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# Bone fragility related to breast cancer treatment: The pivotal role of nurses in bone health program development, implementation, and testing

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## ABSTRACT

Breast cancer treatment can affect estrogen levels leading to significant bone loss, osteoporosis, and risks for fracture. Although bone care guidelines are published, bone health interventions are often not routinely offered to at-risk individuals. This paper reports on the process of developing and implementing a nurse-led bilingual Breast and Bone Health Program (BBHP) in-person and online at a cancer centre in Montreal, Quebec ([www.breastandbonehealth.ca](http://www.breastandbonehealth.ca), [www.santeseinsetos.ca](http://www.santeseinsetos.ca)). The BBHP offers tailored bone health interventions (e.g., risk screening, information, rehabilitation, exercise prescriptions, nutritional counselling, and support for a health-promoting lifestyle). Over a two-year period, women treated for breast cancer (N = 430) took part in the program. Forty percent of surveyed participants (n = 97) initially reported being unaware that some breast cancer treatment could significantly affect bone health. Following the initial informational session with the BBHP nurse, self-reported bone health knowledge significantly increased, with 96% reporting sufficient information to manage their bone health. The BBHP offers both online and in-person risk assessment and bone health promotion activities and tools to both health care professionals and women with breast cancer. Herein, we review the background, BBHP development and implementation as well as preliminary program evaluation.

## BACKGROUND

One in eight Canadian women will develop breast cancer (bca) in her lifetime, accounting for 25% of all new cancer cases among women (Canadian Cancer Statistics Advisory Committee, 2017). Approximately 75% of bca-related diagnoses will be hormone-dependent (i.e., estrogen-receptor dependent) (American Cancer Society, 2019), requiring endocrine therapy (ET) (e.g., aromatase inhibitors, selective estrogen receptor modulators) to either inhibit estrogen production or modulate estrogen action on bca cells. Because estrogen is needed to regulate bone formation and resorption, changing its level and action through various means (e.g., ET or ovarian function loss/suppression related to surgery, medication and/or chemotherapy) can significantly increase bone loss. Women treated for bca, for instance, may encounter a 40% increased incidence of osteoporosis, 30% increased risk of fracture, and 20% increased risk of hospitalization due to fracture (Chen et al., 2005; Colzani et al., 2016; Bruyère et al. 2017). Despite the increased use of bone mineral density (BMD) scans, typically used for osteoporosis screening among women with bca, screening remains suboptimal (Henault et al., 2018).

More generally, financial burden related to osteoporosis in Canada is estimated to cost 4.6 billion dollars annually (Hopkins et al., 2016), with those who sustain a hip fracture more likely to die within one year and for those who survive, only 40% return to pre-fracture levels of independence (Abrahamsen et al., 2009). In addition to functional decline and morbidity, fractures are also linked to rises in fall risk, re-fracture, loss of autonomy, and adverse mental health outcomes, such as greater isolation and depression (Adachi et al., 2003; Stinchcombe et al., 2014).

Clinical guidelines and recommendations regarding pharmacological and non-pharmacological management of bone health (BH) for women living with bca (Gralow et al., 2013; Hadji et al., 2017; Runowicz et al., 2016) include the provision of bone-modifying agents, such as bisphosphonates, optimizing calcium and vitamin D intake, performing weight-bearing exercises, preventing falls, and modifying lifestyles (e.g., inactivity, home safety, smoking, alcohol consumption). Whereas pharmacological interventions are applied when medically indicated, non-pharmacological interventions are recommended to all women as preventive measures. Commonly, calcium and vitamin D supplements are recommended to preserve bone strength. However, among women treated for bca, empirical evidence suggests that supplements alone are insufficient (Datta & Schwartz, 2013), supporting the need for a multimodal approach. For example, moderate-intensity aerobic and resistance exercises have the potential to maintain BMD in women

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treated for bca (Waltman et al., 2009; Knobf et al., 2016; Winters-Stone et al., 2011; Schwartz & Winters-Stone, 2009), whereas other types of exercise (e.g., Tai Chi, balance or strength training) are successful for fall prevention (Gillespie et al., 2012).

Despite their increased risk, women living with bca are not routinely provided with sufficient counselling on non-pharmacological aspects of BH (Peppone et al., 2014; Szabo et al., 2010). Furthermore, those aware of their increased risk lack the practical information and knowledge to safely engage in BH self-management (des Bordes et al., 2016). Whereas affected women express the need for more tailored BH information and care (des Bordes et al., 2016), research shows that healthcare professionals (e.g., physicians, nurses, physiotherapists, dieticians) are often unprepared to counsel individuals on prevention and management strategies for bone loss and osteoporosis (Nguyen, 2016).

Led by a nurse specialized in bone health and cancer, a team of clinicians and researchers worked collaboratively on conceptualizing and implementing the Breast and Bone Health Program (BBHP), delivered in English and French. This paper presents the development, preliminary assessment, implementation, and dissemination of the BBHP initially based at a large McGill University-affiliated cancer centre in Montreal, Quebec.

## PROGRAM DEVELOPMENT

Development of the BBHP was informed by self-management strategies associated with the Chronic Care Model (McCorkle et al., 2011), clinical observations, and empirical evidence. The main goals of the program were to (1) raise awareness on the effects of bca treatment on bone health; (2) provide bone health assessment and non-pharmacological and tailored materials; and last, (3) enhance bone health care by disseminating the evidence-based program in-person and online. The team included clinicians, researchers, and patient representatives to ensure that bone care remained a shared goal among multidisciplinary oncology team members and affected women. To assess the potential magnitude of BH issues at the participating centre, a retrospective chart review focusing on bone-related data was conducted coupled with patient interviews and feedback from various disciplines (i.e., nursing, physiotherapy, nutrition, medical and surgical oncology) and other stakeholders (e.g., administrators). Guided by the Hospital Quality Improvement Program, chart review was undertaken in the oncology department only.

As a pre-program assessment, a random chart review was conducted (in the last week of April 2015) for 80 of the 183 patients who were newly diagnosed with breast tumours between January and June 2014 at our cancer centre. This review included nominal data on documented clinical characteristics related to BH in bca (e.g., ET plans, bone mineral density results, calcium and vitamin D supplement prescriptions, BH risk communication, osteoporosis diagnosis, smoking status; Table 1 for data summary). The average age at diagnosis was 62.7 years and 62.5% were documented as post-menopausal. Nearly three-quarters (71.3%) received prescriptions for ET, most of which were for aromatase inhibitors. Of the latter, 50%

had either documented osteoporosis or osteopenia, although only 42.5% had a documented bone mineral density scan.

Based on existing literature, clinical recommendations, and guidelines, the BBHP (Table 2) was developed with an emphasis on promoting awareness and non-pharmacological interventions. BBHP consists of the seven following components: (1) key bone health information in breast cancer; (2) screening/assessing bone

**Table 1**

*Retrospective Chart Review on Bone Health-Related Characteristics*

<b>Documented BH-related characteristics</b>	<b>All patients</b>	<b>ET subgroup – Aromatase Inhibitor</b>	<b>ET Subgroup – Tamoxifen</b>
N	80	40	17
<b>ET prescription, n (%)</b>			
Aromatase inhibitor*	40 (50.0)		
Tamoxifen*	17 (21.3)		
Refused or planned*	5 (6.3)		
None*	18 (22.5)		
Age, mean (SD), years	62.7 (13.0)	67.0 (11.4)	53.4 (9.9)
First primary bca, n (%)	66 (82.5)	33 (82.5)	16 (94.1)
Post-menopausal at diagnosis, n (%)	50 (62.5)	33 (82.5)	6 (35.3)
Provision of information on endocrine therapy BH risk, n (%)	13 (16.3)	13 (32.5)	0 (0.0)
Baseline bone mineral density scan, n (%)	21 (26.3)	17 (42.5)	(11.8)
<b>Existing or new low bone density, n (%)</b>			
Osteopenia*	16 (20.0)	12 (30.0)	1 (5.9)
Osteoporosis*	10 (12.5)	8 (20.0)	2 (11.8)
History of bone modifying agent, n (%)	12 (15.0)	7 (17.5)	2 (11.8)
<b>Smoking status, n (%)</b>			
Current smoker*	5 (6.3)	3 (7.5)	1 (5.9)
Ex-smoker*	10 (12.5)	5 (12.5)	3 (17.6)
Non-smoker*	30 (37.5)	14 (35.0)	9 (52.9)
Not documented*	35 (43.8)	18 (45.0)	4 (23.5)
<b>Calcium and/or Vitamin D supplements, n (%)</b>			
Previously taking*	32 (40.0)	20 (50.0)	5 (29.4)
New prescription or renewal*	15 (18.8)	12 (30.0)	3 (17.6)
<b>Specialty service consultation, n (%)</b>			
Osteoporosis clinic*	10 (12.5)	9 (22.5)	1 (5.9)
Oncology Dietician*	12 (15.0)	3 (7.5)	2 (11.8)
Hope & Cope Physiotherapy*	9 (11.3)	4 (10.0)	2 (11.8)
<b>Adverse event, n (%)</b>			
Fall history*	4 (5.0)	1 (2.5)	0 (0.0)
Previous fragility fracture*	3 (3.8)	1 (2.5)	0 (0.0)
New fall*	4 (5.0)	2 (5.0)	0 (0.0)
New fragility fracture*	2 (2.5)	1 (2.5)	0 (0.0)

Note: Bold text indicates a superordinate category

\* Subordinate categories

**Table 2**

*Breast & Bone Health Program (BBHP) Components*

Program components and focus	Materials (available online)	Clinician/ healthcare professionals involved
<p><b>1. Awareness raising and information provision:</b> Overview of estrogen's bone-protective role, bca treatment that may lead to bone fragility, and strategies to manage BH. Information presented in brochures includes 1) what I should know about my BH; 2) what I can do to keep my bones healthy; and 3) resources to get started.</p>	<p>BBHP leaflet 10-page BBHP Brochure</p>	<p>Nurse Nurse</p>
<p><b>2. Screening and assessment:</b> Screens based on empirical evidence, clinical guidelines on bca survivorship (Runowicz et al. 2016; Schmitz et al. 2010) bone loss prevention and management for the general (Papaioannou et al. 2010; Kohrt et al. 2004) and bca population (Gralow et al. 2013; Hadji et al., 2017; Coleman et al., 2014; Rizzoli et al., 2013) and the International Osteoporosis Foundation One-Minute Osteoporosis Risk Test. Risk factors screened included medical and family history of breast cancer, osteoporosis, falls, fragility and/or hip fractures; social history; physical assessment (i.e., weight, height, BMI, rib to pelvis distance, occiput to wall distance, posture) physical activity profile (i.e., pain, mobility, activities of daily living); smoking and alcohol consumption; diet (e.g., calcium or supplement intake).</p>	<p>International Osteoporosis Foundation One-Minute Osteoporosis Risk Test BBHP Nursing Evaluation BBHP Physiotherapy Evaluation</p>	<p>Nurse Nurse Physiotherapist</p>
<p><b>3. Exercises for BH maintenance:</b> Focus on improving skeletal integrity, muscular performance and bone mineral density (BMD) and in turn, lower the risk of osteoporotic fractures and falls (Waltman et al., 2010; Knobf et al., 2016; Winters-Stone et al., 2011; Schwartz &amp; Winters-Stone, 2009; McNeely et al., 2010; Howe et al., 2011; Madureira 2007). Recommendation of exercise categories: a) general bone healthy exercises (i.e., weight-bearing aerobic, strengthening, balance and posture exercises); b) biomechanical precautions or modifications for healthy postural alignment (e.g., to reduce the development of kyphotic deformities, risk of spinal compression and spine-sparing techniques); c) home exercise programs for either osteoporosis prevention or management based on the Osteoporosis Canada Benefit Guidelines (Giangregorio et al., 2015).</p>	<p>6-page BBHP Exercise Brochure Biomechanical Considerations in Osteoporosis Home Exercise Plans (Osteoporosis Prevention and Management)</p>	<p>Nurse, Physiotherapist Physiotherapist Physiotherapist, Hope &amp; Cope Exercise Specialist</p>
<p><b>4. Nutrition for healthy bones</b> Illustrate optimal calcium intake through diet (e.g., 500 mg or less at a time); Calcium &amp; Vitamin D supplements in line with Osteoporosis Canada (Papaioannou et al., 2010); list of calcium-rich foods and portion sizes.</p>	<p>2-page BBHP Nutrition Brochure</p>	<p>Nurse</p>
<p><b>5. Support for bone healthy lifestyles</b> Encourage positive approaches based on identified needs: smoking cessation, alcohol reduction, fall prevention, home safety, and other BH-related goals (Bodenheimer et al., 2007)</p>	<p>BBHP Home safety checklist BBHP Action plan worksheet</p>	<p>Nurse Nurse</p>
<p><b>6. Rehabilitation from bca treatment</b> Minimizing risks of upper extremity musculoskeletal complications following breast surgery</p>	<p>Physiotherapy Rehabilitation Exercise Prescription Sheet Post-Surgery Exercise Plan Post-Radiation Exercise Plan</p>	<p>Physiotherapist Physiotherapist Physiotherapist</p>
<p><b>7. Additional clinician-focused tools</b> Equip clinicians with relevant online continuing education opportunities supplemented with key published guidelines to provide optimal counsel on BH in cancer</p>	<p>Published Reviews, Recommendations, and Clinical Guidelines Continuing Education Opportunities</p>	<p>(for all healthcare professionals)</p>

health needs; (3) exercises for bone health maintenance; (4) nutrition; (5) healthy lifestyles; (6) rehabilitation from breast cancer treatment; and (7) healthcare professional support.

## GUIDING PRINCIPLES FOR PROGRAM IMPLEMENTATION

### The Lean Approach

The Lean methodology was used initially to guide program implementation as it provides a reiterative improvement process that enables the efficient provision of high-quality healthcare services (Fine et al., 2009; Aij & Rapsaniotis, 2017). Using this approach, the BBHP was integrated into the participating cancer centre through (1) meetings with clinicians and patients to discuss how BH care is valued in terms of needs, preferences, and timing of program delivery; (2) mapping what and who should be involved in bone care delivery; (3) tracking demand and acceptability of program materials; and (4) applying continuous cycles of BBHP quality improvement.

Six tasks were addressed to progressively integrate BBHP into routine cancer care at the participating centre: (1) setting up a clinical presence and working space, (2) familiarizing with current hospital services, infrastructure, and documentation systems, (3) establishing a weekly communication routine among BBHP clinicians, (4) working with key individuals (e.g., medical oncologist and nurse navigators) in the cancer clinic to refer program participants, (5) promoting BBHP services to a wider group of clinicians and encouraging referral, and (6) actively inviting women to the BBHP from clinics and community settings. Participation in the BBHP was tracked by logging participant encounters and collating additional information (e.g., new referrals, follow-up assessments, length of visits, program components reviewed). Reports on these data were generated regularly for assessment and comparison. In addition, various stakeholder feedback and quality indicators, such as participant satisfaction and self-reported knowledge on BH, informed program refinement.

### Funding and Setting for Initial Program Delivery

A four-year grant from the Quebec Breast Cancer Foundation supported program development and its implementation. Hope & Cope (<https://hopeandcope.ca>) professionals and volunteers provided the physical space for related BH activities, recruitment, and program delivery.

### Program Enrollment and Reach

The BBHP targeted women recently diagnosed with non-distant metastatic bca receiving care at a large McGill University-affiliated cancer centre between 2015 and 2017. With 75% of bca diagnoses expected to require ET (Dunnwald et al., 2007), we aimed to enroll 175 participants per year. From September 2015 to October 2017, the program provided BH care to 430 participants who met the inclusion criteria and agreed to take part in the program. Participant characteristics are presented in Table 3.

Of note, enrollment increased gradually as more clinicians became aware of the program. Typically, referrals to the program were made when BMD scan reports were received and/or treatment-related rehabilitation needs were presented. In addition, any affected women who inquired about

the program were offered BH materials. Ninety-seven participants were initially surveyed to assess their bca and BH knowledge (Table 4). Whereas more than half of these self-identified as active bca information seekers, many were unaware that specific bca treatments could affect BH. Some also reported uncertainty regarding their bca diagnosis subtype, ET, or whether bone mineral density tests were performed.

### Program Delivery

In addition to having previous oncology experience and being involved in the development of the BBHP materials, prior to program delivery, the oncology nurse completed training modules on bone health in cancer, undertook Osteoporosis Canada certification, and subsequently developed most of the BBHP materials. Initial sessions were 30–60 minutes in length and included screening, assessment, and tailored BH information provision. These sessions were typically provided as part of their ongoing cancer care appointments (e.g., oncologist follow-up). One to two follow-up appointments of 30 minutes were provided by phone or in-person to review tailored action plans and support goal attainment. The program nurse liaised with the multidisciplinary team to recommend additional tests or prescriptions (e.g., BMD scan, x-rays, supplements) or referral to other relevant services when indicated (e.g., osteoporosis clinic, occupational therapy, dietitian, pharmacy, psychosocial services, lymphedema therapy). Most participants consulted with the program physiotherapist, and some required additional follow-up for rehabilitation of common bca sequela following surgery and/or radiation. Participants were also referred to volunteer community services provided by Hope & Cope (e.g., exercise support) or the broader community (e.g., Osteoporosis Canada). As the main goal was to begin to raise awareness among affected women, longer-term follow-up was not part of the initial BBHP.

**Table 3**

*Breast & Bone Health Program (BBHP) Participant Characteristics (N = 430)*

Participant characteristics	Mean (SD) and n (%)
Age in years	56.1 (13.5)
Follow-up with BBHP clinicians, total number	1.7 (2.4)
Time since bca diagnosis at program enrollment in months	
< 3	96 (22.3)
3 to < 12	130 (30.2)
12 to < 24	55 (12.8)
24 to < 36	41 (9.5)
36 to < 48	38 (8.8)
48+	70 (16.3)
Referred to program by	
Medical or surgical oncologist	238 (55.3)
Nurse or allied health professional	54 (12.6)
Preoperative education session with BBHP physiotherapist	94 (21.9)
Hospital volunteer	11 (2.6)
Other (friend, clinic poster, pamphlet)	33 (7.8)

## Acceptability

Feedback from participants and ongoing referrals from clinicians showed that program services were enthusiastically endorsed. From the clinicians' perspective, referral to the program nurse who had the training, time, and resources to provide adequate counsel on BH added value to patient care and reduced workload. To gauge program acceptability at the early

**Table 4**

*Initial Program Participant Self-Report Survey (n = 97)*

Patient Survey Items	n (%)
<b>Taking ET</b>	
Aromatase inhibitor	32 (41.0)
Tamoxifen	17 (21.8)
GnRH alone or in combo	9 (11.5)
None	15 (19.2)
Not sure	5 (6.4)
Total responses	78
<b>Cancer information seeking preference (Loiselle, 2019)</b>	
Intense	25 (30.9)
Complementary	30 (37.0)
Fortuitous	4 (4.9)
Minimal	15 (18.5)
Guarded/avoidant	7 (8.6)
Total responses	81
<b>Previously aware that certain types of bca treatment can affect BH</b>	
Yes	53 (56.9)
No	36 (40.4)
Total responses	89
<b>Has ER positive bca</b>	
Yes	37 (56.1)
No	17 (25.8)
Not sure	12 (18.2)
Total responses	66
<b>Has had a bone mineral density scan</b>	
Yes	50 (53.2)
No	34 (36.2)
Not sure	10 (10.6)
Total responses	94
<b>If has had BMD scan, knows that results</b>	
Yes	32 (68.1)
No	15 (31.9)
Total responses	47
<b>Taking calcium supplements</b>	
Yes	47 (49.5)
No	47 (49.5)
Not sure	1 (1.0)
Total responses	95
<b>Taking vitamin D supplements</b>	
Yes	66 (68.8)
No	30 (31.3)
Total responses	96

Note: Bold text indicates a superordinate category

stages of implementation, a subgroup of 57 participants were surveyed pre- and post-first session (Table 5). Pre-session, 58.5% agreed or strongly agreed that they had enough information to take care of their bone health. This increased to 95.9% post-first session. Mean scores of self-reported BH knowledge rated 0 (lowest) to 10 (highest) increased from 5.1 (pre-session) to 7.5 (post-session). These changes were statistically significant ( $p < 0.01$ ), as indicated by Wilcoxon Signed-ranks tests. Similarly, following a group information session by the program physiotherapist, self-reported knowledge on bca rehabilitation-related content increased significantly (Ibrahim et al., 2018).

## Challenges and Facilitators related to Program Delivery

Several factors affected program implementation. For example, the lack of a provincial electronic health record meant that documentation of services or procedures (e.g., BMD scan results, dietitian consultation notes, physiotherapy evaluation) completed outside of the cancer centre were not readily accessible, often delaying program delivery. The reorganization of provincial healthcare delivery at the time also challenged timely referrals to services within and external to the participating cancer centre.

Despite these challenges, certain factors promoted BBHP implementation. For instance, clinicians and administrators valued the program contributions and supported these through regular referrals and encouraging feedback. Program participants were highly engaged and appreciative with the program quickly gaining accrual through word of mouth among patients. Also, program delivery facilitated by Hope & Cope readily availed participants to relevant clinical and community resources for BH self-management.

**Table 5**

*Pre-Post Nursing session participant survey (n = 57)*

Survey Items	Pre	Post
<b>I have the information I need to take care of my bones, n (%)</b>		
Strongly disagree	3 (6.1)	0 (0.0)
Disagree	17 (34.7)	2 (4.2)
Agree	25 (51.0)	19 (39.6)
Strongly agree	4 (8.2)	27 (56.3)
Total answered	49	48
<b>My knowledge of my bone health is</b>		
(0–10 scale, 0 = lowest, 10 = highest), mean score (SD)	5.1 (2.9)	7.5 (2.3)
Total answered	53	49
<b>I found this session useful</b>		
Yes		57 (100.0)
No		0 (0.0)
Total answered		57
<b>I would recommend this session to others</b>		
Yes		54 (100.0)
No		0 (0.0)
Total answered		54

Note: Bold text indicates a superordinate category

## Program Refinement

Several components of the BBHP were further refined to better reflect clinical and participants contexts. For instance, in response to limitations of upper extremity movements following breast surgery and/or radiation therapy, specific interventions were added to program delivery. Physiotherapy sessions, for instance, focused specifically on improving arm and shoulder mobility. The BBHP also began to provide treatment recovery education and exercise plans to participants before surgery and/or radiation therapy to minimize the need for subsequent intensive rehabilitation. Furthermore, the BBHP collaborated with nurse pivots/navigators and oncology occupational therapists to incorporate program rehabilitation interventions into monthly information sessions offered to women awaiting breast surgery. Based on user feedback, awareness-raising tools were revised to be more interactive and appealing in terms of content, layout, and language use.

## Program Dissemination and Sustainability

Accumulating evidence documents significant gaps between BH management recommendations and clinical uptake, underscoring the importance of active dissemination of knowledge on the long-term risk of bone-related issues in bca (Peppone et al., 2014; Szabo et al., 2010). To enhance BBHP knowledge dissemination, a communication firm was hired to assist our team to embed program key components online in French and English ([www.breastandbonehealth.ca](http://www.breastandbonehealth.ca)) ([www.santeseinsetos.ca](http://www.santeseinsetos.ca)). Key drivers and prompts, such as leaflets, cards, letters to health care providers, and referral sheets, were developed to enhance visibility and encourage access to the free online content and tools. As of now, most program components are stand-alone online or integrated into existing bca activities at Hope & Cope (e.g., support groups, nutrition workshops, exercise support, pre-operative orientation session).

## CONCLUSION AND FUTURE DIRECTIONS

Women with bca who experience estrogen decreases secondary to ET, ovarian failure/suppression due to surgery,

medication, and/or chemotherapy are at significant risk for bone loss and ensuing bone fragility. Both pharmacological and non-pharmacological interventions are recommended to manage these adverse events. Timely assessment, personalized information, and hands on interventions are most appreciated by affected patients and multidisciplinary team members. Future directions would include adaptation and dissemination of program materials relevant to other diagnoses such as prostate cancer, where treatment is also associated with significant bone loss. Exploring differences in uptake according to socio-demographic and economic status would inform further tailoring of bone health interventions in cancer. Further work could also document the effects of these kinds of program on patient cancer care pathways and long-term outcomes.

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