CMAJ
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A Snapshot of Breast Cancer Surgery in Canada

Journal:	*CMAJ*
Manuscript ID:	CMAJ-13-0552
Manuscript Type:	Research - Cohort study (retrospective)
Date Submitted by the Author:	10-Apr-2013
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Keywords:	Oncology, Surgery
More Detailed Keywords:	Breast Cancer, Mastectomy, Breast conservation
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	care exists in Canada. Further research is needed to better understand such variation, and continued monitoring should be the cornerstone of quality initiatives.

A Snapshot of Breast Cancer Surgery in Canada

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Source of Support: N/A

Disclaimers: None

Running title: Breast Cancer Surgery in Canada

Key Words: Breast cancer, surgery, mastectomy, breast conservation

Word Count
Manuscript: 2,497
Abstract: 230

Appendix: 1
Tables: 6
References: 46

ABSTRACT

Background: Surgery is both a common and important component of breast cancer (BC) treatment. In this article, we provide a pan-Canadian picture of surgical care for the treatment of BC from 2007 - 2008 to 2009 - 2010.

Methods: Provincial / territorial hospital and day surgery data standardized by the Canadian Institute for Health Information (CIHI) was used to assemble a breast cancer surgery cohort. For each woman represented in the analysis, an index surgical procedure was identified, as were subsequent surgical procedures that took place within one year.

Results: Among the 57,840 women undergoing breast cancer surgery, the crude mastectomy rate at one year among women with unilateral invasive breast cancer (UIBC) was 39%. Adjusted mastectomy rates varied widely by province (26% to 69%). The rate of re-excision within one year for women who had breast-conserving surgery (BCS) as their index procedure was 23% and varied widely by province both in terms of frequency and type (mastectomy or repeat BCS). Among women who underwent mastectomy for UIBC, 6% also underwent contralateral prophylactic mastectomy, and 7% had immediate breast reconstruction following their surgery. Day surgery was used in 20% of women undergoing mastectomy and 70% of women undergoing BCS.

Interpretation: Significant interprovincial variation in surgical breast cancer care exists in Canada. Further research is needed to better understand such variation, and continued monitoring should be the cornerstone of quality initiatives.

INTRODUCTION

In Canada in 2012, an estimated 22,700 women were diagnosed with invasive breast cancer, and 5,100 women died of the disease.[1] In the setting of population-based screening programs, women are increasingly diagnosed with early-stage breast cancer, which carries a favourable prognosis following treatment. In the vast majority of cases, treatment involves surgery.[2]

Significant improvements in the local management of invasive breast cancer have occurred over the past three decades. Long-term survival following breast-conserving surgery (BCS) plus radiotherapy is at least equivalent to mastectomy for early-stage breast cancer. [3-8] Although local recurrence may be slightly increased, BCS has been associated with improved quality-of-life outcomes compared with mastectomy.[9] Some women have relative or absolute contraindications to breast-conservation therapy, such as poor tumour / breast ratio, multicentric tumours, or a contraindication to radiation therapy, and thus undergo mastectomy. In addition, some women who are candidates for BCS choose to have a mastectomy. Women who undergo mastectomy may undergo a contralateral prophylactic mastectomy in an effort to reduce the risk of developing contralateral breast cancer in the future; in an average patient, this risk is estimated to be 6% at 10 years and 12% at 20 years.[10]

To date, there have been few published reports of the surgical care provided to women with breast cancer from a pan-Canadian perspective. Thus, the objective of this study was to examine, at a population level, the contemporary surgical treatment of invasive breast cancer in Canada. Specifically, we sought to examine trends in the use of: BCS and mastectomy, re-excision following BCS, contralateral prophylactic mastectomy

(CPM), reconstructive surgery after mastectomy, and different sites of breast cancer surgical care (day surgery or inpatient care). In addition to descriptive trends, we sought to examine practice pattern variation by province, as well as examine the impact of patient age, income, and geographic access (as measured by travel time to the nearest radiation treatment centre).

METHODS

Three databases identified all inpatient and day surgery procedures: Hospital Morbidity Database, the National Ambulatory Care Reporting System (CIHI), and the Alberta Ambulatory Care Reporting System (Alberta Health and Wellness). Surgical treatment for breast cancer was defined as discharges with a most responsible diagnosis of breast cancer, and a related surgical intervention indicated anywhere on the abstract (see Appendix A for a list of codes). Inclusion and exclusion criteria are shown in Table 1.

Women's first-known (i.e., index) procedures that occurred between fiscal years 2007 - 2008 and 2009 - 2010, and subsequent one-year treatment episodes, were constructed using record linkage. All patient records were linked deterministically using a combination of encrypted health card number and birth year. Index procedures were the first discharge meeting the inclusion / exclusion criteria with no record of surgical treatment of breast cancer in the past year and no recorded past history of breast cancer.

Laterality of the index breast cancer (left, right or bilateral) was identified using the diagnostic code recorded for the index hospitalization. Information on the stage of the cancer was not available from any of the databases used in this study.

Treatment episodes were used to identify final procedure (mastectomy or BCS), re-excision (either repeat BCS or mastectomy), breast reconstruction, and contralateral

prophylactic mastectomy (CPM) within a year of the patient's index procedure (see Appendix A). The coding of final procedure (BCS vs. mastectomy) was hierarchical. For example, a woman who underwent BCS as her index procedure, and, within 365 days, had a mastectomy, was coded as having a mastectomy as the final procedure. Re-excision was defined as surgery for breast cancer (mastectomy or BCS) following index BCS that was performed on the same breast and occurred within 365 days of the index surgery. Breast reconstruction and contralateral prophylactic mastectomy rates were calculated among women who underwent a mastectomy as their index procedure.

Age group, neighborhood income quintile, and travel time to the closest cancer centre were specified as co-variates. Age was categorized into approximate quartiles, using ranges that aligned with existing literature. Neighborhood income quintile was derived from the postal code recorded on the index discharge. Travel time from patient residence to the closest radiation facility was derived from the postal code recorded on the index discharge. Patient residence and cancer centres were geocoded using latitude and longitude derived from Statistics Canada's Postal Code Conversion File (PCCF+) Version 5G. Travel time by car to the closest available cancer centre was performed using the "closest facility" feature of the Network Analyst extension of ESRI's ArcGIS 10 software program. Designation of province was based on patient's residence, not location of surgery. Data from the territories are included in the overall analyses but are not reported by territory due to small numbers.

A logistic regression model was estimated for the mastectomy rate using all eligible cases for women in Canada. Residents of Quebec (N=14,930) were excluded because Quebec does not submit postal code information, as were women from the territories

(N=113) due to small numbers. Among the remaining provinces, women for whom age, neighborhood income quintile and / or travel time could not be calculated (N=972) were excluded. Predicted mastectomy was calculated for each patient using the regression coefficients, then averaged across each province's eligible patients to yield a provincial predicted mastectomy rate. Adjusted mastectomy rates were calculated for each province using Adjusted Mastectomy Rate = (Crude Mastectomy Rate / Predicted Mastectomy Rate) x Canada Crude Rate.

All data were collected, held, and analyzed by CIHI staff using SAS 9.2.

RESULTS

Overall, 57,840 women received their index surgery for breast cancer between 2007 - 2008 and 2009 - 2010. The vast majority of these women (56,892, 98%) were treated for unilateral invasive disease. Given the small number of bilateral cases, results are reported only for women with unilateral invasive breast cancer (UIBC).

Breast-Conserving Surgery and Mastectomy

Among all patients with UIBC, 18,375 (32%) underwent mastectomy as the initial surgical procedure. Among the 38,517 patients who initially had BCS, 4,078 (11%) subsequently underwent a mastectomy within a year of their initial procedure, resulting in an overall increase in the use of mastectomy from 32% (index) to 39% (final). Significant variation in index ($\chi^2(9)=1519$, $p<0.0001$) and final ($\chi^2(9)=1698$, $p<0.0001$) mastectomy rates was observed between provinces (Table 2). For example, the final mastectomy rate among women with UIBC ranged from 26% in Quebec to 69% in Newfoundland and Labrador.

Mastectomy rates according to age, income, and travel time to radiation therapy facility are shown in Table 3. A U-shaped distribution was observed, with the highest rates seen among the youngest and oldest women. A modest decrease in use of mastectomy was observed, among women within higher income quintiles, while increasing distance from a radiation facility was associated with higher mastectomy rates.

Given the association of age, neighbourhood income and travel time with mastectomy rates, adjusted mastectomy rates controlling for these three variables were calculated for each province (Table 4). Exclusions from the logistic regression had almost no influence on crude rates for the provinces included in the analysis (Ontario and Nova Scotia increased by 1%). Relative to crude rates, adjustment slightly reduced the range of observed mastectomy rates (36%-69%, 35%-61%, respectively); however, interprovincial variation was still significant following adjustment [$\chi^2(8)=738$, $p<0.0001$].

Re-excision Following Initial BCS

Surgical re-excision within one year of index BCS was performed in 8,854 (23%) women (Table 5). Overall, 4,078 (46%) re-excisions were mastectomies, while 54% were repeat BCS. In addition to significant variation in the overall re-excision rate among provinces [$\chi^2(9)=399$, $p<0.0001$], the type of re-excision procedure (mastectomy or BCS) varied significantly between provinces [$\chi^2(9)=65$, $p<0.0001$]. For example, the re-excision rate in Newfoundland was 56%, with 204 (75%) such re-excisions being mastectomies, whereas in Quebec, the re-excision rate was 17%, with only 813 (40%) re-excisions being mastectomies.

Contralateral Prophylactic Mastectomy (CPM), Reconstructive Surgery after Mastectomy, and Location of Surgical Care (Day Surgery or Inpatient Care)

Among women who underwent a mastectomy as their initial procedure for UIBC between 2007 - 2008 and 2009 - 2010, 1,066 (6%) underwent CPM within one year. Overall, 1,571 (9%) women with UIBC undergoing mastectomy had reconstruction within a year. Among those women who underwent reconstruction, 1,196 (76%) had immediate reconstruction (7% of all women undergoing index mastectomy). Due to the uncommon nature of CPM and reconstruction, no interprovincial analyses are presented. Among women undergoing mastectomy for UIBC, only 20% were performed as a day surgery procedure. Conversely, most women undergoing BCS (70%) had their procedure performed as day surgery. The use of day surgery for women undergoing both index BCS and mastectomy varied significantly by province [$\chi^2(9)=617$, $p<0.0001$; $\chi^2(9)=1504$, $p<0.0001$; respectively].

INTERPRETATION

This study, a joint effort by the Canadian Institute for Health Information (CIHI) and the Canadian Partnership Against Cancer (CPAC), is the largest and most comprehensive examination of breast cancer surgery in Canada to date, and builds on a non-peer reviewed breast cancer surgery report.[11] In addition to describing breast cancer surgery from a pan-Canadian perspective, this study demonstrated variation in clinical practice related to surgical breast cancer care, and is an important first step in understanding how care can be improved.

Significant geographic variation in mastectomy rates has been previously reported both within and outside Canada.[12,13] The choice between mastectomy and BCS is

complex, but it is clearly influenced by the stage of a woman's disease at presentation. Unfortunately, clinicopathologic variables such as tumour size were not available for analysis, and thus this study cannot clarify the proportion of eligible patients who received BCS. However, it is unlikely that stage distribution alone accounts for the mastectomy rate, as recently published analyses demonstrate generally comparable stage distribution across provinces.[14]

The choice of breast cancer surgical procedure may be influenced by a woman's access to therapeutic interventions, such as radiotherapy in the setting of BCS. Findings from this study support this hypothesis,[15,16] where women with lengthier travel times to a radiation facility were significantly more likely to undergo mastectomy. The finding of relatively high rates of mastectomy among younger women is consistent with the results of United States population-based studies, where a recent trend has been observed toward increased mastectomy use among relatively young women living in socio-economically advantaged neighbourhoods.[17] Proposed explanations for this include younger women's higher cumulative local recurrence, larger mean tumour size (a relative indication for mastectomy) where screen-detected cancers are far less frequent, and higher prevalence of BRCA 1 and 2 mutations.[17,18] Aside from biological factors, age may influence perceptions of risk, the value placed upon body image, and attitudes toward radiation therapy and breast reconstruction.[19,20]

The re-excision rates reported in this study fall within the range reported in contemporary studies from Canada, the United States, and the United Kingdom;[21-23] most re-excisions are performed for a positive margin at initial BCS.[21] It is possible that some women may choose mastectomy because of this substantial risk of subsequent surgical

procedures following BCS.[24] Unfortunately, there exists no pan-Canadian standard for acceptable margins following BCS; provincial differences in the approach to margins may account for some of the variation in re-excision rate, as has been reported in the United States.[23]

The limited use of CPM in Canada found in this study (6% of all women undergoing mastectomy for UIBC) is approximately half the rate observed in the United States,[25] where there has also been well-documented increased use of CPM over the past 10 years.[25-28] While the risk of developing contralateral breast cancer is nearly eliminated with CPM, it remains unclear whether CPM improves breast cancer-specific survival.[29-31] Although small subgroups of women at greater risk of contralateral breast cancer, such as women with BRCA mutations, may be best served by CPM, evidence suggests that both patients and surgeons overestimate the risk of developing contralateral breast cancer and thus the potential benefit of CPM.[32-34] The modest increase in CPM use within Canada (from 5% in 2007 - 2008 to 7% in 2009 - 2010) should be monitored.

Similarly, this study confirmed previous work[35] suggesting the use of reconstructive surgery among women with breast cancer in Canada appears to be markedly lower than in other high-income countries. For example, it is estimated that 24% of U.S. women who underwent mastectomy for breast cancer from 1999 to 2003 elected to have ipsilateral breast reconstruction at the same time (immediate reconstruction).[36] Whether these international differences are due to womens' preferences or to issues related to access[37] cannot be determined by these analyses. The delayed reconstruction rates identified in this study were limited to one year, which most likely markedly underestimates the true use of delayed reconstruction.

Less invasive surgery (e.g., BCS, adoption of sentinel node biopsy), improved surgical care, and cost-containment efforts have led to shorter hospital stays for breast cancer surgery.[38-41] From a historical perspective, a woman hospitalized in 1981 for breast cancer surgery in Canada was discharged after 15 days whereas by 2000, the average length of stay had dropped to 4.5 days.[42] Current findings reveal a further shortening of hospitalization.

The use of day surgery for breast cancer surgery varied across Canada. Findings of relatively high use of day surgery in Ontario reported here are comparable with findings from a study of the use of day surgery in Ontario, where more than half (52%) of women undergoing surgery for invasive breast cancer in 2003 - 2004 had day surgery.[2]

Major strengths of this study include its ability to examine Canadian breast cancer surgery in a population-based fashion over a contemporary time period. However, the study does have some limitations. A lack of several important clinically-derived variables, such as stage, limits their inclusion in explanatory analyses. Similarly, association of practice pattern variation with eventual cancer-related outcomes, such as recurrence and survival, was not possible. From a methodologic perspective, it is possible that some of the specific procedure codes related to BCS (see Appendix A) may in fact have represented diagnostic excisional biopsies, and not therapeutic-intent BCS. This issue has been identified previously[43] and has the potential to result in an underestimation of true "index" mastectomy rates and / or overestimation of true re-excision rates. Thus, provincial variation in the use of excisional biopsy rather than a less invasive core biopsy to make a breast cancer diagnosis may partially account for differences in "initial" mastectomy rates, as well as subsequent re-excision rates. However, it is important to consider that over the

time period of this study (2006 - 2009), open excisional biopsy was not generally recommended as an initial diagnostic procedure for breast cancer, as core needle biopsy procedures are less invasive, are associated with fewer complications, reduce the need for re-excisions, and are less costly.[44-45] Indeed, the use of core needle biopsy instead of open excisional biopsy is widely regarded as an indicator of quality breast cancer care.[46]

CONCLUSION

Breast cancer surgery in Canada can be described in a population based fashion. Significant interprovincial variation in surgical breast cancer care exists in Canada. Further research is needed to better understand such variations and their impact on outcome, as well as to inform potential quality initiatives. Continued pan-Canadian monitoring is important to evaluate the impact of such initiatives, and provide a national lens to this common disease and treatment.

Contributors: The project was initiated by CIHI and CPAC. The authors worked collaboratively to design the study. Data collection and statistical analyses were performed by Brandon Wagar. All authors contributed to the interpretation of the data. Geoff Porter drafted the manuscript, which was revised and accepted by the other authors. All of the authors approved the final version submitted for publication.

Funding: The study was supported though existing infrastructure within the Canadian Institutes of Health Information and the Canadian Partnership Against Cancer. There was no specific study funding sponsor.

Acknowledgments: The authors extend sincere gratitude to Margaret Jorgensen for administrative support and manuscript review. The authors are grateful for the contributions of the following employees from CIHI and CPAC: Julie Klein-Geltink, CPAC; Gina Lockwood, CPAC; Marilee Allerdings, CIHI; Kinga David, CIHI; Jin Huang, CIHI; Janet Manuel, CIHI; Kathleen Morris, CIHI; and Bernie Paillé, CIHI.

Appendix A: Surgical and Diagnostic Codes

Table A1: Breast Cancer as Diagnosis Type (Most Responsible) and Procedure	
Diagnostic codes	**ICD-10-CA**
Invasive Breast Cancer	C50.00, C50.01, C50.09, C50.10, C50.11, C50.19, C50.20, C50.21, C50.29, C50.30, C50.31, C50.39, C50.40, C50.41, C50.49, C50.50, C50.51, C50.59, C50.60, C50.61, C50.69, C50.80, C50.81, C50.89, C50.90, C50.91, C50.99
Procedure codes	**ICD-10-CA**
Mastectomy	1.YM.89–1.YM.92
Breast-Conserving Surgery	1.YM.87, 1.YM.88

Table A2: Prophylactic Mastectomy		
	ICD-10-CA	**Note**
	Z40.00	Flag Z85.3 (coding is optional)

Table A3: Reconstruction		
	ICD-10-CA	**Note**
Immediate (if Index)	[1.YM.88, 1.YM.90, 1.YM.92]	
Delayed (if Not Index)	Z42.1 **or** [1.YM.88, 1.YM.90, 1.YM.92]	Flag Z85.3 (coding is optional)

Table 1: Inclusion and Exclusion Criteria

Inclusion Criteria • Gender = female • Age ≥18 years • Discharged from acute care or day surgery facility • Breast cancer surgical intervention coded anywhere in the abstract and location attribute in right, left, bilateral • Breast cancer diagnosis code coded as most responsible diagnosis (MRDx) Exclusion Criteria • Potential duplicate records removed from analysis • Invalid Health Card Number • Health Card Province Code = CA • Invalid postal code • Procedures coded as abandoned • Newborns, stillbirths and cadaveric donors • Invalid episode date

Table 2: Mastectomy and BCS Among Women With Unilateral Invasive Breast Cancer, Index Versus Final Procedure

Index Procedure

	B.C.	Alta.	Sask.	Man.	Ont.	Que.	N.B.	N.S.	P.E.I.	N.L.	Canada
BCS	4,877	2,490	790	1,396	14,738	11,792	837	928	133	481	38,517
Mastectomy	2,596	2,482	896	607	6,719	3,138	521	843	107	406	18,375
Total	7,473	4,972	1,686	2,003	21,457	14,930	1,358	1,771	240	887	56,892
Index Mastectomy Rate (%)	35	50	53	30	31	21	38	48	45	46	32
95% CI	33.6 - 35.8	48.5 - 51.3	50.7 - 55.5	28.2 - 32.3	30.6 - 31.9	20.3 - 21.6	35.7 - 40.9	45.2 - 49.9	38.2 - 50.8	42.4 - 49.0	31.9 - 32.6

Final Procedure

	B.C.	Alta.	Sask.	Man.	Ont.	Que.	N.B.	N.S.	P.E.I.	N.L.	Canada
BCS	4,040	2,204	592	1,282	13,413	10,979	719	794	100	277	34,439
Mastectomy	3,433	2,767	1,094	721	8,045	3,951	639	977	141	609	22,453
Total	7,473	4,971	1,686	2,003	21,458	14,930	1,358	1,771	241	886	56,892
Final Mastectomy Rate (%)	46	56	65	36	37	26	47	55	59	69	39
95% CI	44.8 - 47.0	54.2 - 57.0	62.6 - 67.1	33.8 - 38.0	36.8 - 38.1	25.7 - 27.1	44.3 - 49.7	52.8 - 57.4	52.2 - 64.7	65.6 - 71.7	39.0 - 39.8

Note: Small differences between the totals for the index and final procedures for selected provinces are due to women moving to another province during the treatment period.

Table 3: Association of Demographic Factors Associated with Mastectomy Rates

		N (%)	Mastectomy Rate	Adjusted Odds Ratio	95% CI
Travel Time (minutes)	**0-39**	2,4161 (59%)	40%	Reference	Reference
	40–89	7,884 (19%)	46%	1.3	1.2-1.4
	90–179	5,131 (13%)	52%	1.6	1.5-1.7
	180+	3,699 (9%)	57%	1.9	1.8-2.0
Age Group (years)	**18-49**	8,708 (21%)	48%	Reference	Reference
	50–59	10,165 (25%)	40%	0.7	0.66-0.74
	60–69	10,346 (25%)	40%	0.7	0.65-0.73
	70+	11,656 (29%)	48%	1.0	0.92-1.03
Neighbourhood Income Quintile	**1 (Least Affluent)**	6,273 (15%)	49%	1.3	1.2-1.4
	2	7,620 (19%)	47%	1.2	1.1-1.3
	3	8,216 (20%)	45%	1.1	1.1-1.2
	4	8,912 (22%)	43%	1.1	1.0-1.2
	5 (Most Affluent)	9854 (24%)	39%	Reference	Reference

Table 4: Crude and Adjusted Final Mastectomy Rates Among Women With Unilateral Invasive Breast Cancer, by Province, 2007–2008 to 2009–2010

	B.C.	Alta.	Sask.	Man.	Ont.	N.B.	N.S.	P.E.I.	N.L.	Canada*
BCS	3,857	2,161	574	1,247	13,180	712	768	98	262	22,859
Mastectomy	3,279	2,724	1,076	712	7,920	626	965	140	574	18,016
Total	7,136	4,885	1,650	1,959	21,100	1,338	1,733	238	836	40,875
Crude Mastectomy Rate (%)	46	56	65	36	38	47	56	59	69	44
Adjusted Mastectomy Rate (%)	45	56	60	35	39	41	52	56	61	

Notes: *Canada excluding Quebec, Yukon, Northwest Territories, and Nunavut (see Methods).

Crude rates in this table differ from those presented in Table 2 due to exclusions from the logistic regression.

Table 5: Rates of Re-Excision Among Women Who Underwent BCS for Invasive Breast Cancer as Their Index Procedure, by Province, 2007–2008 to 2009–2010

	B.C.	Alta.	Sask.	Man.	Ont.	Que.	N.B.	N.S.	P.E.I.	N.L.	Canada
Re-excisions											
BCS	995	229	176	46	1,756	1,237	137	109	19	67	4,776
Mastectomy	837	286	114	198	1,325	813	118	134	33	204	4,078
Total	1,832	515	290	244	3,081	2,050	255	243	52	271	8,854
Index BCS	4,877	2,490	790	1,396	14,738	11,792	837	928	133	481	38,517
Re-excision Rate (%)	38	21	37	17	21	17	30	26	39	56	23

Table 6: Location for Surgery (index procedure) among Women With Unilateral Breast Cancer, by Procedure and Province, 2007–2008 to 2009–2010

	B.C.	Alta.	Sask.*	Man.	Ont.	Que.	N.B.	N.S.	P.E.I.*	N.L.	Canada
Index BCS											
Day Surgery	3,108	1,104	462	1,026	11,973	7,715	544	626	55	414	27,053
Inpatient	1,769	1,386	328	370	2,765	4,077	293	302	78	67	11,464
Total	4,877	2,490	790	1,396	14,738	11,792	837	928	133	481	38,517
Index Mastectomy											
Day Surgery	169	35	<5	134	2,203	784	135	114	<5*	32	3,609
Inpatient	2,427	2,447	893	473	4,516	2,354	386	729	107	374	14,766
Total	2,596	2,482	896	607	6,719	3,138	521	843	107	406	18,375

Note: *Data suppressed due to small cell size.

REFERENCES

1. Canadian Cancer Society's Steering Committee on Cancer Statistics. Canadian Cancer Statistics 2012. Toronto, ON: Canadian Cancer Society; 2012.
2. Quan ML, Hodgson N, Schultz SE, et al. Surgery for Breast Cancer. In: Urbach DR, Simunovic M, SE Schultz, editors. Cancer Surgery in Ontario: ICES Atlas. Toronto: Institute for Clinical Evaluative Sciences, December 2008, p. 7-28.
3. Fisher B, Anderson S, Bryant J, Margolese RG, Deutsch M, Fisher ER, et al. Twenty-year follow-up of a randomized trial comparing total mastectomy, lumpectomy, and lumpectomy plus irradiation for the treatment of invasive breast cancer. N Engl J Med. 2002;347(16):1233-41.
4. Veronesi U, Cascinelli N, Mariani L, Greco M, Saccozzi R, Laini A, et al. Twenty-year follow-up of a randomized study comparing breast-conserving surgery with radical mastectomy for early breast cancer. N Engl J Med. 2002;347(16):1227-32.
5. Scarth H, Cantin J, Levine M, for the Steering Committee on Clinical Practice Guidelines for the Care and Treatment of Breast Cancer. Clinical practice guidelines for the care and treatment of breast cancer: Mastectomy or lumpectomy? The choice of operation for clinical stages I and II breast cancer (summary of the 2002 update). CMAJ. 2002;167(2):154-5.
6. Clark M, Collins R, Darby S, Davies C, Elphinstone P, Evans E, et al. Effects of radiotherapy and of differences in the extent of surgery for early breast cancer on local recurrence and 15-year survival: an overview of the randomized trials. Lancet. 2005;366(9503):2087-106.

7. Vinh-Hung V, Verschraegen C. Breast-conserving surgery with or without radiotherapy: pooled-analysis for risks of ipsilateral breast tumor recurrence and mortality. J Natl Cancer Inst. 2004;96(2):115-21.

8. Hwang ES, Lichtensztajn DY, Gomez SL, Fowble B, Clarke CA. Survival after lumpectomy and mastectomy for early stage invasive breast cancer: The effect of age and hormone receptor status. Cancer. 2013;119(7):1402-11.

9. Montazeri A. Health-related quality of life in breast cancer patients: a bibliographic review of the literature from 1974 to 2007. J Exp Clin Cancer Res. 2008;27:32.

10. Gao X, Fisher SG, Emami B 2003. Risk of second primary cancer in the contralateral breast in women treated for early-stage breast cancer: a population-based study. Int J Radiat Biol Phys. 2003;56(4):1038-45.

11. Canadian Institute for Health Information / Canadian Partnership Against Cancer. Breast Cancer Surgery in Canada, 2007-2008 to 2009-2010. Available from: https://secure.cihi.ca/free_products/BreastCancer_7-8_9-10_EN.pdf. Accessed January 31, 2013.

12. Gaudette LA, Gao RN, Spence A, Shi F, Johansen H, Olivotto IA. Declining use of mastectomy for invasive breast cancer in Canada, 1981-2000. Can J Public Health. 2004;95(5):336-40.

13. Brownlee S, Wennberg JE, Barry MJ, Fisher ES, Goodman DC, Bynum JPW. Improving patient decision-making in health care: A 2011 Dartmouth Atlas Report Highlighting Minnesota. Bronner KK, editor. Lebanon, NH:The Dartmouth Institute for Health Policy and Clinical Practice;February 24, 2011.

14. Canadian Partnership Against Cancer (2012). Breast cancer control in Canada: A system performance special focus report. Toronto, ON: Canadian Partnership Against Cancer.

15. Celaya MO, Rees JR, Gibson JJ, Riddle BL, Greenberg ER. Travel distance and season of diagnosis affect treatment choices for women with early-stage breast cancer in a predominantly rural population (United States). Cancer Causes Control. 2006;17(6):851-6.

16. Schroen AT, Brenin DR, Kelly MD, Knaus WA, Slingluff CL Jr. Impact of patient distance to radiation therapy on mastectomy use in early-stage breast cancer patients. J Clin Oncol. 2005;23(28):7074-80.

17. Gomez SL, Lichtensztajn D, Kurian AW, Telli ML, Chang ET, Keegan TH, Glaser SL, Clarke CA. Increasing mastectomy rates for early-stage breast cancer? Population-based trends from California. J Clin Oncol. 2010;28(10):e155-7; author reply e158.

18. Bartelink H, Horiot JC, Poortmans PM, Struikmans H, Van den Bogaert W, Fourquet A, et al. Impact of a higher radiation dose on local control and survival in breast-conserving therapy of early breast cancer: 10-year results of the randomized boost versus no boost EORTC 22881-10882 Trial. J Clin Oncol. 2007,25(22):3259-65.

19. Wang J, Kollias J, Boult M, Babidge W, Zorbas HN, Roder D, Maddern G. Patterns of surgical treatment for women with breast cancer in relation to age. Breast J. 2010;16(1):60-5.

20. Bleicher RJ, Abrahamse P, Hawley ST et al. The influence of age on the breast surgery decision-making process. Ann Surg Oncol. 2008;15(3):854-62.

21. Lovrics PJ, Cornacchi SD, Farrokhyar F, et al. 2010. Technical factors, surgeon case volume and positive margin rates after breast conservation surgery for early-stage breast cancer. Can J Surg. 2010;53(5):305-12.

22. Jeevan R, Cromwell DA, Trivella M, Lawrence G, Kearins O, Pereira J, et al. Reoperation rates after breast conserving surgery for breast cancer among women in England: retrospective study of hospital episode statistics. BMJ. 2012;345:e4505.

23. McCahill LE, Single RM, Aiello Bowles EJ, Feigelson HS, James TA, Barney T, et al. Variability in reexcision following breast conservation surgery. JAMA. 2012;307(5):467-75.

24. Nekhlyudov L, Habel LA, Achacoso N, Jung I, Hague R, Collins LC, et al. Ten-year risk of diagnostic mammograms and invasive breast procedures after breast-conserving surgery for DCIS. J Natl Cancer Inst. 2012;104(8):614-21.

25. Tuttle TM, Habermann EB, Grund EH, Morris TJ, Virnig BA. Increasing use of contralateral prophylactic mastectomy for breast cancer patients: a trend toward more aggressive surgical treatment. J Clin Oncol. 2007;25(33):5203-9.

26. Jones NB, Wilson J, Kotur L, Stephens J, Farrar WB, Agnese DM. Contralateral prophylactic mastectomy for unilateral breast cancer: an increasing trend at a single institution. Ann Surg Oncol. 2009;16(10):2691-6.

27. McLaughlin CC, Lillquist PP, Edge SB. Surveillance of prophylactic mastectomy: trends in use from 1995 through 2005. Cancer. 2009;115(23):5404-12.

28. Stucky CC, Gray RJ, Wasif N, Dueck AC, Pockaj BA. Increase in contralateral prophylactic mastectomy: echoes of a bygone era? Surgical trends for unilateral breast cancer. Ann Surg Oncol. 2010;17 Suppl 3:330-7.

29. Lostumbo L, Carbine NE, Wallace J. Prophylactic mastectomy for the prevention of breast cancer. Cochrane Database Syst Rev. 2010;(11):CD002748.

30. Boughey JC, Mittendorf EA, Solin LJ, Michael Dixon J, Tuttle TM, Beitsch PD, et al. Controversies in breast surgery. Ann Surg Oncol. 2010;17Suppl 3:230-2.

31. Morrow M. 2011. Prophylactic mastectomy of the contralateral breast. Breast. 2011;20 Suppl 3:S108-10.

32. Giuliano AE, Boolboi S, Degnim A. Kuerer H, Leitch AM, Morrow M. Society of Surgical Oncology: position statement on prophylactic mastectomy. Approved by the Society of Surgical Oncology Executive Council, March 2007. Ann Surg Oncol. 2007;14(9):2425-27.

33. Khan SA. Contralateral prophylactic mastectomy: what do we know and what do our patients know? J Clin Oncol. 2011;29(16):2132-5.

34. Metcalfe KA, Narod SA. Breast cancer risk perception among women who have undergone prophylactic bilateral mastectomy. J Natl Cancer Inst. 2002;94(20):1564-9.

35. Platt J, Baxter N, Zhong T. Breast reconstruction after mastectomy for breast cancer. CMAJ. 2011;183(18):2109-16.

36. Reuben BC, Manwaring J, Neumayer LA. Recent trends and predictors in immediate breast reconstruction after mastectomy in the United States. Am J Surg. 2009;198(2):237-243.

37. Porter GA, McMulkin-Tait H. Practice patterns in breast cancer surgery: a Canadian perspective. World J Surg. 2004;28(1):80-6.

38. Lindqvist R, Möller TR, Stenbeck M, Diderichsen F. Do changes in surgical procedures for breast cancer have consequences for hospital mean length of stay? A study of women operated on for breast cancer in Sweden, 1980-95.Int J Technol Assess Health Care. 2002 Summer;18(3):566-75.

39. Downing A, Lansdown M, West RM, Thomas JD, Lawrence G, Forman D. Changes in and predictors of length of stay in hospital after surgery for breast cancer between 1997/98 and 2004/05 in two regions of England: a population-based study. BMC Health Serv Res. 2009 (9):202.

40. Weber WP, Barry M, Junqueira MJ, Lee SS, Mazzella AM, Sclafani LM. Initial experiences with a multidisciplinary approach to decreasing the length of hospital stay for patients undergoing unilateral mastectomy. Eur J Surg Oncol. 2011;37(11):944-9.

41. Marsden J. Shortening length of stay in breast cancer surgery. Ann R Coll Surg Engl (Suppl). 2011;93(2):50-1.

42. Neutel CI, Gao R, Gaudette L, et al. 2004. Shorter hospital stays for breast cancer. Health Reports 16(1):19-31.

43. Mayo NE, Scott SC, Shen N, Hanley J, Goldberg MS, MacDonald N. Waiting time for breast cancer surgery in Quebec. CMAJ. 2001;164(8):1133-8.

44. Kerlikowske K, Smith-Bindman R, Ljung BM, Grady D. Evaluation of abnormal mammography results and palpable breast abnormalities. Ann Intern Med. 2003;139(4):274-84.

45. Clarke-Pearson EM, Jacobson AF, Boolbol SK, Leitman IM, Friedmann P, Lavarias V, et al. Quality assurance initiative at one institution for minimally invasive breast biopsy as the initial diagnostic technique. J Am Coll Surg. 2009; 208(1):75–8.

46. Silverstein MJ, Lagios MD, Recht A, Allred DC, Harms SE, Holland R, et al. Image-detected breast cancer: state of the art diagnosis and treatment. J Am Coll Surg. 2005; 201(4):586–97.