Barbara Poole, MPA, Karen Gelmon, MD, Marilyn Borugian, PhD, Lisa Kan, MSc, Moira Stilwell, MD

Breast cancer screening and diagnosis in British Columbia

We need to update our provincial practices to ensure that BC continues to be among the jurisdictions with the best breast cancer survival rates in the world.

ABSTRACT: Although major gains have been made in improving outcomes for breast cancer patients over the past two decades, women continue to be deeply concerned about how the system is organized. According to a Canadian Breast Cancer Foundation study, both women and care providers see the process of obtaining a breast cancer diagnosis in BC as "emotionally troubling and structurally problematic." Women describe their experience as a journey through a diagnostic "maze." A comparison of service in BC with national and international service guidelines suggests there is room for improvement. The process for early detection and diagnosis of breast cancer in BC is marked by both too little and too much service. Many women do not participate in the screening program. Furthermore many women undergo more diagnostic procedures than required, and these procedures either do not provide adequate information for adjuvant treatment planning or are more invasive than necessary. Despite these problems, BC's 5-year survival rates for breast cancer are among the best in the world. To maintain these rates and improve on them, the BC system will need to encourage greater participation in screening and provide better access to core biopsy and tumor marker pathology.

Even though breast cancer is a major killer of women, especially women age 35 to 64, mortality rates have declined steadily since 1986.[1] This improvement has been attributed to two main factors:

- Increased screening, which has allowed for earlier and thus more effective intervention.
- Improved treatment with adjuvant therapies.

The Cancer Intervention and Surveillance Modeling Network of the National Institute of Health attempted to define the respective contributions of increased screening and advances in adjuvant therapies while accounting for changes in background risks.[2]

Ms Poole is a health service policy and research analyst with the BC Cancer Agency (BCCA) and a doctoral student in the School of Health Care and Epidemiology at the University of British Columbia, under the supervision of Dr Charlyn Black. Dr Gelmon is the former head of the Breast Tumour Group at the BCCA. Dr Borugian is a scientist with the BCCA. Ms Kan is the operations leader of screening programs at BCCA. Dr Stilwell is president of the Canadian Breast Cancer Foundation, BC/Yukon division.

The results of this modeling estimated that the observed mortality decline between 1990 and 2000 was 23.5% for women age 30 to 79. The decline in mortality due to screening and early intervention was 8% to 23%, while the decline due to improved adjuvant therapy was 12% to 21%.

Breast cancer is a heterogeneous disease. Specific molecular attributes of the disease must be identified before systemic treatment recommendations can be made. As adjuvant therapy options are now based on the specific pathological characteristics of tumors, the identification of these characteristics is a critically important part of the detection and initial diagnosis of cancer.

Despite the decline in mortality rates, women in British Columbia have expressed deep concern about how the breast health system is organized.[3] According to a Canadian Breast Cancer Foundation study from 2001, both women and care providers see the process of obtaining a breast cancer diagnosis in BC as "emotionally troubling and structurally problematic." Women describe their experience as a journey through a diagnostic "maze."

Breast cancer epidemiology

The lifetime risk of breast cancer is 1 in 9 for women in BC.[4] Approximately 2700 BC women are diagnosed with breast cancer annually.[5] Incident rates have been relatively stable over time.[6] However, the demography of BC indicates that we will see higher incidence rates in the next few years. The number of women age 40 to 79 is expected to grow 21.4%, from 1 020 484 in 2007 to 1 239 286 in 2017.[7] Because breast cancer risk increases with age, the growth in this older age group, the 50 to 79 subgroup, will result in an increased incidence of cancer. BC Cancer Agency BCCA projections suggest that 2849 women will have been diagnosed with breast cancer in BC by 2007, and that this number will grow to 3619 by 2017, an increase of 27%.[8]

Breast health care guidelines

The BC Cancer Agency develops cancer management guidelines through various "tumor groups," whose members review the latest evidence for the care of cancer types. Clinical guidelines developed by the BCCA focus on detection, diagnosis, and treatment paths.

In BC women age 40 to 79 can refer themselves to the Screening Mammography Program (SMPBC). Women younger than 40 with a strong family history of breast cancer and women older than 80 require a referral to the program from a family doctor. The SMPBC recommends that women age 40 to 49 be screened every 12 to 18 months and women age 50 to 79 be screened every 2 years.

The current BCCA guidelines for diagnosis of breast cancer (available on the agency's web site)[9] include the following recommendations:

- Diagnostic mammograms should be performed if there is any suspicious finding on a screening mammogram or if there is a palpable finding.
- Abnormalities detected by mammography may take the form of either a mass, a change in breast architecture, or abnormal calcifications within the breast.
- If there is an abnormality that is not clearly malignant but is new, further imaging with additional views and magnification views should be undertaken.
- A suspicious new finding should be further assessed with imaging and a pathological diagnosis. A stereotactic core biopsy under mammographic guidance may be undertaken.
- If the diagnostic radiologist thinks the mass may be benign (e.g., there is a strong possibility it is a nonpalpable cyst or a small fibroadenoma), then an ultrasound examination may help distinguish between a cystic and a solid lesion.
- If the lesion is likely cystic, then aspiration of the lesion under ultrasound control by the diagnostic radiologist may both diagnose and treat the abnormality, and may be all the treatment that is needed.
- If the lesion is found to be solid on ultrasound, or if the mammographic appearances are not clearly those of a benign abnormality, then one or more of the following are mandatory, depending on the level of suspicion and on the size and discreteness of the lesion: fine needle aspiration under ultrasound guidance, stereotactic core needle biopsy, or open surgical biopsy guided by fine wire localization.
- A core biopsy is strongly recommended to obtain adequate tissue for pathological diagnosis and to plan surgical intervention if necessary.
- Where a cluster of fine calcifications is identified and the diagnostic radiologist finds the appearance sufficiently suspicious, a stereotactic core needle biopsy or an open biopsy is required.

Given the current state of our knowledge about effective intervention, it is particularly important to consider health care service guidelines for population-based screening, high-risk screening, and diagnosis.

Population-based screening

The Public Health Agency of Canada (PHAC) reviewed international service guidelines for population-based screening in 1997.[10] Table 1 uses the PHAC format to provide the most recent information about these

Table 1. Population-based screening guidelines for breast cancer in Canada and other jurisdictions.

	Canada[5]	Sweden[11]	Europe[12]	United Kingdom[13‡]	Australia[14]
Age group	50–69		50–64	50–64	50–69
Attendance rate	70%	No specific guideline	Acceptable: ≥70% Desirable: ≥75%	Acceptable: ≥70% Desirable: ≥80%	≥70%
Retention rate	≥75% within 30 months	No specific guideline	Acceptable: ≥95% Desirable: ≥100%	Acceptable: ≥90% Desirable: ≥100%	≥75% screened (of those rescreened, >90% to be screened biennially)
Abnormal recall rate*	*Initial screen* <10% *Rescreen* <5%	9% (overall)	*Initial Screen* Acceptable: <7% Desirable:<5% *Rescreen* Acceptable: <5% Desirable: <3%	*Initial screen* Acceptable: <10% Desirable: <7% *Rescreen* Acceptable: <7% Desirable: <5%	*Initial screen* <10 % *Rescreen* <5 %
Cancer detection rate	*Initial screen* >5 per 1000 *Rescreen* >3 per 1000	≥3xIR† (overall)	*Initial Screen* ≥3xIR† *Rescreen* ≥1.5xIR†	*Initial screen* Acceptable: ≥2.7 per 1000§ Desirable: ≥3.6 per 1000 *Rescreen* Acceptable: ≥3.0 per 1000§ Desirable: ≥4.2 per 1000	*Initial screen* >5 per 1000 *Rescreen* >3.5 per 1000
Benign-to-malignant biopsy ratio	≤2:1 (open biopsy)	<3:1	Acceptable: <1:2 Desirable: <1:4	Minimum <3:1	*Initial screen* ≤2:1 *Rescreen* ≤1:1 (< 4% after open biopsy)
Detected invasive cancers that are small	Tumors ≤10 mm >25%	Tumors <15 mm >50%	Tumors ≤10 mm Acceptable: >25% Desirable: >30% Tumors ≤15 mm Acceptable: >50% Desirable: >50%	Tumor <15 mm *Initial screen* Acceptable: ≥1.5 per 1000 Desirable: ≥2.0 per 1000 *Rescreen* Acceptable: ≥1.7 per 1000 Desirable: ≥2.3 per 1000	Tumor ≤15 mm >25 per 10 000
Detected cancers that are in situ	No specific guideline	No specific guideline	No specific guideline	*Initial screen* 0.4–0.9 per 1000 *Rescreen* 0.5–1.0 per 1000	*Initial screen* 1.2 per 1000 *Rescreen* 0.7 per 1000
Rate of cancers presenting between screening episodes	<6 per 10 000 screened women within 12 months <12 per 10 000 screened women within 2 years	No specific guideline	No specific guideline	<12 per 10 000 screened women within 2 years of screen	<7.5 per 10 000 screened women within 1 year of screen

* Mammography alone as screening modality
† IR = expected incidence rate in the absence of screening
‡ The United Kingdom recalls women for mammography every 3 years
§ Invasive cancers only, excludes cancers that are purely in situ (noninvasive or intraductal)

Table 2. High-risk screening guidelines for breast cancer in Scotland, the United Kingdom, and Australia.

	Scotland[15]	United Kingdom[16,17]	Australia[18]
Eligibility for genetic screening	Women from families with four or more relatives with either breast or ovarian cancer in three generations and one alive affected individual	Women from families with >20% chance of gene mutation*	Women from families with three cases in females Women from families with two cases if one was multiple cancers (breast or ovarian), or one was a breast cancer in a male, or family is of Jewish ancestry
Surveillance of known gene carriers	Enrollment in MRI study and screening in a clinically audited screening program	Annual MRI surveillance	Annual transvaginal pelvic ultrasound commencing between age 25 and 40; annual mammography with clinical breast exam at age 40
Preventive intervention	Bilateral mastectomy with total reconstruction an option for women at >35% lifetime risk	Bilateral mastectomy an option, with all women at high risk subject to genetic counseling in a specialist cancer genetics clinic before a decision is made	Bilateral mastectomy or oopherectomy an option after extensive counseling

*Includes TP53 mutation

Table 3. Diagnosis guidelines for breast cancer in Europe and the United Kingdom.

	EUSOMA[24,25]	United Kingdom[26]
Proportion of patients diagnosed with breast cancer with a preoperative fine needle aspiration cytology (FNAC) or core biopsy	Acceptable: >90% Desirable: >90%	No specific guideline
Sensitivity/specificity	*FNAC* Acceptable: >60% / >55% Desirable: >70% / >65% *Core biopsy* Acceptable: >70% / >75% Desirable: >80% / >85%	No specific guideline
Diagnostic procedures	Triple assessment: clinical evaluation, imaging, and biopsy in one visit	Triple assessment: clinical evaluation, imaging, and biopsy in one visit
Markers	No specific guideline	Determine hormone receptor status on all excised tumor samples (estrogen receptor status assessed first); if negative or poor, progesterone receptor status measured and confirmed by high-volume reference labs
Volume	150 new cancers per year per clinic	Data not available

guidelines.[5,11-14] For many of the indicators used, including the age group screened and the cancer detection rate, Canada's standards are in line with those of other jurisdictions.

High-risk screening

Service guidelines also exist for screening high-risk populations, as shown in Table 2.[15-18] The inheritance of a *BRCA1* or *BRCA2* mutation places a woman at a 50% to 85% lifetime risk (to age 70) for developing breast cancer and a 40% to 60% risk for a second breast cancer once she has had breast cancer.[19,20] The contribution of *BRCA1* and *BRCA2* mutations in breast cancer populations, unselected for age and family history, has been examined in several studies reporting mutation frequencies between 1% and 12%.[21] The wide range is a reflection of the fact that the frequency of *BRCA1* and *BRCA2* mutations in women with breast cancer varies according to the age at diagnosis, family history of cancer, and ethnicity or country of origin.

At present most genetic screening is for the *BRCA1* and *BRCA2* gene

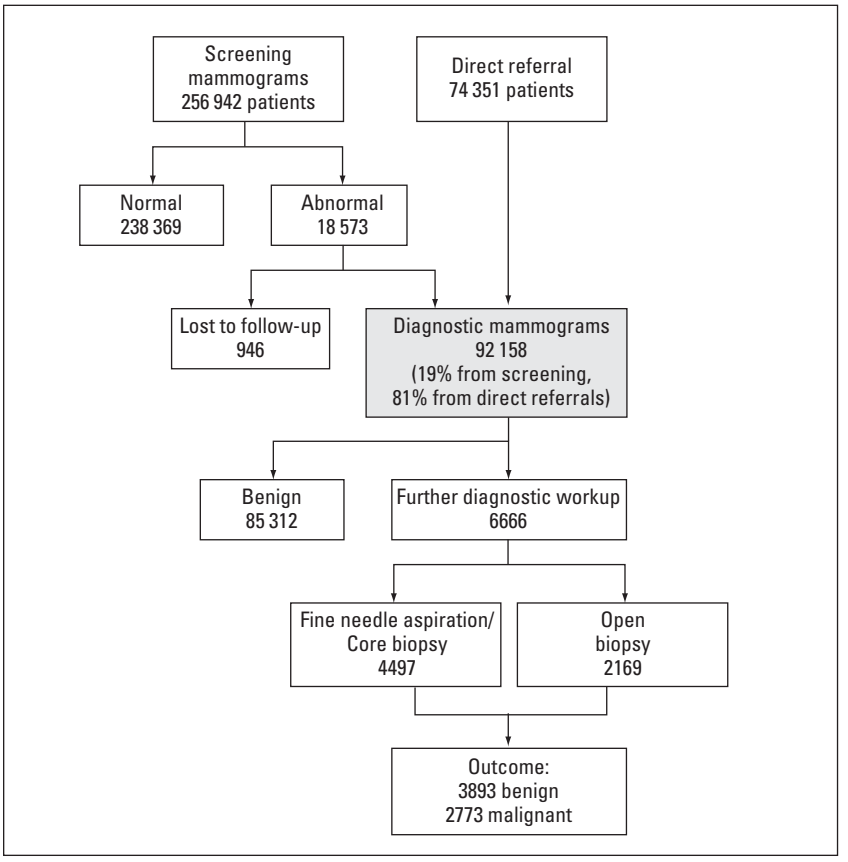

Figure. Utilization of breast cancer diagnostic services in BC, 2005.

Source: Data drawn from Screening Mammography Program of BC,[5] BCCA statistics, and Ministry of Health MSP fee-for-service figures

mutations only; however, some work on screening for CAG trinucleotide repeat sequences is being explored in certain jurisdictions.[22] Other factors that put a woman at a greater than 20% risk of developing breast cancer should be considered in a similar fashion. This includes treatment with mantle (chest) radiation for Hodgkin disease before the age of 25.[23]

Diagnosis

The diagnostic phase of the breast health care system is unlike the screening phase. In Canada diagnosis usually occurs in public or radiologist-led facilities. In Europe diagnostic services are frequently part of a specialized breast unit, and service guidelines have been developed in support of this part of the system. Table 3 summarizes diagnosis guidelines used in Europe and the United Kingdom.[23-25] Unfortunately, these service guidelines do not distinguish between core and fine needle for biopsies—information that would be useful, given that observational studies have shown core biopsy to have higher unequivocal results than fine needle biopsy (85% vs 62%) but also higher false-negative rates (13% vs 6%).[27-29]

Breast health service utilization in BC

In 2005, 256 942 screening mammograms were performed in BC.[5] Although all women age 40 to 79 are eligible to participate in the provincial screening mammography program without a doctor's referral, only 42% of eligible women actually did participate. In the 50 to 69 age group only 49% of eligible women participated. Consequently, only 38% of breast cancers diagnosed in 2005 were the result of screening. The Figure summarizes the utilization of diagnostic services in BC, beginning with the 18 573 mammograms and the 74 351 direct referrals that led to diagnostic mammograms and further workup.[5]

The Canadian benchmark for screening mammography announced in December 2005 specifies that 70% of women age 50 to 69 should have a screening mammogram every 2 years. The Screening Mammography Program of BC has submitted a plan to the Ministry of Health to reach this target by 2017. The main challenges are the high number of nonparticipants, a system-wide shortage of mammography technologists, and the need to convert to digital format. The 10-year plan involves performing 16 000 more screens a year. More screening means that an estimated 2640 more patients will need diagnostic mammograms, 211 more patients will need surgical biopsy, and 84 more cancers will be diagnosed—mostly cancers that would have been found at later stages in the absence of a screening program.

Best practices versus current practices

Table 4 compares the European and Canadian best practice guidelines with the current screening practices in BC, Ontario, and the UK.[5,30,31] There are a few causes for concern, beginning with BC's low attendance rate for screening mammography, which is lower than Ontario's performance in the 50 to 69 age group. In fact, both Ontario and BC fall far short of the Canadian

Table 4. Guideline requirements for breast cancer screening in Europe and Canada compared with current practices in BC, Ontario, and the United Kingdom.

	Europe: Best practice	Canada: Best practice	BC: Current practice[5]	Ontario: Current practice[30]	United Kingdom: Current practice[31]
Age group	50–69	50–69	50–69	50–69	50–64
Attendance	Acceptable: >70% Desirable: >75%	>70%	49% (55% if including bilateral mammograms under MSP)	56.4%	71.5%
Retention rate	Acceptable: ≥95% Desirable: 100%	≥75% within 30 months	54% by 24 months 83% by 36 months	81.9% within 30 months	81.5% within 36 months
Abnormal recall rate	*Initial screen* Acceptable: <7% Desirable: <5% *Rescreen* Acceptable: <5% Desirable: <3%	*Initial screen* <10% *Rescreen* <5%	*Initial screen* 16.3% *Rescreen* 5.8%	*Initial screen* 12% *Rescreen* 7.3%	*Initial screen* 8.4% *Rescreen* 3.7%
Cancer detection rate	*Initial screen* ≥3xIR† *Rescreen* ≥1.5xIR†	*Initial screen* >5 per 1000 *Rescreen* >3 per 1000	*Initial screen* 6.5 per 1000 *Rescreen* 4.8 per 1000 (prevalence to expected incidence as per European standard = 3.83)	*Initial screen* 4.2 per 1000 *Rescreen* 3.4 per 1000	5.2 per 1000 screened
Benign-to-malignant biopsy ratio	Acceptable: <1:2 Desirable: <1:4	≤2:1 (open biopsy)	1.1:1	No specific guideline	No specific guideline
Detected invasive cancers that are small	*Tumors 10 mm* Acceptable: >25% Desirable: >30% *Tumors ≤15 mm* Acceptable: >50% Desirable: >50%	*Tumors ≤10 mm* >25%	*Tumors ≤10 mm* 34% *Tumors ≤15 mm* 61%	*Tumors ≤10 mm* 32.4%	*Tumors ≤15 mm* 48.1%
Triple assessment*	Yes	No	No	No	No

* Clinical evaluation, imaging, and biopsy in one visit
† IR = expected incidence rate in the absence of screening

and European targets for the 50 to 69 population. The UK, in contrast, has been able to meet these targets.

Once women enter the screening program in BC, the retention rates meet Canadian standards of more than 75% within 30 months. The European target, however, is higher and the Canadian target may reflect awareness of how hard it is to provide service to a small population spread over a large area. We see this in the fact that health service delivery areas in BC have widely varying rates of participation from a low of 30% in the East Kootenays to a high of 57% in the Okanagan.[32] To effectively reduce mortality from breast cancer in the population, it is essential to improve utilization of screening mammography. A projected 30% mortality reduction from screening is based on screening 70% of women age 50 to 69.

The abnormal recall rate from screening (i.e., the proportion of screens requiring additional diagnostic workup) is higher in BC than the Canadian and European targets suggest. The Canadian standard is not as rigorous as the European one, and although the current practice in the UK would meet the Canadian standard, it too does not meet the European

target. BC's higher abnormal recall rate likely reflects a conservative approach and no doubt contributes to the higher proportion of biopsies being conducted on benign masses. There is room for improvement with respect to the specificity of the service, which may be resulting in overservice at present.

Another potential source of concern not included in Table 4 is the proportion of women who have a preoperative diagnosis of cancer. In BC this is about 64% at present, compared with a European target of more than 90%. In the UK the proportion is 80.5% for initial screens and 86.8% for subsequent screens. This means that women in BC are undergoing more invasive procedures to receive a definitive diagnosis.

Overall, the current BC screening system is effectively detecting cancer (exceeding both European and Canadian guideline requirements) and is also detecting invasive cancers while they are small and thus more amenable to treatment resulting in positive outcomes. However, we still lack information in several key areas. We do not know the utilization rates of triple assessment (clinical evaluation, imaging, and biopsy),which is still regarded as the criterion standard. We do not know how the use of core biopsy compares with fine needle aspiration. This is important because core biopsy permits the collection of more tissue than fine needle aspiration does, and provides information necessary for treatment decisions, including whether the disease is invasive or in situ and the patient's estrogen and HER2 status. Even though this information is needed for determining adjuvant therapy, we do not know the percentage of cases where this information is collected and we do not routinely collect data that allows us to evaluate compliance with this guideline. With respect to high-risk populations, patients who are *BRCA1* or *BRCA2* carriers or who have had mantle radiation for Hodgkin disease at a young age should be having annual MRIs; however we do not know whether these women are receiving this service.

Conclusions

In BC participation in population-based screening falls below the level recommended by international guidelines. Only 49% of the 50 to 69 age group receive mammograms, well below the 70% recommended in 2005 for Canada. Because many BC women do not receive mammograms, only 38% of cancers are diagnosed through the screening program. Women in BC are also undergoing more diagnostic procedures than required to receive a diagnosis: 15% are recalled after initial screening in contrast to the Canadian standard of 10% and the European standard of 7%. In addition, women in BC are having surgery with an open biopsy to receive a definitive diagnosis at a higher rate (36%) than current guidelines, including our BC recommendations, would suggest is appropriate (<10%).

At present the outcomes for breast cancer patients in industrialized nations are excellent. The 5-year survival rate for women diagnosed in BC with breast cancer in 2000 is 88%.[33] A recent study of breast cancer in Europe explored 5-year survival of patients diagnosed in 1995. The 5-year survival for all European countries was 79.5%, with lows of 70% in the Czech Republic and Slovenia, and highs of 88% in Iceland.[34] (In contrast, the 5-year survival in BC for the same period was 86%[35]).

The present good outcomes for breast cancer patients in BC are the result of a screening and diagnosis system based on what was best practice 10 years ago. To ensure that BC continues to be among the jurisdictions with the best outcomes in the world, we must avail ourselves of new knowledge and update our provincial practices accordingly. Enhanced use of core biopsy to provide tissue samples for determining tumor features and planning treatment is a key element of the contemporary diagnostic process for breast cancer. To improve survival rates for breast cancer further will require both greater participation in screening, particularly in women age 50 to 69, and better access to core biopsy and tumor marker pathology.

Competing interests

None.

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