seer.cancer.gov/seerstat*.
Data Sources	• Cancer mortality data: Ontario Cancer Registry, 2012. • Population data: Canadian Demographic Estimates, 2007/2008, Statistics Canada, released July 2009 (1981–2006); Ontario Ministry of Finance. Ontario Population Projections Update, 2010–2036. Spring 2011 release (2007–2009).

C) CANCER PREVALENCE

CANCER BURDEN INDICATOR	CANCER PREVALENCE
Definition	The number of cases of cancer diagnosed during a specified time period who were still alive on a given date.
Calculation	Number of Ontario females diagnosed within the previous 10 years who were still alive on a given date.
Denominator	Not applicable.
Numerator	Not applicable.
Data Availability and Limitations	• The Ontario Cancer Registry does not actively follow cases and so deaths may be missed. This may lead to overestimates of prevalence. Prevalence is shown for cancers diagnosed through 2009, the most recent year for which the Ontario Cancer Registry had received complete data at the time of analysis.
Other Jurisdictions	• Ellison LF and Wilkins K. Cancer prevalence in the Canadian population. Health Rep 2009; 20: 7–19. • Louchini R, Beaupré M, Demers AA, Goggin P, Bouchard C. Trends in cancer prevalence in Quebec. Chronic Dis Can. 2006; 27:110–9. • Micheli A, Mugno E, Krogh V, et al. Cancer prevalence in European registry areas. Ann Oncol. 2002; 13:840–65.
Analysis	Number of Ontario females diagnosed with cancer of the breast (ICD-O-3 code: C50.0–C50.9) during the preceding 10 years and were still alive on January 1, 2010. • Also expressed as a total and as a fraction of the 2009 Ontario female population.
Data Sources	• Ontario Cancer Registry, Cancer Care Ontario, 2012 (Surveillance extract May 2012).

Appendix B: Methodology for Program Indicators

Data were extracted from the Integrated Client Management System (ICMS), a provincial breast cancer screening database developed by Cancer Care Ontario (CCO) to facilitate the operation, monitoring and evaluation of OBSP breast cancer screening and assessment activities. ICMS data were further linked to the Ontario Cancer Registry Information System (OCRIS), Pathology Information Management System (PIMS), and the all-cause Ontario Registrar's Mortality file to obtain non-program detected breast cancer diagnosis, stage and death data for indicator calculation.

Data presented in this report are based on Ontario Breast Screening Program (OBSP) centres only and do not reflect all breast cancer screening activity in the province. Data for opportunistic screening that takes place at non-OBSP centres were not included in this program evaluation report.

This report includes performance indicators for women at average risk and at high risk for breast cancer. For those aged 50 to 74 at average risk, program mammography performance is presented. Due to data availability and completeness, participation, abnormal call rate, diagnostic interval and positive predictive value (PPV) were reported up to 2011; cancer detection rates by type of cancer (in situ versus invasive) were reported up to 2010. Sensitivity, specificity and retention were reported up to 2009 to allow enough follow-up data to be captured.

This report also presents program performance for eligible women aged 30 to 69 at high risk for breast cancer registered in the OBSP High Risk Screening Program between July 2011 and June 2012. Follow-up of these women is through to March 2013.

METHODOLOGY FOR AVERAGE RISK PROGRAM INDICATORS

D) COVERAGE: PARTICIPATION RATE

AVERAGE RISK INDICATOR	PARTICIPATION RATE
Definition	Percentage of Ontario screen-eligible women, 50–74 years old, who completed at least one OBSP screening mammogram in a two-year period.
Calculation	$\frac{\text{Number of women completing at least one OBSP screening mammogram in a two-year period}}{\text{Number of Ontario screen-eligible women, 50–74 years old, in a given two-year period}} \times 100$
Denominator	**Definition:** • Number of Ontario screen-eligible women, 50–74 years old, in a given two-year period. **Inclusions:** • Ontario women aged 50–74 at the index date. • Index date was defined as the midpoint in a two-year period, e.g., January 1, 2011 for 2010–2011. **Exclusions**: • Women with a missing or invalid HIN, date of birth or postal code. • Women with an invasive or DCIS breast cancer, a mastectomy or a mammogram exclusion fee code (Q141) prior to the index date.
Numerator	**Definition:** • Number of Ontario screen-eligible women, 50–74 years old, who have completed at least one OBSP screening mammogram in a given two-year period. **Inclusions:** • OBSP mammograms for screening purposes were identified in ICMS. • Each woman was counted once regardless of the number of mammograms performed in a two-year period.
Data Availability and Limitations	• Historical RPDB address information is incomplete; therefore, the most recent primary address was selected for reporting, even for historical study periods.
Other Jurisdictions	• International Agency for Research on Cancer (IARC): Participation rate • Public Health Agency of Canada (PHAC): Participation rate • Canadian Partnership Against Cancer (CPAC): Participation rate
Analysis	• Age-standardized rate for 2008–2009, 2010–2011 for women aged 50–74. • Crude rate for 2010–2011 by five-year age group for women aged 50–74 and 50–69. • Age-standardized rate for 2010–2011 by LHIN for women aged 50–74. • The 2006 Canadian population was used as the standard population for calculating age-standardized rates. • PCCF+ version 5k was used to convert clients' residential postal code to LHIN[30].
Data Sources	• Integrated Client Management System (ICMS), Ontario Cancer Registry (OCR), Pathology Information Management System (PIMS), Registered Persons Database (RPDB), OHIP Claims History Database (CHDB), PCCF+ version 5k. • Data were extracted from the ICMS in January 2013.

E) COVERAGE: RETENTION RATE

AVERAGE RISK INDICATOR	RETENTION RATE
Definition	Percentage of OBSP screen-eligible women, 50–72 years old, who had a subsequent OBSP screening mammogram within 30 months of their previous OBSP screening mammogram.
Calculation	$\frac{\text{Number of women who had a subsequent OBSP screening mammogram within 30 months of a previous OBSP screening mammogram}}{\text{Number of women who had an OBSP screening mammogram in a given year}}$
Denominator	**Definition:** • Number of OBSP screen-eligible women, 50–72 years old, who had an OBSP screening mammogram in a given year. **Inclusions:** • Women who had an OBSP screening mammogram, aged 50–72 at the index date. • Index date was defined as the first OBSP screening mammogram date per woman in ICMS in a given year. • Each woman was counted once regardless of the number of screening mammograms performed; if a woman had multiple screening mammograms in a given year, the first screening mammogram date was selected. **Exclusions:** • Women with a missing or invalid HIN, date of birth or postal code. • Women with an invasive or DCIS breast cancer, a mastectomy or a mammogram exclusion fee code (Q141) prior to the index date. • Women who died, had breast cancer, had mammogram exclusion fee code (Q141) or had a mastectomy during the 30-month interval and who were not rescreened. • Women who were rescreened during the 30-month interval but who had a mastectomy, breast cancer diagnosis or mammogram exclusion fee code (Q141) before the rescreen date.
Numerator	**Definition**: • Number of Ontario screen-eligible women, 50–72 years old, who had a subsequent OBSP screening mammogram within 30 months of a previous OBSP screening mammogram. **Inclusion:** • Women, 50–72 years old, who had a subsequent mammogram within 30 months. • If a woman had more than one subsequent OBSP screening mammogram during the 30-month interval, the earliest screen date was selected.
Data Availability and Limitations	• OBSP data are available from 1990. • This indicator includes OBSP mammograms only (excludes non-OBSP mammograms) as the current report is intended to monitor the performance of the OBSP. • Women who have moved out of the province could not be excluded. • There is a 31-month reporting lag for this indicator, as 1 month is required to allow for the data entry of the screening result and 30 months is required to follow up clients to determine the next screen date.
Other Jurisdictions	• Public Health Agency of Canada (PHAC): Retention rate • Canadian Partnership Against Cancer (CPAC): Retention rate • European Union: No similar measure
Analysis	• For 2008 and 2009, initial screens and rescreens for women aged 50–72. • For 2009 by five-year age group, initial screens and rescreens for women aged 50–72 and 50–67. • For 2009 by LHIN, initial screens and rescreens for women aged 50–72 (LHIN is based on the location of the OBSP screening site).
Data Sources	• Integrated Client Management System (ICMS), Ontario Cancer Registry (OCR), Pathology Information Management System (PIMS), OHIP Claims History Database (CHDB). • Data were extracted from the ICMS in January 2013.

F) FOLLOW-UP: ABNORMAL CALL RATE

AVERAGE RISK INDICATOR	ABNORMAL CALL RATE
Definition	Percentage of OBSP women, 50–74 years old, who were referred for further testing because of an abnormal program screening mammogram result.
Calculation	$\frac{\text{Number of women with an abnormal OBSP screening mammogram result}}{\text{Number of women who had an OBSP screening mammogram in a given year}} \times 100$
Denominator	**Definition:** • Number of women, 50–74 years old, who had an OBSP screening mammogram in a given year. **Inclusions:** • Women who had an OBSP screening mammogram, aged 50–74 at the index date. • Index date was defined as the first OBSP screening mammogram date per woman in ICMS in a given year. • Each woman was counted once regardless of the number of screening mammograms performed; if a woman had multiple screening mammograms in a given year, the first screening mammogram date was selected. **Exclusions:** • Women with a missing or invalid HIN, date of birth or postal code. • Women with an invasive or DCIS breast cancer, a mastectomy or a mammogram exclusion fee code (Q141) prior to the index date.
Numerator	• Number of women who had an OBSP screening mammogram, 50–74 years old, who were referred for further testing because of an abnormal OBSP screening mammogram result. **Inclusions:** • Women, aged 50–74, who had an abnormal OBSP screening mammogram result. • An abnormal screening mammogram result was defined as an OBSP screening mammogram referred for further testing by the screening radiologist in ICMS.
Data Availability and Limitations	• OBSP data are available from 1990. • This indicator includes OBSP mammograms only (excludes non-OBSP mammograms) as the current report is intended to monitor the performance of the OBSP.
Other Jurisdictions	• Public Health Agency of Canada (PHAC): Abnormal rate • Canadian Partnership Against Cancer (CPAC): Abnormal rate • European Union: Abnormal rate
Analysis	• For 2008–2011, initial screens and rescreens for women aged 50–74. • For 2011 by five-year age group, initial screens and rescreens, for women aged 50–74 and 50–69. • For 2011 by LHIN, initial screens and rescreens for women aged 50–74 (LHIN is based on the location of the OBSP screening site).
Data Sources	• Integrated Client Management System (ICMS), Ontario Cancer Registry (OCR), Pathology Information Management System (PIMS), OHIP Claims History Database (CHDB). • Data were extracted from the ICMS in January 2013.

G) FOLLOW-UP: DIAGNOSTIC INTERVAL

AVERAGE RISK INDICATOR	DIAGNOSTIC INTERVAL
Definition	Percentage of women who had an abnormal OBSP screening mammogram result, 50–74 years old, who were diagnosed (benign or cancer) within the recommended time interval.
Calculation	$\frac{\text{Number of women who had an abnormal OBSP screening mammogram diagnosed within the recommended time interval}}{\text{Number of women who had an abnormal OBSP screening mammogram}} \times 100$
Denominator	**Definition:** • Number of women who had an abnormal OBSP screening mammogram result, 50–74 years old. **Inclusions:** • Women who had an abnormal OBSP screening mammogram result, aged 50–74 at the index date. • Index date was defined as the first OBSP screening mammogram date per woman in ICMS in a given year. • An abnormal screening mammogram result was defined as an OBSP screening mammogram referred for further testing by the screening radiologist in ICMS. • Each woman was counted once regardless of the number of screening mammograms performed; if a woman had multiple screening mammograms in a given year, the first screening mammogram date was selected. **Exclusions:** • Women with a missing or invalid HIN, date of birth or postal code. • Women with an invasive or DCIS breast cancer, a mastectomy or a mammogram exclusion fee code (Q141) prior to the index date. • Women with a final result of "unknown/lost to follow-up".
Numerator	**Definition:** • Number of women who had an abnormal OBSP screening mammogram result, 50–74 years old, who were diagnosed within the recommended time interval. **Inclusions:** • Women who had an abnormal OBSP screening mammogram result, aged 50–74 at the index date, who were diagnosed within the recommended time interval: five weeks of the abnormal screening mammogram date if without a tissue (core or surgical) biopsy, OR seven weeks of the abnormal screening mammogram date if with a tissue biopsy. • Date of diagnosis for benign cases was defined as (in order of preference): 1) date of the last benign biopsy, 2) date of the last benign procedure or 3) date of the last procedure prior to a recommendation to return to regular screening or early recall. • Date of diagnosis for breast cancer cases was defined as the date of the first cytologic or pathologic diagnosis of breast cancer (in situ or invasive). • For cases that were diagnosed as ductal carcinoma in situ (DCIS) on core biopsy but as invasive breast carcinoma on surgical biopsy, the date of diagnosis was defined as the earlier date (date of the core biopsy).
Data Availability and Limitations	• OBSP data are available from 1990. • This indicator includes OBSP mammograms only (excludes non-OBSP mammograms) as the current report is intended to monitor the performance of the OBSP.
Other Jurisdictions	• Public Health Agency of Canada (PHAC): Diagnostic interval • Canadian Partnership Against Cancer (CPAC): Diagnostic interval • European Union: Interval between screening test and final assessment/surgery
Analysis	• For 2008–2011, with and without tissue biopsy for women aged 50–74. • For 2011 by five-year age group, with and without tissue biopsy, for women aged 50–74 and 50–69. • For 2011 by LHIN, with and without tissue biopsy for women aged 50–74 (LHIN is based on the location of the OBSP screening site).
Data Sources	• Integrated Client Management System (ICMS), Ontario Cancer Registry (OCR), Pathology Information Management System (PIMS), OHIP Claims History Database (CHDB). • Data were extracted from the ICMS in January 2013.

H) QUALITY OF SCREENING: POSITIVE PREDICTIVE VALUE

AVERAGE RISK INDICATOR	POSITIVE PREDICTIVE VALUE
Definition	Percentage of women with an abnormal OBSP screening mammogram result, 50–74 years old, who were diagnosed with breast cancer (DCIS or invasive) after diagnostic work-up.
Calculation	$\frac{\text{Number of women who had an abnormal mammogram with a screen-detected breast cancer diagnosis}}{\text{Number of women who had an abnormal OBSP screening mammogram}} \times 100$
Denominator	**Definition:** • Number of women who had an abnormal OBSP screening mammogram result, 50–74 years old. **Inclusions:** • Women who had an abnormal OBSP screening mammogram result, aged 50–74 at the index date. • Index date was defined as the first OBSP screening mammogram date per woman in ICMS in a given year. • An abnormal screening mammogram result was defined as an OBSP screening mammogram referred for further testing by the screening radiologist in ICMS. • Each woman was counted once regardless of the number of screening mammograms performed; if a woman had multiple screening mammograms in a given year, the first screening mammogram date was selected. **Exclusions:** • Women with a missing or invalid HIN, date of birth or postal code. • Women with an invasive or DCIS breast cancer, a mastectomy or a mammogram exclusion fee code (Q141) prior to the index date. • Women with a final result of "unknown/lost to follow-up".
Numerator	**Definition:** • Number of women who had an abnormal OBSP screening mammogram result, 50–74 years old, who were diagnosed with breast cancer (DCIS or invasive) after diagnostic work-up.
Data Availability and Limitations	• OBSP data are available from 1990. • This indicator includes OBSP mammograms only (excludes non-OBSP mammograms) as the current report is intended to monitor the performance of the OBSP program.
Other Jurisdictions	• Public Health Agency of Canada (PHAC): Positive predictive value • Canadian Partnership Against Cancer (CPAC): Positive predictive value • European Union: Positive predictive value of screening test, recall, FNA and core biopsy
Analysis	• For 2008–2011, initial screens and rescreens for women aged 50–74. • For 2011 by five-year age group, initial screens and rescreens for women aged 50–74 and 50–69. • For 2011 by LHIN, initial screens and rescreens for women aged 50–74 (LHIN is based on the location of the OBSP screening site).
Data Sources	• Integrated Client Management System (ICMS), Ontario Cancer Registry (OCR), Pathology Information Management System (PIMS), OHIP Claims History Database (CHDB). • Data were extracted from the ICMS in January 2013.

I) QUALITY OF SCREENING: SENSITIVITY AND SPECIFICITY

AVERAGE RISK INDICATOR	SENSITIVITY AND SPECIFICITY
Definition	**Sensitivity:** Percentage of women diagnosed with breast cancer (DCIS or invasive) within a year of the mammogram date, 50–74 years old, who had an abnormal OBSP screening mammogram result followed by a final diagnosis of breast cancer after completion of diagnostic assessment. **Specificity:** Percentage of women without a breast cancer diagnosis (DCIS or invasive) within a year of the mammogram date, 50–74 years old, who had a normal OBSP screening mammogram result.
Calculation	**OBSP Screening Mammogram Result** / **DCIS/Invasive Breast Cancer**: **Present** / **Absent** Abnormal: True-Positive / False-Positive Normal: False-Negative / True-Negative **Sensitivity** $\frac{\text{Number of true-positives}}{\text{Number of true-positives and false-negatives}} \times 100$ **Specificity** $\frac{\text{Number of true-negatives}}{\text{Number of true-negatives and false-positives}} \times 100$
Denominator	**Definition for Sensitivity:** • Number of women who had an OBSP screening mammogram, 50–74 years old, who were diagnosed with breast cancer (DCIS or invasive) within one year of the index date. **Definition for Specificity:** • Number of women who had an OBSP screening mammogram, 50–74 years old, who were not diagnosed with breast cancer (DCIS or invasive) within one year of the index date. **Inclusions:** • Women who had an OBSP screening mammogram, aged 50–74 at the index date. • For sensitivity, women who were diagnosed with breast cancer within one year of the index date. Women with a breast cancer diagnosis were defined as those women with a screen-detected or post-screen cancer. • For specificity, women who were not diagnosed with breast cancer within one year of the index date. Women without a breast cancer diagnosis were defined as those women without a screen-detected or post-screen cancer. • Index date was defined as the first OBSP screening mammogram date per woman in ICMS in a given year. • Post-screen cancers were defined as any cancer diagnosed before the next scheduled screening mammogram visit after a previous normal or benign screening episode. A normal screening episode was defined as a normal screening mammogram. A benign screening episode was defined as an abnormal screening mammogram followed by diagnostic assessment, resulting in a final benign diagnosis. • Each woman was counted once regardless of the number of screening mammograms performed. **Exclusions:** • Women with a missing or invalid HIN, date of birth or postal code. • Women with an invasive or DCIS breast cancer, a mastectomy or a mammogram exclusion fee code (Q141) prior to the index date. • Women with a final result of "unknown/lost to follow-up".

AVERAGE RISK INDICATOR	SENSITIVITY AND SPECIFICITY
Numerator	**Definition for Sensitivity:** • Women, 50–74 years old, who had an abnormal OBSP screening mammogram result and who, after completion of diagnostic assessment, were diagnosed with breast cancer (DCIS or invasive) within one year of the index date. **Definition for Specificity:** • Women, 50–74 years old, who had a normal OBSP screening mammogram result and who were not diagnosed with breast cancer (DCIS or invasive) within one year of the index date. **Inclusions:** • For sensitivity, women, 50–74 years old, who had an abnormal OBSP screening mammogram result and who, after completion of diagnostic assessment, were diagnosed with breast cancer (DCIS or invasive) within one year of the index date for sensitivity. An abnormal screening mammogram result was defined as an OBSP screening mammogram that was referred for further testing by the screening radiologist in ICMS. • For specificity, women, 50–74 years old, who had a normal OBSP screening mammogram result and who were not diagnosed with breast cancer (DCIS or invasive) within one year of the index date for specificity. A normal screening mammogram result was defined as an OBSP screening mammogram that was not referred for further testing by the screening radiologist in ICMS.
Data Availability and Limitations	• OBSP data are available from 1990. • This indicator includes OBSP mammograms only (excludes non-OBSP mammograms) as the current report is intended to monitor the performance of the OBSP.
Other Jurisdictions	• Public Health Agency of Canada (PHAC): Interval cancer rate • Canadian Partnership Against Cancer (CPAC): Sensitivity • European Union: Interval cancer rate, Specificity of the screening test
Analysis	• For 2008 and 2009, overall rates for women aged 50–74. • For 2009 by five-year age group, for women aged 50–74 and 50–69. • For 2009 by LHIN for women aged 50–74 (LHIN is based on the location of the OBSP screening site).
Data Sources	• Integrated Client Management System (ICMS), Ontario Cancer Registry (OCR), Pathology Information Management System (PIMS), OHIP Claims History Database (CHDB). • Data were extracted from the ICMS in January 2013.

J) DETECTION: BREAST CANCER DETECTION RATE

AVERAGE RISK INDICATOR	BREAST CANCER DETECTION RATE
Definition	Number of women, 50–74 years old, with a screen-detected breast cancer per 1,000 women who had an OBSP screening mammogram.
Calculation	$\frac{\text{Number of women with a screen-detected breast cancer}}{\text{Number of women who had an OBSP screening mammogram in a given year}} \times 1{,}000$
Denominator	**Definition:** • Number of women who had an OBSP screening mammogram, 50–74 years old. **Inclusions:** • Women who had an OBSP screening mammogram, aged 50–74 at the index date. • Index date was defined as the first OBSP screening mammogram date per woman in ICMS in a given year. • Each woman was counted once regardless of the number of screening mammograms performed; if a woman had multiple screening mammograms in a given year, the first screening mammogram date was selected. **Exclusions:** • Women with a missing or invalid HIN, date of birth or postal code. • Women with an invasive or ductal carcinoma in situ (DCIS) breast cancer, a mastectomy or a mammogram exclusion fee code (Q141) prior to the index date. • Women with a final result of "unknown/lost to follow-up".
Numerator	**Definition:** • Number of women who had an OBSP screening mammogram, 50–74 years old, with a screen-detected breast cancer diagnosis. **Inclusions:** • Women who had an OBSP screening mammogram, aged 50–74 at the index date, with a screen-detected breast cancer diagnosis.
Data Availability and Limitations	• OBSP data are available from 1990. • This indicator includes OBSP mammograms only (excludes non-OBSP mammograms) as the current report is intended to monitor the performance of the OBSP.
Other Jurisdictions	• Public Health Agency of Canada (PHAC): In situ and invasive cancer detection rate • Canadian Partnership Against Cancer (CPAC): Pre-cancer and cancer detection rate • European Union: Proportion of screen-detected cancers that are invasive versus in situ
Analysis	• For 2008–2010, initial screens and rescreens for women aged 50–74 by type of cancer (DCIS versus invasive). • For 2010 by five-year age group, initial screens and rescreens for women aged 50–74 and 50–69 by type of cancer (DCIS versus invasive). • For 2010 by LHIN , initial screens and rescreens for women aged 50–74 (LHIN is based on the location of the OBSP screening site) by type of cancer (DCIS versus invasive). • DCIS versus invasive cancer was defined based on the behaviour code (5th digit of the morphology code).
Data Sources	• Integrated Client Management System (ICMS), Ontario Cancer Registry (OCR), Pathology Information Management System (PIMS), OHIP Claims History Database (CHDB). • Data were extracted from the ICMS in January 2013.

K) DISEASE EXTENT AT DIAGNOSIS: EARLY STAGE INVASIVE BREAST CANCER DETECTION RATE

AVERAGE RISK INDICATOR	EARLY STAGE INVASIVE BREAST CANCER DETECTION RATE
Definition	Percentage of women who had an OBSP screening mammogram, 50–74 years old, with an early stage (stage I) screen-detected invasive breast cancer.
Calculation	$\frac{\text{Number of women with an early stage (stage I) screen-detected invasive breast cancer}}{\text{Number of women with a screen-detected invasive breast cancerr}} \times 100$
Denominator	**Definition:** • Number of women who had an OBSP screening mammogram, 50–74 years old, with a screen-detected invasive breast cancer. **Inclusions:** • Women who had an OBSP screening mammogram, aged 50–74 at the index date, and who had a screen-detected invasive breast cancer. • Index date was defined as the first OBSP screening mammogram date per woman in ICMS in a given year. • Invasive breast cancer was defined based on the behaviour code (5th digit of morphology code). • Each woman was counted once regardless of the number of screening mammograms performed; if a woman had multiple screening mammograms in a given year, the first screening mammogram date was selected. **Exclusions:** • Women with a missing or invalid HIN, date of birth or postal code. • Women with an invasive or DCIS breast cancer, a mastectomy or a mammogram exclusion fee code (Q141) prior to the index date. • Women with invasive cancer with unknown stage.
Numerator	**Definition:** • Number of women who had an OBSP screening mammogram, 50–74 years old, with an early stage (stage I) screen-detected invasive breast cancer.
Data Availability and Limitations	• OBSP data are available from 1990. • This indicator includes OBSP mammograms only (excludes non-OBSP mammograms) as the current report is intended to monitor the performance of the OBSP.
Other Jurisdictions	• Public Health Agency of Canada (PHAC): Screen-detected invasive cancer tumour size and axillary lymph nodal status. • Canadian Partnership Against Cancer (CPAC): Early stage invasive cancer detection rate. • European Union: Stage of screen-detected cancers (includes in situ as well as invasive cancers).
Analysis	• For 2008–2010, overall rates for women aged 50–74. • For 2010 by five-year age group for women aged 50–74 and 50–69. • For 2010 by LHIN for women aged 50–74 (LHIN is based on the location of the OBSP screening site).
Data Sources	• Integrated Client Management System (ICMS), Ontario Cancer Registry (OCR), Pathology Information Management System (PIMS), OHIP Claims History Database (CHDB). • Data were extracted from the ICMS in January 2013.

Methodology for High Risk Program Indicators

A) COVERAGE: ELIGIBILITY – PERCENTAGE OF WOMEN CONFIRMED TO BE AT HIGH RISK (CATEGORY B)

HIGH RISK INDICATOR	PERCENTAGE OF WOMEN CONFIRMED TO BE AT HIGH RISK (CATEGORY B)
Definition	Percentage of women (Category B) confirmed to be at high risk by genetic assessment (counselling and/or testing). • Category B is defined as those women who are referred to genetic assessment to determine their eligibility for the OBSP High Risk Screening Program.
Calculation	$\frac{\text{Number of women confirmed to be at high risk by genetic assessment}}{\text{Total number of women who completed genetic assessment}} \times 100$
Denominator	**Definition:** • Total number of women, aged 29–69 years, who completed genetic assessment. **Inclusions:** • Women, 29–69 years old, who completed genetic assessment. • Women with an OBSP registration date (date the high risk referral information was entered). • Women with an initial primary care provider visit date. • Women with a genetic counselling date and genetic testing date, if done. • The woman's most current genetic assessment (based on the breast cancer genetic assessment report data entry date). • The age as of OBSP registration date. **Exclusions:** • Women with a missing or invalid HIN, or date of birth. • Women who completed genetic assessment but for whom eligibility is unknown.
Numerator	• Number of women, aged 29–69 years, confirmed to be at high risk by genetic assessment (counselling and/or testing). **Inclusions:** • Women, 29–69 years old, confirmed to be at high risk.
Data Availability and Limitations	• Data are available from July 2011.
Other Jurisdictions	• None
Analysis	• For women aged 29–69 registered between July 1, 2011 and June 30, 2012 by LHIN. • Follow-up was through March 2013. • Analysis by type of genetic assessment received (genetic counselling only versus genetic counselling and testing).
Data Sources	• Integrated Client Management System (ICMS). • Data were extracted from the ICMS in March 2013.

B) FOLLOW-UP: DURATION INDICATORS

HIGH RISK INDICATOR	DURATION INDICATORS
Definition	1) Duration (days) from the client's initial healthcare provider visit to the subsequent genetic counselling date (Category B) 2) Duration (days) from genetic counselling to genetic testing (Category B) 3) Duration (days) from the genetic lab report issue date to the date the client was informed of their risk assessment results by the genetic clinic (Category B) 4) Duration (days) from the appointment booking date to the first screen date (Category A and B) • Category A is defined as those women with known risk referred directly to the OBSP High Risk Screening Program by a physician. • Category B is defined as those women who are referred to genetic assessment to determine their eligibility for the OBSP High Risk Screening Program.
Measures	**Definition:** • Median and 90th percentile durations (days) among women aged 29–69 years for the following periods: 1) From health care provider visit to genetic counseling or 2) From genetic counseling date to genetic testing or 3) From genetic lab report issue date to the date the client was informed of their risk assessment results by the genetic clinic or 4) From the last booking date (if more than one due to rescheduling) to the first high risk screening test date **Inclusions:** • Women, 29–69 years old, who received genetic counselling (for first duration) and genetic testing (for second and third duration) or confirmed high risk women for the fourth duration. • Women with an OBSP registration date (date the high risk referral information was entered). • Women with an initial primary care provider visit date. • The woman's most current genetic assessment (based on the breast cancer genetic assessment report data entry date) (Category B women only). • The age as of OBSP registration date. **Exclusions:** • Women with a missing or invalid HIN, or date of birth. • Women with negative durations. • Women who completed genetic assessment (counselling and/or testing) but for whom eligibility is unknown.
Data Availability and Limitations	• Data are available from July 2011.
Other Jurisdictions	• None
Analysis	• For women aged 29–69 registered between July 1, 2011 and June 30, 2012. • Follow-up was through March 2013.
Data Sources	• Integrated Client Management System (ICMS). • Data were extracted from the ICMS in March 2013.

C) FOLLOW-UP: PRIOR TO SCREENING – PERCENTAGE OF WOMEN WITH A LAB REPORT RESULT WITHIN 90 DAYS OF A GENETIC TEST (CATEGORY B)

HIGH RISK INDICATOR	PERCENTAGE OF WOMEN WITH A LAB REPORT RESULT WITHIN 90 DAYS OF A GENETIC TEST (CATEGORY B)
Definition	• Percentage of women (Category B) with a lab report result within 90 days (or 60 days if expedited test) of genetic testing. Category B is defined as those women who are referred to genetic assessment to determine their eligibility for the OBSP High Risk Screening Program.
Calculation	$\frac{\text{Number of women with a lab report date within 90 days (or 60 days if expedited test) of genetic test date}}{\text{Number of women who received genetic testing}} \times 100$
Denominator	**Definition:** • Number of women, aged 29–69 years, who received genetic testing. **Inclusions:** • Women, 29–69 years old, who received genetic testing. • Women with an OBSP registration date (date the high risk referral information was entered). • Women with an initial primary care provider visit date. • Women with a lab report date and genetic test date. • The woman's most current genetic test (based on the breast cancer genetic assessment report data entry date). • The age as of OBSP registration date. **Exclusions:** • Women with a missing or invalid HIN, or date of birth. • Women with negative durations (lab report result before genetic test date).
Numerator	**Definition:** • Number of women, 29–69 years old, with a lab report result within 90 days of the genetic test date. **Inclusions:** • Women, 29–69 years old, with a lab report result within 90 days (or 60 days if expedited test) of the genetic test date.
Data Availability and Limitations	• Data are available from July 2011.
Other Jurisdictions	• None
Analysis	• For women aged 29–69 registered between July 1, 2011 and June 30, 2012. • Follow-up was through March 2013.
Data Sources	• Integrated Client Management System (ICMS). • Data were extracted from the ICMS in March 2013.

D) FOLLOW-UP: PRIOR TO SCREENING – PERCENTAGE OF WOMEN SCREENED WITHIN 90 DAYS OF CONFIRMATION OF HIGH RISK STATUS

HIGH RISK INDICATOR	PERCENTAGE OF WOMEN SCREENED WITHIN 90 DAYS OF CONFIRMATION OF HIGH RISK STATUS
Definition	Percentage of women screened with both tests within 90 days of confirmation of high risk status. • Date of confirmation of high risk status for women referred by a physician (Category A) is defined as the most recent of either the original date the referral was entered or the updated date. For women referred to genetic assessment (Category B) it is defined as the most recent of either the original date the genetic assessment was entered or the updated date. • Date of screen is defined as the date of the woman's last screening test in the OBSP High Risk Screening Program.
Calculation	$\frac{\text{Number of women screened with both tests within 90 days of confirmation of high risk status}}{\text{Total number of women confirmed to be at high risk}} \times 100$
Denominator	**Definition:** Total number of women, aged 30–69 years, confirmed to be at high risk. **Inclusions:** • Women, 30–69 years old, confirmed to be at high risk. • Women screened with at least an MRI (or ultrasound) or with no screen. • Includes partial screens where a normal complementary screening test was performed within the previous six months. • Women who had an ultrasound instead of an MRI (i.e., MRI is contraindicated). • Women with an OBSP registration date (date the high risk referral information was entered). • Women with an initial primary care provider visit date. • The woman's most current genetic assessment (counselling and/or testing) (based on the breast cancer genetic assessment report data entry date). • The age as of OBSP registration date. **Exclusions:** • Women with a missing or invalid HIN, or date of birth. • Women who declined (includes unable to contact), are ineligible for screening or deferred screening • Women with negative duration (confirmation date after last screen date). • Women who had a prior external MRI within the first year of the OBSP High Risk Screening Program. • A woman's subsequent screen in each calendar year.
Numerator	**Definition:** Number of women, aged 30–69 years, screened with an MRI (or ultrasound) within 90 days of confirmation of high risk status. **Inclusions:** • Women, 30–69 years old, confirmed to be at high risk. • Women screened with both tests within 90 days of confirmation of high risk status. • Includes partial screens where a normal complementary screening test was performed within the previous six months.
Data Availability and Limitations	• Data are available from July 2011. • Women can be referred to genetic assessment at age 29, but cannot be screened in the OBSP High Risk Screening Program until age 30 (or 10 weeks short of their 30th birthday). • There is a four-month reporting lag for this indicator as up to three months are required to allow follow-up of women for the screening to occur after confirmation of high risk status. Another month is required for the data entry of the screening result. • Some women may have deferred or declined their screening appointments; this is not always documented in ICMS. • Women referred by a physician (Category A) after July 1, 2011 may have had both an MRI and mammogram prior to their registration in the OBSP High Risk Screening Program and are not due to be rescreened until one year after their previous screening date. These women will therefore not meet the 90-day target.
Other Jurisdictions	• None
Analysis	• For women aged 29–69 registered between July 1, 2011 and June 30, 2012. • Follow-up was through March 2013.
Data Sources	• Integrated Client Management System (ICMS). • Data were extracted from the ICMS in March 2013.

E) FOLLOW-UP: BETWEEN SCREENING MODALITIES – PERCENTAGE OF WOMEN SCREENED WITH BOTH TESTS WITHIN 30 DAYS

HIGH RISK INDICATOR	PERCENTAGE OF WOMEN SCREENED WITH BOTH TESTS WITHIN 30 DAYS
Definition	Percentage of women screened with MRI within 30 days of a mammogram.
Calculation	$\frac{\text{Number of women screened with MRI within 30 days of the mammogram}}{\text{Total number of women screened with mammogram}} \times 100$
Denominator	**Definition:** • Number of women screened with a mammogram, aged 30–69 years. **Inclusions:** • Women, 30–69 years old, confirmed to be at high risk and screened with a mammogram. • Complete screens (mammogram and MRI performed where the MRI took place after the mammogram). • Includes MRI-only screens where there was a normal mammogram performed within the previous six months. • Mammogram-only screens (no recent previous MRI and no subsequent MRI). • Women who had an ultrasound instead of an MRI (i.e., MRI is contraindicated). • Women with an OBSP registration date (date the high risk referral information was entered). • Women with an initial primary care provider visit date. • The age as of the earliest screening modality (MRI/ultrasound or mammogram). **Exclusions:** • Women with a missing or invalid HIN, or date of birth. • A woman's subsequent screen in each calendar year.
Numerator	**Definition:** • Number of women, aged 30–69 years, screened with MRI within 30 days of the mammogram. • MRI-only screens with a previous recent mammogram within six months are counted as having met the target. **Inclusions:** • Women, 30–69 years old, confirmed to be at high risk. • Women screened with MRI within 30 days of the mammogram (MRI-only screens where there was a normal mammogram performed within the previous six months were coded as having met the target).
Data Availability and Limitations	• Data are available from July 2011. • Women can be referred to genetic assessment at age 29, but cannot be screened in the OBSP High Risk Screening Program until age 30 (or 10 weeks short of their 30th birthday). • There is a two-month reporting lag for this indicator as one complete month is required to allow follow-up of women for the second screening modality to occur and another month is required for the data entry of the screening result into ICMS.
Other Jurisdictions	• None
Analysis	• For women aged 29–69 registered between July 1, 2011 and June 30, 2012. • Follow-up was through March 2013.
Data Sources	• Integrated Client Management System (ICMS). • Data were extracted from the ICMS in March 2013.

F) FOLLOW-UP: AFTER SCREENING – ABNORMAL CALL RATE

HIGH RISK INDICATOR	ABNORMAL CALL RATE
Definition	Percentage of high risk screened women referred for further testing because of an abnormal screen result.
Calculation	$\frac{\text{Number of high risk screened women referred for further testing because of an abnormal screen result}}{\text{Total number of women who had a high risk screen}} \times 100$
Denominator	**Definition:** • Total number of women, aged 30–69 years, with a high risk screen. **Inclusions:** • Women, 30–69 years old, who were screened and have a screen result entered. • Women screened with at least an MRI (or ultrasound). • Includes partial screens where there was a normal complementary screening test performed within the previous six months. • Women who had an ultrasound instead of an MRI (i.e., MRI is contraindicated). • Women with an OBSP registration date (date the high risk referral information was entered). • Women with an initial primary care provider visit date. • The age as of the earliest screening modality (MRI/ultrasound or mammogram). **Exclusions:** • Women with a missing or invalid HIN, or date of birth. • A woman's subsequent screen in each calendar year.
Numerator	**Definition:** • Number of high risk screened women, 30–69 years old, referred for further testing because of an abnormal screen result. **Inclusions:** • Women, 30–69 years old, confirmed to be at high risk, with an abnormal screen result (mammogram and/or MRI or ultrasound).
Data Availability and Limitations	• Data are available from July 2011. • Women can be referred to genetic assessment at age 29, but cannot be screened in the OBSP High Risk Screening Program until age 30 (or 10 weeks short of their 30th birthday). • There is a two-month reporting lag for this indicator as one complete month is required to allow follow-up of women for the second screening modality to occur and another month is required for the data entry of the screening result into ICMS.
Other Jurisdictions	• Public Health Agency of Canada (PHAC): Abnormal call rate • Canadian Partnership Against Cancer (CPAC): Abnormal rate • European Union: Abnormal rate
Analysis	• For women aged 29–69 registered between July 1, 2011 and June 30, 2012. • Follow-up was through March 2013.
Data Sources	• Integrated Client Management System (ICMS). • Data were extracted from the ICMS in March 2013.

G) QUALITY OF SCREENING: POSITIVE PREDICTIVE VALUE

HIGH RISK INDICATOR	POSITIVE PREDICTIVE VALUE
Definition	Percentage of women with abnormal mammograms diagnosed with breast cancer (DCIS or invasive) after completion of diagnostic work-up.
Calculation	$\frac{\text{Number of women with screen-detected breast cancer (DCIS and invasive)}}{\text{Number of high risk screened women referred for further testing because of an abnormal screen result}} \times 100$
Denominator	**Definition:** • Number of high risk screened women, aged 30–69 years, referred for further testing because of an abnormal screen result. **Inclusions:** • Women, 30–69 years old, confirmed to be at high risk. • Women with an abnormal screen result (mammogram and/or MRI or ultrasound). • Women screened with at least an MRI (or ultrasound). • Includes partial screens where there was a normal complementary screening test performed within the previous six months. • Women who had an ultrasound instead of an MRI (i.e., MRI is contraindicated). • Women with an OBSP registration date (date the high risk referral information was entered). • Women with an initial primary care provider visit date. • The age as of the earliest screening modality (MRI/ultrasound or mammogram). **Exclusions:** • Women with a missing or invalid HIN, or date of birth. • A woman's subsequent screen in each calendar year. • Women with no final result entered.
Numerator	**Definition**: • Number of women, aged 30–69 years, with a screen-detected breast cancer (DCIS or invasive) following an abnormal screen result. **Inclusions:** • Women, 30–69 years old, confirmed to be at high risk. • Women with a screen-detected breast cancer (DCIS or invasive) following an abnormal screen result.
Data Availability and Limitations	• Data are available from July 2011. • Women can be referred to genetic assessment at age 29, but cannot be screened in the OBSP High Risk Screening Program until age 30 (or 10 weeks short of their 30th birthday). • There is an eight-month reporting lag for this indicator as regions have up to eight months following the abnormal screen date to enter all of the assessment information and final diagnosis into the ICMS.
Other Jurisdictions	• Public Health Agency of Canada (PHAC): Positive predictive value • Canadian Partnership Against Cancer (CPAC): Positive predictive value • European Union: Positive predictive value of screening test, recall FNA and core biopsy
Analysis	• For women aged 29–69 registered between July 1, 2011 and June 30, 2012. • Follow-up was through March 2013.
Data Sources	• Integrated Client Management System (ICMS). • Data were extracted from the ICMS in March 2013.

H) DETECTION: BREAST CANCER DETECTION RATE (DCIS AND INVASIVE)

HIGH RISK INDICATOR	BREAST CANCER DETECTION RATE (DCIS AND INVASIVE)
Definition	Number of women detected with breast cancer (DCIS and invasive) per 1,000 women screened.
Calculation	$\frac{\text{Number of women with screen-detected breast cancer (DCIS and invasive)}}{\text{Number of women who had a high risk screen}} \times 1000$
Denominator	**Definition:** • Number of women, aged 30–69 years, screened in the OBSP High Risk Screening Program with a final result. **Inclusions:** • Women, 30–69 years old, confirmed to be at high risk. • Women screened with at least an MRI (or ultrasound). • Includes partial screens where there was a normal complementary screening test performed within the previous six months. • Women who had an ultrasound instead of an MRI (i.e., MRI is contraindicated). • Women with an OBSP registration date (date the high risk referral information was entered). • Women with an initial primary care provider visit date. • The age as of the earliest screening modality (MRI/ultrasound or mammogram). **Exclusions:** • Women with a missing or invalid HIN, or date of birth. • A woman's subsequent screen in each calendar year. • Women with no final result entered.
Numerator	**Definition**: • Number of women, aged 30–69 years, with a screen-detected breast cancer (DCIS or invasive) following an abnormal screen result. **Inclusions:** • Women, 30–69 years old, confirmed to be at high risk with a screen-detected breast cancer (DCIS or invasive) following an abnormal screen result.
Data Availability and Limitations	• Data are available from July 2011. • Women can be referred to genetic assessment at age 29, but cannot be screened in the OBSP High Risk Screening Program until age 30 (or 10 weeks short of their 30th birthday). • There is an eight month reporting lag for this indicator as regions have up to eight months following the abnormal screen date to enter all of the assessment information and final diagnosis into the ICMS.
Other Jurisdictions	• Public Health Agency of Canada (PHAC): In situ cancer detection rate; invasive cancer detection rate. • Canadian Partnership Against Cancer (CPAC): Pre-cancer detection rate; invasive cancer detection rate. • European Union: Combined (in situ plus invasive) breast cancer detection rate.
Analysis	• For women aged 29–69 registered between July 1, 2011 and June 30, 2012. • Follow-up was through March 2013.
Data Sources	• Integrated Client Management System (ICMS). • Data were extracted from the ICMS in March 2013.

Appendix C: Data Sources

DATA SOURCE	TYPE OF DATA
ICMS: Integrated Client Management System	The ICMS is a provincial breast cancer screening database developed by CCO to facilitate the operation, monitoring and evaluation of OBSP screening and assessment activities.
OCRIS: Ontario Cancer Registry Information System	OCRIS is a computerized database of information from various sources: CIHI DAD, CIHI NACRS, RCC record, PMH record, OOP record, PIMS and Ontario Mortality Files.
CIHI DAD: Canadian Institute for Health Information Discharge Abstract Database	CIHI receives inpatient hospital discharge data directly from participating hospitals. These include all hospitals in every province and territory, except Quebec. A subset of these data from all Ontario hospitals is imported into OCRIS for every inpatient discharge containing ICD disease coding within the neoplastic range, plus related event and history codes.
CIHI NACRS: Canadian Institute for Health Information National Ambulatory Care Reporting System	NACRS is ambulatory hospital and clinic discharge data. CIHI receives different kinds of ambulatory discharge records depending on the reporting mandate of each individual province or territory. Ontario has mandated reporting to CIHI of ER, day surgery, dialysis, cardiac catheterization and oncology (including all regional cancer centres). Only day surgery is loaded into OCRIS.
RCC: Regional Cancer Centre Record	CCO receives an associated set of patient, disease, treatment and provider records for every patient attending an Ontario regional cancer centre. Selected fields, mainly from the patient and disease records, are loaded into OCRIS. Since 2005, Princess Margaret Hospital has also reported its cases in this format.
PMH: Princess Margaret Hospital Record	Until 2005, PMH submitted its patient, disease and treatment information in a unique format downloaded from its own cancer registry.
OOP: Out of Province Record	CCO has ongoing data exchange agreements with all other provinces and territories. Typically, once a year each province or territory will send to OCRIS the person and disease information for Ontario residents diagnosed and/or treated for cancer within their jurisdiction.
PIMS: Pathology Information Management System	PIMS database and its secure transport mechanism is the current CCO e-path solution. PIMS is responsible for the collection of all data associated with pathology reports from hospital laboratories across Ontario. Ninety percent of all pathology reports from Ontario laboratories are received via PIMS, with the remainder coming as hard copy. PIMS automatically selects and saves reports with vocabulary included in a dictionary of reportable diseases. These reports are then coded manually at CCO, and selected patient and disease data items are imported into OCRIS.
Ontario Mortality Files	Death certificate information is collected by and coded in the Office of the Registrar General of Ontario. The office regularly sends CCO electronic files containing records with fields from death certificates, including current address and fact of death. A yearly file containing coded cause of death is received one to two years after each death year.
OHIP: Ontario Health Insurance Plan Database of Physician Billings	The OHIP database contains all claims made by Ontario physicians for insured services rendered to Ontario residents. Each record represents a separate service (identified by fee code) rendered to a specific person on a specific day. It includes the following information: type of service, diagnosis, who provided the service, who received it, service date, physician's practice group and referring physician (where applicable).

DATA SOURCE	TYPE OF DATA
RPDB: Registered Persons Database	The RPDB is a population-based registry maintained by the Ministry of Health and Long-Term Care (MOHLTC) to manage publicly funded healthcare services covered under OHIP. The RPDB is essentially a historical listing of the unique health numbers issued to each person eligible for Ontario health services. This listing includes corresponding demographic information, such as date of birth, sex, address, date of death (where applicable) and changes in eligibility status. When new RPDB data arrive at the Institute for Clinical Evaluative Sciences (ICES), personal information, such as name and street address, is removed and each unique health number is converted into an anonymous identifier, ensuring the protection of each individual's privacy.
OCR: Ontario Cancer Registry	The OCR registers newly-diagnosed cases of invasive neoplasia, except for basal cell and squamous cell skin cancers. Within the OCR database electronic records collected for other purposes are linked at the person level and then "resolved" into incident cases of cancer using computerized medical logic. The OCR relies on four major data sources to identify incident cancer cases: 1) Cancer-related hospital discharge and day surgery records (DAD and NACRS records collected by CIHI) 2) Cancer-related pathology reports, 90% of which are received electronically directly from hospital and community labs 3) Consultation and treatment records of patients referred to one of 14 regional cancer centres (including PMH), which provide all radiation services in Ontario and the majority of chemotherapy 4) Death certificates with cancer identified as the underlying cause of death, received from the Ontario Registrar General

Appendix D: Incidence and Mortality Rates by Local Health Integration Network (LHIN)

TABLE 5 | Breast cancer age-standardized incidence and mortality rates* by LHIN, women aged 50–74, 2005–2009

LHINS	INCIDENCE	95% CI	MORTALITY	95% CI
Erie St. Clair	287.35	271.33–304.07	62.77	55.40–70.84
South West	281.61	268.61–295.08	58.80	52.88–65.20
Waterloo Wellington	281.81	265.60–298.75	61.98	54.41–70.29
Hamilton Niagara Haldimand Brant	303.93	292.73–315.46	67.13	61.89–72.69
Central West	275.17	259.18–291.89	50.61	43.81–58.16
Mississauga Halton	290.54	276.87–304.70	54.17	48.31–60.55
Toronto Central	269.42	257.35–281.90	58.05	52.49–64.04
Central	286.87	276.15–297.90	47.45	43.11–52.11
Central East	281.88	271.26–292.81	52.07	47.53–56.92
South East	285.04	267.92–302.96	55.09	47.66–63.35
Champlain	290.69	278.63–303.14	59.09	53.67–64.90
North Simcoe Muskoka	286.65	267.71–306.56	61.82	53.19–71.46
North East	277.49	261.95–293.72	59.86	52.74–67.67
North West	288.52	262.26–316.70	46.63	36.31–58.95
Ontario**	**285.67**		**56.95**	

Note: *Rates are per 100,000 and standardized to the age distribution of the 1991 Canadian population.
**Cases with unknown LHIN were excluded.
Data Source: Ontario Cancer Registry

Appendix E: Average Risk Program Indicators by Local Health Integration Network (LHIN)

TABLE 6 | Regional variation in OBSP coverage, by LHIN, women aged 50–74

LHINS	PARTICIPATION RATE* (2010–2011) (%)		
	WOMEN SCREENED (N)	PARTICIPATION RATE* (%)	95% CI
Erie St. Clair	38,816	42.0	41.6–42.4
South West	70,804	51.6	51.2–52.0
Waterloo Wellington	43,139	46.6	46.2–47.1
Hamilton Niagara Haldimand Brant	94,143	46.5	46.2–46.8
Central West	35,521	35.3	34.9–35.7
Mississauga Halton	59,468	41.1	40.8–41.5
Toronto Central	46,109	30.8	30.5–31.0
Central	107,268	46.3	46.0–46.6
Central East	89,963	41.3	41.0–41.5
South East	39,108	48.8	48.4–49.3
Champlain	66,730	37.9	37.6–38.1
North Simcoe Muskoka	28,556	42.6	42.1–43.1
North East	48,294	52.9	52.4–53.4
North West	17,205	49.5	48.7–50.2
OBSP	**785,124**	**43.2**	**43.1–43.3**

LHINS	RETENTION RATE (2009)** (%)			
	INITIAL SCREENS	95% CI	RESCREENS	95% CI
Erie St. Clair	83.8	80.8–86.8	92.1	90.6–93.5
South West	74.0	72.0–76.1	89.1	88.1–90.1
Waterloo Wellington	75.9	73.8–78.0	87.2	85.7–88.7
Hamilton Niagara Haldimand Brant	74.8	73.1–76.5	89.2	88.2–90.2
Central West	67.1	64.3–70.0	85.3	83.5–87.2
Mississauga Halton	72.8	71.1–74.5	86.1	84.9–87.3
Toronto Central	73.7	71.8–75.6	87.1	86.0–88.2
Central	74.5	73.2–75.8	86.7	85.8–87.6
Central East	75.1	73.5–76.8	90.1	89.1–91.1
South East	69.7	67.3–72.2	85.1	83.6–86.6
Champlain	78.1	76.2–80.1	89.2	88.1–90.3
North Simcoe Muskoka	75.1	71.8–78.5	87.1	85.3–89.0
North East	69.5	66.9–72.2	86.6	85.4–87.9
North West	78.2	74.5–82.0	87.6	85.5–89.7
OBSP	**74.5**	**73.9–75.0**	**88.0**	**87.7–88.4**

Note: *Age-standardized to the 2006 Canadian population.
**Retention is for ages 50–72.
Data Sources: Ontario Health Insurance Plan, Integrated Client Management System

TABLE 7 | Regional variation in OBSP follow-up, by LHIN, women aged 50–74, 2011

LHINS	ALL SCREENS (N)		ABNORMAL SCREENS (N)	
	INITIAL SCREENS	RESCREENS	INITIAL SCREENS	RESCREENS
Erie St. Clair	3,790	20,581	415	1,066
South West	6,337	37,437	1,269	2,953
Waterloo Wellington	5,145	19,545	682	1,454
Hamilton Niagara Haldimand Brant	11,727	44,043	1,726	3,834
Central West	3,801	11,433	714	850
Mississauga Halton	8,685	28,169	1,193	2,224
Toronto Central	9,847	31,481	1,088	2,127
Central	14,606	55,024	1,695	3,390
Central East	15,413	44,965	1,925	3,389
South East	4,372	17,465	525	1,160
Champlain	7,560	34,882	687	1,597
North Simcoe Muskoka	2,372	11,097	324	766
North East	3,969	24,728	639	1,742
North West	1,561	8,681	228	567
OBSP	**99,185**	**389,531**	**13,110**	**27,119**

LHINS	ABNORMAL CALL RATE (%)			
	INITIAL SCREENS	95% CI	RESCREENS	95% CI
Erie St. Clair	10.9	9.9–12.1	5.2	4.9–5.5
South West	20.0	18.9–21.2	7.9	7.6–8.2
Waterloo Wellington	13.3	12.3–14.3	7.4	7.1–7.8
Hamilton Niagara Haldimand Brant	14.7	14.0–15.4	8.7	8.4–9.0
Central West	18.8	17.4–20.2	7.4	6.9–8.0
Mississauga Halton	13.7	13.0–14.5	7.9	7.6–8.2
Toronto Central	11.0	10.4–11.7	6.8	6.5–7.0
Central	11.6	11.1–12.2	6.2	6.0–6.4
Central East	12.5	11.9–13.1	7.5	7.3–7.8
South East	12.0	11.0–13.1	6.6	6.3–7.0
Champlain	9.1	8.4–9.8	4.6	4.4–4.8
North Simcoe Muskoka	13.7	12.2–15.2	6.9	6.4–7.4
North East	16.1	14.9–17.4	7.0	6.7–7.4
North West	14.6	12.8–16.6	6.5	6.0–7.1
OBSP	**13.2**	**13.0–13.4**	**7.0**	**6.9–7.0**

LHINS	DIAGNOSTIC INTERVAL (%)			
	WITHIN FIVE WEEKS WITHOUT A TISSUE BIOPSY	95% CI	WITHIN SEVEN WEEKS WITH A TISSUE BIOPSY	95% CI
Erie St. Clair	93.6	87.9–99.6	74.6	66.3–83.6
South West	57.5	55.0–60.0	42.5	37.5–47.9
Waterloo Wellington	73.8	70.0–77.8	63.4	53.4–74.7
Hamilton Niagara Haldimand Brant	86.1	83.5–88.7	74.5	68.0–81.4
Central West	86.9	82.0–92.0	56.7	46.6–68.3
Mississauga Halton	86.8	83.4–90.2	45.2	39.3–51.7
Toronto Central	88.0	84.4–91.6	59.3	51.8–67.6
Central	93.4	90.6–96.3	69.3	62.6–76.4
Central East	95.0	92.2–97.8	70.5	64.1–77.4
South East	92.5	87.5–97.6	72.8	62.7–84.0
Champlain	94.2	89.9–98.7	80.1	71.6–89.4
North Simcoe Muskoka	95.7	89.5–100.0	66.9	54.9–80.7
North East	90.0	86.0–94.2	65.0	56.6–74.4
North West	83.4	76.6–90.5	45.0	33.3–59.4
OBSP	**86.2**	**85.2–87.2**	**64.0**	**61.9–66.2**

Note: Upper confidence limit was set to a maximum of 100.
Data Source: Integrated Client Management System

TABLE 8 | Regional variation in OBSP quality of screening, by screen type and LHIN, women aged 50–74, 2009 and 2011

LHINS	ABNORMAL SCREENS* (N)		BREAST CANCERS (N)	
	INITIAL SCREENS	RESCREENS	INITIAL SCREENS	RESCREENS
Erie St. Clair	406	1,052	34	120
South West	1,255	2,931	46	188
Waterloo Wellington	677	1,447	31	75
Hamilton Niagara Haldimand Brant	1,707	3,802	83	236
Central West	699	839	26	45
Mississauga Halton	1,166	2,194	58	134
Toronto Central	1,009	2,027	35	125
Central	1,653	3,336	78	227
Central East	1,884	3,347	78	160
South East	513	1,149	21	93
Champlain	683	1,594	41	133
North Simcoe Muskoka	318	756	12	57
North East	626	1,736	26	102
North West	228	560	**	38
OBSP	**12,824**	**26,770**	**573**	**1,733**

LHINS	POSITIVE PREDICTIVE VALUE (2011) (%)			
	INITIAL SCREENS	95% CI	RESCREENS	95% CI
Erie St. Clair	8.4	5.8–11.7	11.4	9.5–13.6
South West	3.7	2.7–4.9	6.4	5.5–7.4
Waterloo Wellington	4.6	3.1–6.5	5.2	4.1–6.5
Hamilton Niagara Haldimand Brant	4.9	3.9–6.0	6.2	5.4–7.1
Central West	3.7	2.4–5.5	5.4	3.9–7.2
Mississauga Halton	5.0	3.8–6.4	6.1	5.1–7.2
Toronto Central	3.5	2.4–4.8	6.2	5.1–7.3
Central	4.7	3.7–5.9	6.8	5.9–7.7
Central East	4.1	3.3–5.2	4.8	4.1–5.6
South East	4.1	2.5–6.3	8.1	6.5–9.9
Champlain	6.0	4.3–8.1	8.3	7.0–9.9
North Simcoe Muskoka	3.8	1.9–6.6	7.5	5.7–9.8
North East	4.2	2.7–6.1	5.9	4.8–7.1
North West	1.8	0.5–4.5	6.8	4.8–9.3
OBSP	**4.5**	**4.1–4.8**	**6.5**	**6.2–6.8**

LHINS	SENSITIVITY (2009) (%)		SPECIFICITY (2009) (%)	
	ONE-YEAR	95% CI	ONE-YEAR	95% CI
Erie St. Clair	87.4	71.9–100.0	95.7	94.4–97.0
South West	85.7	74.2–98.5	92.3	91.4–93.3
Waterloo Wellington	86.6	70.2–100.0	93.9	92.7–95.2
Hamilton Niagara Haldimand Brant	88.3	78.2–99.3	91.5	90.7–92.4
Central West	86.9	68.1–100.0	91.1	89.5–92.8
Mississauga Halton	79.9	67.7–93.7	92.1	91.0–93.1
Toronto Central	86.0	72.9–100.0	92.8	91.8–93.8
Central	85.6	75.3–96.9	93.9	93.2–94.7
Central East	85.3	73.5–98.5	91.9	91.1–92.8
South East	89.5	73.6–100.0	93.3	91.9–94.6
Champlain	85.9	74.1–99.1	95.7	94.7–96.7
North Simcoe Muskoka	83.1	64.0–100.0	91.7	90.1–93.4
North East	89.6	75.7–100.0	93.4	92.3–94.6
North West	86.2	64.0–100.0	92.8	90.9–94.7
OBSP	**86.1**	**82.5–89.9**	**93.1**	**92.8–93.3**

Note: *Include only abnormal screens with a known final result.
**Value not reported (≤5).
Upper confidence limit was set to a maximum of 100.
Data Source: Integrated Client Management System

TABLE 9 | Regional variation in OBSP detection, by screen type and LHIN, women aged 50–74, 2010

LHINS	ALL SCREENS* (N)		BREAST CANCERS (N)			
	INITIAL SCREENS	RESCREENS	IN SITU INITIAL	IN SITU RESCREENS	INVASIVE INITIAL	INVASIVE RESCREENS
Erie St. Clair	4,435	18,428	6	14	22	70
South West	6,855	36,042	6	38	32	150
Waterloo Wellington	6,083	17,610	**	**	22	62
Hamilton Niagara Haldimand Brant	11,196	41,483	16	31	64	175
Central West	4,200	11,580	**	10	13	46
Mississauga Halton	9,224	27,227	10	24	51	83
Toronto Central	7,993	30,094	**	21	27	115
Central	15,451	50,988	9	33	56	184
Central East	13,447	41,122	16	31	53	164
South East	4,456	14,880	6	12	22	66
Champlain	7,378	32,840	6	22	44	120
North Simcoe Muskoka	3,108	12,502	**	9	16	44
North East	3,711	23,995	**	8	19	94
North West	1,993	8,695	-	7	15	43
OBSP	**99,530**	**367,486**	**96**	**265**	**456**	**1,416**

LHINS	IN SITU BREAST CANCER DETECTION RATE (PER 1,000 SCREENS)			
	INITIAL SCREENS	95% CI	RESCREENS	95% CI
Erie St. Clair	1.4	0.5–2.9	0.8	0.4–1.3
South West	0.9	0.3–1.9	1.1	0.7–1.4
Waterloo Wellington	0.8	0.3–1.9	0.3	0.1–0.7
Hamilton Niagara Haldimand Brant	1.4	0.8–2.3	0.7	0.5–1.1
Central West	1.0	0.3–2.4	0.9	0.4–1.6
Mississauga Halton	1.1	0.5–2.0	0.9	0.6–1.3
Toronto Central	0.6	0.2–1.5	0.7	0.4–1.1
Central	0.6	0.3–1.1	0.6	0.4–0.9
Central East	1.2	0.7–1.9	0.8	0.5–1.1
South East	1.3	0.5–2.9	0.8	0.4–1.4
Champlain	0.8	0.3–1.8	0.7	0.4–1.0
North Simcoe Muskoka	1.6	0.5–3.8	0.7	0.3–1.4
North East	0.5	0.1–1.9	0.3	0.1–0.7
North West	-	–	0.8	0.3–1.7
OBSP	**1.0**	**0.8–1.2**	**0.7**	**0.6–0.8**

LHINS	INVASIVE BREAST CANCER DETECTION RATE (PER 1,000 SCREENS)			
	INITIAL SCREENS	95% CI	RESCREENS	95% CI
Erie St. Clair	5.0	3.1–7.5	3.8	3.0–4.8
South West	4.7	3.2–6.6	4.2	3.5–4.9
Waterloo Wellington	3.6	2.3–5.5	3.5	2.7–4.5
Hamilton Niagara Haldimand Brant	5.7	4.4–7.3	4.2	3.6–4.9
Central West	3.1	1.6–5.3	4.0	2.9–5.3
Mississauga Halton	5.5	4.1–7.3	3.0	2.4–3.8
Toronto Central	3.4	2.2–4.9	3.8	3.2–4.6
Central	3.6	2.7–4.7	3.6	3.1–4.2
Central East	3.9	3.0–5.2	4.0	3.4–4.6
South East	4.9	3.1–7.5	4.4	3.4–5.6
Champlain	6.0	4.3–8.0	3.7	3.0–4.4
North Simcoe Muskoka	5.1	2.9–8.4	3.5	2.6–4.7
North East	5.1	3.1–8.0	3.9	3.2–4.8
North West	7.5	4.2–12.4	4.9	3.6–6.7
OBSP	**4.6**	**4.2–5.0**	**3.9**	**3.7–4.1**

Note: *Include only screens with a known final result.
**Value not reported (≤5).
Data Source: Integrated Client Management System

TABLE 10 | Regional variation in OBSP disease extent at diagnosis, by LHIN, women aged 50–74, 2010

LHINS	INVASIVE BREAST CANCERS WITH KNOWN TMN STAGE GROUP (N)	STAGE I INVASIVE BREAST CANCER (%)	95% CI
Erie St. Clair	88	62.5	47.1–81.4
South West	168	60.1	49.0–73.1
Waterloo Wellington	79	63.3	47.0–83.4
Hamilton Niagara Haldimand Brant	229	55.9	46.6–66.5
Central West	49	51.0	33.0–75.3
Mississauga Halton	98	66.3	51.2–84.5
Toronto Central	124	68.5	54.8–84.8
Central	206	60.2	50.1–71.8
Central East	197	68.5	57.5–81.1
South East	78	70.5	53.1–91.8
Champlain	160	58.8	47.5–71.9
North Simcoe Muskoka	30	56.7	33.0–90.7
North East	102	60.8	46.6–77.9
North West	52	69.2	48.5–95.8
OBSP	**1,660**	**62.2**	**58.4–66.1**

Data Source: Integrated Client Management System

Appendix F: OBSP High Risk Screening Program Indicators by Local Health Integration Network (LHIN)

TABLE 11 | High risk indicators by LHIN, for women registered July 2011–June 2012

LHINS	NUMBER OF WOMEN REFERRED AND REGISTERED (N)	NUMBER OF WOMEN CONFIRMED HIGH RISK AND INELIGIBLE (CATEGORY B)* (N)		
	CATEGORY A AND B COMBINED	NUMBER OF CATEGORY B WOMEN WHO RECEIVED GENETIC ASSESSMENT	CATEGORY B: ELIGIBLE	CATEGORY B: INELIGIBLE
Erie St. Clair	219	145	31	114
South West	531	407	91	316
Waterloo Wellington	346	285	71	214
Hamilton Niagara Haldimand Brant	615	483	173	310
Central West and Mississauga Halton	447	414	133	281
Toronto Central	2,382	1,647	588	1,059
Central	399	380	115	265
Central East	337	302	90	212
South East	290	179	39	140
Champlain	920	661	238	423
North Simcoe Muskoka	72	66	7	59
North East	221	171	38	133
North West	84	61	15	46
OBSP	**6,863**	**5,201**	**1,629**	**3,572**

LHINS	PERCENTAGE OF CATEGORY B WOMEN CONFIRMED HIGH RISK BY GENETIC ASSESSMENT (%)	95% CI	NUMBER OF WOMEN SCREENED (CATEGORY A AND B COMBINED)
Erie St. Clair	21.4	14.5–30.3	27
South West	22.4	18.0–27.5	142
Waterloo Wellington	24.9	19.5–31.4	72
Hamilton Niagara Haldimand Brant	35.8	30.7–41.6	186
Central West and Mississauga Halton	32.1	26.9–38.1	133
Toronto Central	35.7	32.9–38.7	1,133
Central	30.3	25.0–36.3	99
Central East	29.8	24.0–36.6	91
South East	21.8	15.5–29.8	18
Champlain	36.0	31.6–40.9	239
North Simcoe Muskoka	10.6	4.3–21.9	–
North East	22.2	15.7–30.5	44
North West	24.6	13.8–40.6	22
OBSP	**31.3**	**29.8–32.9**	**2,207**

Note: *Unknowns were excluded.
Data Sources: Integrated Client Management System, Ontario Cancer Registry, Pathology Information Management System.

Appendix G: OBSP Age-Standardized Participation Rates for Women at Average Risk for Breast Cancer by

TABLE 12 | OBSP age-standardized participation rates for women at average risk for breast cancer by census division in Ontario, women aged 50–74, calendar years 2008–2009 and 2010–2011

	2008–2009			
CENSUS DIVISION	**WOMEN SCREENED (N)**	**DENOMINATOR (N)**	**PARTICIPATION RATE* (%)**	**95% CI**
Algoma	11,330	19,828	57.0	55.9–58.0
Brant	9,970	17,911	55.6	54.5–56.7
Bruce	5,008	11,004	45.2	44.0–46.5
Chatham-Kent	7,752	15,533	49.8	48.6–50.9
Cochrane	5,202	11,421	45.6	44.4–46.9
Dufferin	805	6,742	11.9	11.1–12.7
Durham	28,160	72,098	39.1	38.7–39.6
Elgin	5,025	11,846	42.1	40.9–43.3
Essex	17,624	51,617	34.0	33.5–34.5
Frontenac	13,344	21,284	62.6	61.5–63.6
Greater Sudbury	12,275	22,883	53.7	52.7–54.6
Grey	7,245	15,328	46.9	45.8–48.0
Haldimand-Norfolk	4,358	16,582	26.1	25.3–26.9
Haliburton	1,722	3,622	47.0	44.8–49.3
Halton	23,072	59,421	38.8	38.3–39.3
Hamilton	31,334	68,718	45.6	45.1–46.1
Hastings	7,330	20,909	34.8	34.0–35.6
Huron	5,167	8,942	57.5	55.9–59.1
Kawartha Lakes	4,878	12,498	38.7	37.6–39.8
Kenora	3,808	7,987	47.7	46.2–49.2
Lambton	8,528	19,853	42.8	41.8–43.7
Lanark	2,810	10,619	26.2	25.3–27.2
Leeds and Grenville	7,061	16,302	42.9	41.9–43.9
Lennox and Addington	3,994	6,538	60.7	58.8–62.6
Manitoulin	1,394	2,422	56.6	53.6–59.6
Middlesex	29,995	57,137	52.4	51.8–53.0
Muskoka	2,957	9,843	29.8	28.7–30.9
Niagara	26,287	64,949	40.3	39.8–40.8
Nipissing	6,909	12,769	53.8	52.6–55.1
Northumberland	3,494	14,255	24.3	23.5–25.1
Ottawa	39,184	110,023	35.6	35.2–35.9
Oxford	6,895	14,241	48.2	47.1–49.4
Parry Sound	4,033	7,760	51.5	49.9–53.1
Peel	53,851	143,725	37.3	37.0–37.6
Perth	6,313	9,970	63.3	61.7–64.9
Peterborough	8,943	21,348	41.6	40.7–42.4
Prescott and Russell	4,106	11,613	35.2	34.2–36.3
Prince Edward	1,632	4,980	32.2	30.6–33.7
Rainy River	1,406	3,014	46.7	44.2–49.1
Renfrew	8,574	15,265	56.0	54.8–57.2
Simcoe	26,142	60,636	42.9	42.4–43.5
Stormont, Dundas and Glengarry	3,571	17,459	20.3	19.6–21.0
Sudbury	1,956	3,669	53.1	50.7–55.4
Thunder Bay	10,689	21,578	49.5	48.5–50.4
Timiskaming	2,934	5,337	54.8	52.8–56.8
Toronto	103,016	330,840	31.2	31.0–31.4
Waterloo	25,501	57,863	44.0	43.4–44.5
Wellington	10,586	26,180	40.4	39.6–41.1
York	56,699	124,400	45.5	45.2–45.9
Ontario	**674,869**	**1,680,762**	**40.1**	**40.0–40.2**

Census Division in Ontario, Women Aged 50–74, Calendar Years 2008–2009 and 2010–2011

	2010–2011			
CENSUS DIVISION	**WOMEN SCREENED (N)**	**DENOMINATOR (N)**	**PARTICIPATION RATE* (%)**	**95% CI**
Algoma	11,672	20,755	55.9	54.8–56.9
Brant	11,323	19,022	59.3	58.2–60.4
Bruce	5,361	11,466	46.1	44.9–47.4
Chatham-Kent	8,717	16,251	53.4	52.2–54.5
Cochrane	5,957	12,212	48.8	47.6–50.1
Dufferin	1,762	7,439	23.6	22.5–24.7
Durham	35,550	79,028	45.1	44.6–45.5
Elgin	5,176	12,562	40.7	39.6–41.8
Essex	20,953	54,988	37.9	37.4–38.4
Frontenac	13,678	22,487	60.5	59.5–61.5
Greater Sudbury	12,790	24,135	52.8	51.8–53.7
Grey	7,837	15,814	48.9	47.8–50.0
Haldimand-Norfolk	6,117	17,702	34.2	33.4–35.1
Haliburton	1,892	3,700	50.0	47.7–52.3
Halton	25,859	64,821	39.8	39.3–40.3
Hamilton	34,708	72,984	47.4	46.9–47.9
Hastings	9,957	22,033	44.9	44.0–45.8
Huron	5,622	9,379	59.2	57.6–60.7
Kawartha Lakes	6,154	13,077	46.3	45.2–47.5
Kenora	4,426	8,626	51.3	49.8–52.8
Lambton	9,146	20,664	43.8	42.9–44.7
Lanark	3,125	11,303	27.3	26.4–28.3
Leeds and Grenville	8,104	17,246	46.4	45.4–47.4
Lennox and Addington	3,757	6,886	53.9	52.2–55.7
Manitoulin	1,373	2,495	53.8	50.9–56.8
Middlesex	32,273	61,285	52.5	51.9–53.1
Muskoka	3,350	10,255	32.2	31.1–33.3
Niagara	30,981	68,166	45.1	44.6–45.6
Nipissing	6,906	13,450	50.9	49.7–52.1
Northumberland	7,259	14,924	48.2	47.0–49.3
Ottawa	45,182	120,436	37.4	37.1–37.8
Oxford	7,430	15,148	48.8	47.6–49.9
Parry Sound	4,267	8,076	52.0	50.4–53.6
Peel	64,480	160,940	40.0	39.7–40.3
Perth	6,973	10,750	64.7	63.2–66.3
Peterborough	10,917	22,387	48.1	47.2–49.0
Prescott and Russell	4,814	12,811	37.5	36.4–38.5
Prince Edward	2,574	5,171	49.1	47.1–51.0
Rainy River	1,581	3,227	48.9	46.5–51.3
Renfrew	8,867	15,923	55.3	54.2–56.5
Simcoe	29,781	64,956	45.7	45.2–46.2
Stormont, Dundas and Glengarry	4,643	18,540	24.8	24.1–25.5
Sudbury	2,023	3,829	52.3	50.0–54.6
Thunder Bay	11,240	22,980	48.7	47.8–49.6
Timiskaming	3,264	5,603	58.0	56.0–60.0
Toronto	124,670	357,459	34.9	34.7–35.1
Waterloo	30,457	62,931	48.2	47.7–48.8
Wellington	12,236	28,222	43.3	42.5–44.0
York	67,940	138,105	49.2	48.8–49.5
Ontario	**785,124**	**1,812,649**	**43.2**	**43.1–43.3**

Note: *Age-standardized to the 2006 Canadian population.
Data Sources: Ontario Health Insurance Plan, Integrated Client Management System

Appendix H: List of Abbreviations

CAR-MAP	Canadian Association of Radiologists Mammography Accreditation Program
CCO	Cancer Care Ontario
CI	confidence interval
CIHI	Canadian Institute for Health Information
CPAC	Canadian Partnership Against Cancer
CSQI	Cancer System Quality Index
DAD	Discharge Abstract Database
DCIS	ductal carcinoma in situ
EU	European Union
FNA	fine needle aspiration
IARC	International Agency for Research on Cancer
ICD	International Classification of Diseases
ICES	Institute for Clinical Evaluative Sciences
ICMS	Integrated Client Management System
IHF	independent health facility
KTE	knowledge translation and exchange
LHIN	Local Health Integration Network
MOHLTC	Ministry of Health and Long-Term Care
MRT	medical radiation technologist
NACRS	National Ambulatory Care Reporting System
OBSP	Ontario Breast Screening Program
OCRIS	Ontario Cancer Registry Information System
OCTRF	Ontario Cancer Treatment and Research Foundation
OHIP	Ontario Health Insurance Plan
OOP	out of province
PCCF	postal code conversion file
PEBC	Program in Evidence-Based Care
PHAC	Public Health Agency of Canada
PIMS	Pathology Information Management System
PMH	Princess Margaret Hospital
RCP	Regional Cancer Program
RPDB	Registered Persons Database
TNM	tumour, node, metastases

Appendix I: List of Figures

Appendix J: List of Tables

References

[1] Canadian Cancer Society's Steering Committee on Cancer Statistics [Internet]. *Canadian Cancer Statistics 2013*. Toronto, ON: Canadian Cancer Society; 2013. Available from: *http://www.cancer.ca/statistics*.

[2] Schnitt SJ. Benign breast disease and breast cancer risk: morphology and beyond. Am J Surg Pathol. 2003;27(6):836–41.

[3] Boyd NF, Martin LJ, Yaffe MJ, Minkin S. Mammographic density: a hormonally responsive risk factor for breast cancer. J Br Menopaus Soc. 2006;12:186–93.

[4] Reeves GK, Pirie K, Green J, Bull D, Beral V. Reproductive factors and specific histological types of breast cancer: prospective study and meta-analysis. Br J Cancer. 2009;100(3):538–44.

[5] World Cancer Research Fund / American Institute for Cancer Research. Continuous update project report summary. Food, nutrition, physical activity, and the prevention of breast cancer [serial on the Internet]. AICR. 2010 [updated 2010; cited 2013 Apr 22]. Available from: *http://www.dietandcancerreport.org/cancer_resource_center/downloads/cu/cu_breast_cancer_report_2008_summary.pdf*.

[6] International Agency for Research on Cancer. IARC monographs on the evaluation of carcinogenic risks to humans. Volume 91. Combined estrogen-progestogen contraceptives and combined estrogen-progestogen menopausal therapy. Lyon: International Agency for Research on Cancer; 2007.

[7] International Agency for Research on Cancer. IARC monographs on the evaluation of carcinogenic risks to humans. Volume 100A. A review of human carcinogens. Part A: Pharmaceuticals. Lyon: International Agency for Research on Cancer; 2012.

[8] Parkin DM, Whelan SL, Ferlay J, Teppo L, Thomas DB, editors. Cancer incidence in five continents. Volume VIII. Lyon (FR): International Agency for Research on Cancer; 2002.

[9] International Agency for Research on Cancer. IARC monographs on the evaluation of carcinogenic risks to humans. Volume 100E. A review of human carcinogens. Part E: Personal habits and indoor combustions. Lyon: International Agency for Research on Cancer; 2012.

[10] U.S. Department of Health and Human Services. The health consequences of smoking: A report of the Surgeon General. Atlanta: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health; 2004.

[11] California Environmental Protection Agency. Proposed identification of environmental tobacco smoke as a toxic air contaminant. Part B: Health effects [Internet]. [updated 2005; cited 2013 June 3]. Available from: *http://www.arb.ca.gov/regact/ets2006/app3partb.pdf*.

[12] Collishaw NE (Chair), Boyd NF, Cantor KP, Hammond SK, Johnson KC, Millar J, et al. Canadian Expert Panel on Tobacco Smoke and Breast Cancer Risk. OTRU Special Report Series. Toronto: Ontario Tobacco Research Unit; 2009 April.

[13] International Agency for Research on Cancer. IARC monographs on the evaluation of carcinogenic risks to humans. Volume 75. Ionizing radiation, part 1: X- and gamma-radiation, and neutrons. Lyon: International Agency for Research on Cancer; 2000.

[14] Larsson SC, Mantzoros CS, Wolk A. Diabetes mellitus and risk of breast cancer: a meta-analysis. Int J Cancer. 2007;121(4):856–62.

[15] Liao S, Li J, Wei W, Wang L, Zhang Y, Li J, et al. Association between diabetes mellitus and breast cancer risk: a meta-analysis of the literature. Asian Pac J Cancer Prev 2011;12(4):1061–5.

[16] Bosetti C, Rosato V, Gallus S, Cuzick J, La VC. Aspirin and cancer risk: a quantitative review to 2011. Ann Oncol. 2012;23(6):1403–15.

[17] John EM, Hopper JL, Beck JC, Knight JA, Neuhausen SL, Senie RT, et al. The Breast Cancer Family Registry: an infrastructure for cooperative multinational, interdisciplinary and translational studies of the genetic epidemiology of breast cancer. Breast Cancer Res. 2004;6(4):R375–389.

[18] The Canadian Task Force on Preventive Health Care. Recommendations on screening for breast cancer in average-risk women aged 40–74 Years. CMAJ. 2011;183(17): 1991–2001.

[19] Pisano ED, Gatsonis C, Hendrick E, Yaffe M, Baum JK, Acharyya S, et al. Diagnostic performance of digital versus film mammography for breast-cancer screening. N Engl J Med. 2005 Oct 27;353(17):1773–83.

[20] Chiarelli AM, Edwards SA, Prummel MV, Muradali D, Majpruz V, et al. Digital compared with screen-film mammography: Performance measures in concurrent cohorts within an organized breast screening program. Radiology [serial on the Internet]. May 2013 [cited 2013 May 20]: 267(3). Available from: *http://radiology.rsna.org/content/early/2013/04/29/radiol.13122567.abstract*.

[21] Warner E, Messersmith H, Causer P, Eisen A, Shumak R, Plewes D. Magnetic resonance imaging screening of women at high risk for breast cancer. Toronto (ON): Cancer Care Ontario; 2012 Aug 31. Program in Evidence-Based Care Evidence-Based Guideline No.: 15-11 Version 2.

[22] Cancer Care Ontario, Cancer Quality Council of Ontario [Internet]. Cancer System Quality Index (CSQI) 2013. Figure 4: Age-standardized 5-year relative survival ratio for the 14 common cancers, Ontario, 1995–1999 vs. 2005– 2009. Available from: *http://www.csqi.on.ca/cancer_in_ontario*.

[23] Corsetti V, Ferrari A, Ghirardi M, Bergonzini R, Bellarosa S, Angelini O, et al. Role of ultrasonography in detecting mammographically occult breast carcinoma in women with dense breasts. Radiol Med. 2006 Apr;111(3):440–8.

[24] Kolb TM, Lichy J, Newhouse JH. Comparison of the performance of screening mammography, physical examination, and breast US and evaluation of factors that influence them: an analysis of 27,825 patient evaluations. Radiology. 2002 Oct;225(1):165–75.

[25] Leconte I, Feger C, Galant C, Berlière M, Berg BV, D'Hoore W, et al. Mammography and subsequent whole-breast sonography of nonpalpable breast cancers: the importance of radiologic breast density. Am J Roentgenol. 2003 Jun;180(6):1675–9.

[26] Canadian Partnership Against Cancer, Screening Performance Measures Group. Guidelines on performance measurement for organized cancer screening programs. Toronto (ON): The Partnership; 2008 Apr. 45 p.

[27] Public Health Agency of Canada, Evaluation Indicators Working Group. Guidelines for Monitoring Breast Screening Program Performance. 3rd ed. Ottawa: Her Majesty the Queen in right of Canada, represented by the Minister of Health; 2013.

[28] Miles A, Cockburn J, Smith RA, Wardle J. A perspective from countries using organized screening programs. Cancer. 2004 Sep 1;101(5 Suppl):1201–13.

[29] World Health Organization, International Agency for Research on Cancer. Cervix cancer screening. IARC handbook of cancer prevention, volume 10. Lyon (FR): IARC Press; 2005.

[30] Wilkins R. PCCF + version 5K user's guide. Automated geographic coding based on the Statistics Canada postal code conversion files [SAS File]. Ottawa: Statistics Canada; 2012.

Cancer Care Ontario
620 University Avenue
Toronto, ON M5G 2L7
416.971.9800

publicaffairs@cancercare.on.ca
www.cancercare.on.ca

Cancer Care Ontario
620 University Avenue
Toronto, Ontario
M5G 2L7

416 971 9800
publicaffairs@cancercare.on.ca
www.cancercare.on.ca