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Conversations in Breast Cancer Screening: An Exploration of Age, Density, and Emerging Technologies

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Introduction

Breast Cancer remains a significant burden in Canada, reflecting global patterns as one of the most common cancers affecting women. In 2023, it was estimated that 26% of all new cancer cases among Canadian women were attributed to breast cancer, contributing to 13% of all cancer deaths in this group.[1] Recent advancements in both detection and treatment of breast cancer have significantly improved cure rates, particularly when breast cancer is detected early. Early-stage breast cancer detected through screening can have a 5-year survival rate of 99%.[2,3] Thus, the quest for early detection through effective and economical screening initiatives is a critical component in minimizing the burden of disease and reducing breast cancer-related mortality.

However, ongoing dialogue continues within the medical community regarding the optimal timing of screening initiation for women at average risk. Discussion about the appropriate age to discontinue screening is an evolving topic. This conversation is complex and multifaceted, involving careful consideration of the intricate balance between the benefits of early detection, economic implications of population screening, and potential harms such as overdiagnosis and the psychological impact of false positives.[4] Current Canadian guidelines, last updated in 2018, recommended mammography screening every 2–3 years for women aged 50–74 years, reflecting an expert consensus that considers both scientific evidence and population health needs.[5] These guidelines are under revision with an update expected in 2024, while other major organizations have recently published new recommendations, reflecting the value of early detection at a younger age in the effort to minimize cancer deaths.[6]

Additionally, the efficacy of mammography alone as a screening modality in women with dense breast tissue, who constitute up to 43% of the screening population, has come into question.[7,8] This challenge has catalyzed discussion around recommended supplementary screening modalities to improve cancer detection rates in women with dense breast tissue.[9]

This article explores the ongoing discourse on breast cancer screening recommendations for average-risk women, including the age at which to initiate and stop screening, imaging modalities, and emerging technologies.

The Age Dilemma: Evidence, Guidelines, and Ongoing Debate.

When to Initiate Breast Cancer Screening

The optimal age to initiate population screening for breast cancer in Canadians remains a contentious issue within the medical community, with various organizations offering varying recommendations. The 2018 consensus guidelines from the Canadian Task Force on Preventive Health Care (CTFPHC) recommend mammography screening every 2–3 years for women aged 50–74 years who are not at increased risk of breast cancer.[5] These guidelines were independently reviewed using the AGREE II (Appraisal of Guidelines for Research and Evaluation) tool and were found to be of high quality. However, they are currently under review, with an anticipated release in 2024. A recent review of breast cancer screening guidelines highlighted how the current Canadian

recommendations differ from recently updated and comparable screening guidelines.[10]

For example, in the United States, revised recommendations by the American Cancer Society (ACS) recommend that women at average risk should have the option to begin annual mammography at age 40 and should definitely begin by age 45.[11] Early initiation of screening aims to reduce breast cancer mortality by diagnosing breast cancer in its earlier stages, which may be more favourable to treatment. The American College of Radiology (ACR) and the Society of Breast Imaging advocate for annual mammograms starting at age 40, citing significant reductions in mortality and increases in years of life saved.[12] Recent Canadian studies also support early screening. One study concluded that starting mammography at age 40 can significantly decrease breast cancer mortality by enabling earlier diagnosis, where treatment may be more effective.[13] Another study discusses the downstream impacts of organized screening programs in Canada, further advocating for the early initiation of screening.[20]

Arguments for Earlier Screening Initiation at Age 40

Proponents of initiating breast cancer screening at the age of 40 emphasize the potential for early detection to reduce breast cancer mortality by up to 30%.[14] A recent study, which involved hypothetical risk assessments and modelling, found that the age-based strategy detected more breast cancers but led to more false-positive mammograms and benign biopsy results. It went on to show that breast cancer in younger women tends to be more aggressive, highlighting the need for early detection.[15]

Beyond mortality, early and localized detection of breast cancer can improve quality of life by allowing for breast conservation options versus mastectomies, thus potentially having more favourable psychosocial outcomes. Earlier stage cancers may also require less aggressive treatments, which may lead to fewer toxicities and late-effects. Canadian authors have conducted a comprehensive review of important non-mortality metrics and quality indicators that demonstrate alternative considerations in the debate on the age of population screening initiation.[16]

Arguments Against Earlier Age-Based Screening at Age 40

Conversely, concerns about overdiagnosis, the benefits of early diagnosis given treatment advances, and the psychological impacts of false positives are ongoing. Overdiagnosis can lead to unnecessary treatments, which carry significant risks and side effects. Recent expert discussions suggest that a significant proportion of cancers detected through early screening may never become clinically significant.[4] Furthermore, false positives may precipitate anxiety, stress, and invasive procedures.[6]

Economic considerations may also play a role in this debate. Screening younger women for breast cancer more frequently can lead to increased healthcare costs, which may not be proportionate to the benefits in mortality reduction, especially with rapid advancements related to breast cancer diagnosis and treatment. For instance, the United Kingdom's National Health Service (NHS) continues to recommend routine screening at the age of 50, citing a more favourable balance of risks and benefits.[10]

Cessation of Breast Cancer Screening

When to discontinue breast cancer screening is also being debated. Canadian guidelines recommend screening up to age 74, citing insufficient evidence to support screening beyond this age. However, they suggest the decision to continue beyond the age of 74 to be individualized and based on informed discussion, overall health, and patient preferences.[5] The revised ACS guidelines recommend women continue mammography as long as they are in good health and expected to live beyond 10 years.[11]

Older Women: To Screen or Not to Screen?

Proponents of screening cessation as women age cite diminishing returns, suggesting that competing causes of death reduces the relative impact of early detection of breast cancer. Some suggest that continuing mammography beyond the age of 70 does not significantly impact breast cancer mortality and may pose a greater risk of overdiagnosis. Additionally, screening may lead to the detection of slow growing tumours that would not have caused harm within their natural lifespan, possibly resulting in unnecessary treatments and associated morbidity.[17-20]

Conversely, some experts argue that screening should continue for as long as women are in good health with a reasonable

life expectancy, as breast cancer risk increases with age.[12,20,21] A recent study by Lee *et al.* (2023) reports that screening mammography has favourable performance metrics in older women, with benefits outweighing the risk until age 90. Improved sensitivity and specificity lead to fewer false positives. They have also reviewed observational studies that demonstrate screen-detected cancers in older women are found at an earlier cancer stage, making them amenable to less invasive treatments. This highlights the importance of adaptable guidelines and individualized care.[22]

Table 1 provides an overview of access to breast cancer screening across all Canadian provinces and territories, focusing on women aged 40–49 at average risk. Additionally, the table highlights the policies regarding breast density notification.

	Women aged 40-49 years can self-refer for a mammogram	Women can self-refer for annual mammograms	All women are directly informed of their breast density	Only women with BI-RADS D density are informed of their density	Only women with BI-RADS D density are invited for annual (instead of biennial) mammography
British Columbia	Yes	No	Yes	No	No
Alberta	Yes with conditions*	Yes with conditions*	Yes	No	No
Saskatchewan	No	No	No	Yes	Yes
Manitoba	No	No	Yes	No	No
Ontario	No	No	No	Yes	Yes
Quebec	No	No	No	No	No
New Brunswick	No	No	Yes	No	No
Nova Scotia	Yes	Yes	Yes	No	No
Prince Edward Island	Yes	Yes	Yes	No	Yes
Newfoundland and Labrador	No	No	No	Yes	Yes
Yukon	Yes	Yes	No	Yes	Yes
Northwest Territories	Yes with conditions*	No	No	Yes	Yes
Nunavut	No	No	No	No	No

*women can self-refer after the first referral is made by the family physician

Table 1: Jurisdictional Screening Access and Breast Density Reporting (Canada); provides an overview of access to breast cancer screening across all Canadian provinces and territories, focusing on women aged 40-49 at average-risk. Some provinces and territories allow for self-referral for mammogram, either directly or after an initial referral by family physician. Additionally, the table highlights the policies regarding breast density notification, including which provinces inform all women of their breast density and which inform only those with BI-RADS (Breast Imaging & Reporting Data System) D density.[6] *Adapted from Yong-Hing CJ et. al, 2023.*

Breast Density and Implications for Mammography

Understanding Breast Density

Breast density refers to the proportion of fibroglandular to fatty tissue in the breast visible on a mammogram. The BI-RADS (Breast Imaging Reporting and Data System) scoring system categorizes breast density into four levels:

- A (almost entirely fatty)
- B (scattered fibroglandular densities)
- C (heterogeneously dense), and
- D (extremely dense)

Women with a BI-RADS score of C or D are considered to have dense breasts.[23,24]

Implications

Dense breasts contain a higher percentage of fibroglandular tissue, which appears white on a mammogram, similar to the appearance of potential tumours, which complicates detection.[7,25] Dense breast tissue not only complicates mammogram readings by obscuring tumours, thereby reducing the sensitivity of mammograms (resulting in lower detection rates), but also independently increases the risk of breast cancer.[23,25,26] These challenges raise the urgency around the need for enhanced screening strategies for women with dense breasts who receive negative mammogram results.

Supplementary imaging for average-risk women with a BI-RADS score of C or D with negative mammography results

To address these challenges, supplementary screening modalities such as ultrasound and magnetic resonance imaging (MRI) are recommended. Canadian guidelines recommend the use of supplemental ultrasound for women with dense breasts following a negative mammogram result. MRI, however, is advised for women with extremely dense breasts or additional risk factors.[7] The DENSE trial in Europe demonstrated that supplemental MRI significantly improved cancer detection rates in women with extremely dense breasts.[9] By comparison, in the USA, the ACR suggests either supplemental MRI or ultrasound for women with dense breasts to improve detection rates.[12]

Current guidelines have adopted recommendations that emphasize a personalized risk assessment to determine the most appropriate screening strategy, balancing the benefits of early detection with the potential harms of overdiagnosis and false positives.

Advanced and Emerging Technologies

Evaluation of advanced imaging techniques such as handheld ultrasound versus automated whole breast ultrasound (AWBUS), digital breast tomosynthesis, and contrast-enhanced mammography are also being explored for their efficacy in improving cancer detection rates.[27] Some provinces have already adopted these advanced technologies. Also emerging in breast cancer screening is the supplementary use of artificial intelligence (AI). AI algorithms may come to play an important role in triaging mammograms, streamlining radiologist workloads, in addition to improving cancer detection rates and diagnostic accuracy.[28]

Thermography

Thermography uses infrared technology to detect heat patterns and vascular flow in breast tissue and has sparked controversial dialogue with respect to its utilization in breast cancer screening. While it offers a non-invasive and radiation-free alternative to mammography, its efficacy has not been established. Studies show variable sensitivity and specificity in the diagnostic accuracy of thermography; however, recent advancements in AI may improve its accuracy. Current evidence strongly suggests that thermography should not replace conventional imaging modalities. However, it may have a utility in underserved areas where access to mammography is limited.[29-31]

Conclusions and Future Directions

Breast cancer remains one of the leading cancers affecting women with a significant population burden. The discourse on breast cancer screening in Canada remains an evolving and rich conversation, centred around when to initiate and cease breast cancer screening, while evaluating benefits, potential harms, risk factors, special populations, rapid advancements in imaging modalities, and cancer therapies. Current Canadian guidelines are under review by the Canadian Task Force for Preventive Health, with an anticipated release of the updated guidelines in 2024. As we await these updates, our focus remains on an evidence-based, individualized, and patient-centric approach that incorporates the importance of early detection in mitigating

breast cancer related morbidity and mortality outcomes, while also mitigating the risks inherent in population screening initiatives.

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