



Breast Cancer Surgery in Canada, 2007–2008 to 2009–2010

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Our Vision

Better data. Better decisions.
Healthier Canadians.

Our Mandate

To lead the development and maintenance of comprehensive and integrated health information that enables sound policy and effective health system management that improve health and health care.

Our Values

Respect, Integrity, Collaboration,
Excellence, Innovation

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About the Canadian Institute for Health Information

The Canadian Institute for Health Information (CIHI) collects and analyzes information on health and health care in Canada and makes it publicly available. Canada's federal, provincial and territorial governments created CIHI as a not-for-profit, independent organization dedicated to forging a common approach to Canadian health information. CIHI's goal: to provide timely, accurate and comparable information. CIHI's data and reports inform health policies, support the effective delivery of health services and raise awareness among Canadians of the factors that contribute to good health.

About the Canadian Partnership Against Cancer

The Canadian Partnership Against Cancer is an independent organization funded by the federal government to accelerate action on cancer control for all Canadians. Bringing together cancer experts, government representatives, the Canadian Cancer Society and cancer patients, survivors and their families through the Canadian Cancer Action Network to implement the first pan-Canadian cancer control strategy, the vision is to be a driving force to achieve a focused approach that will help prevent cancer, enhance the quality of life of those affected by cancer, lessen the likelihood of dying from cancer and increase the efficiency of cancer control in Canada.

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Executive Summary

Introduction

In 2012, 22,700 women will be diagnosed with invasive breast cancer, and many others will be diagnosed with non-invasive forms of the disease that also require treatment. The care for women with breast cancer is complex and must be tailored to each woman's unique circumstances; however, most women with breast cancer are offered surgery as a component of their care. To date, very little has been published on surgical patterns of care from a pan-Canadian perspective. Such reporting is vital to understanding measures of quality of care that are emerging from clinical and epidemiological research. Increasingly, cancer care is being driven by evidence-based guidelines to ensure optimal outcomes for patients. The extent to which practice patterns are consistent with these guidelines on a national or provincial/territorial basis is not well known. Identifying variation in clinical practice and exploring its sources across jurisdictions is often a first step in understanding how care can be improved.

A picture of surgical care from 2007–2008 to 2009–2010 is provided in this report, based on hospital and ambulatory care data that has been standardized by the Canadian Institute for Health Information (CIHI) to allow for pan-Canadian analyses. Important information on stage of disease, a critical determinant of treatment, was not available for these analyses; however, general trends in breast-conserving surgery (BCS) and mastectomy, surgical re-excisions, reconstructive surgery and complications of surgery are provided. In addition, information on how care was provided (either in hospital or as day surgery) is described. The results presented include women with invasive breast cancer and those with a non-invasive form of the disease, ductal carcinoma in situ (DCIS).

This report was jointly prepared by CIHI and the Canadian Partnership Against Cancer (CPAC).

Key Findings

How many Canadian women are treated surgically for breast cancer?

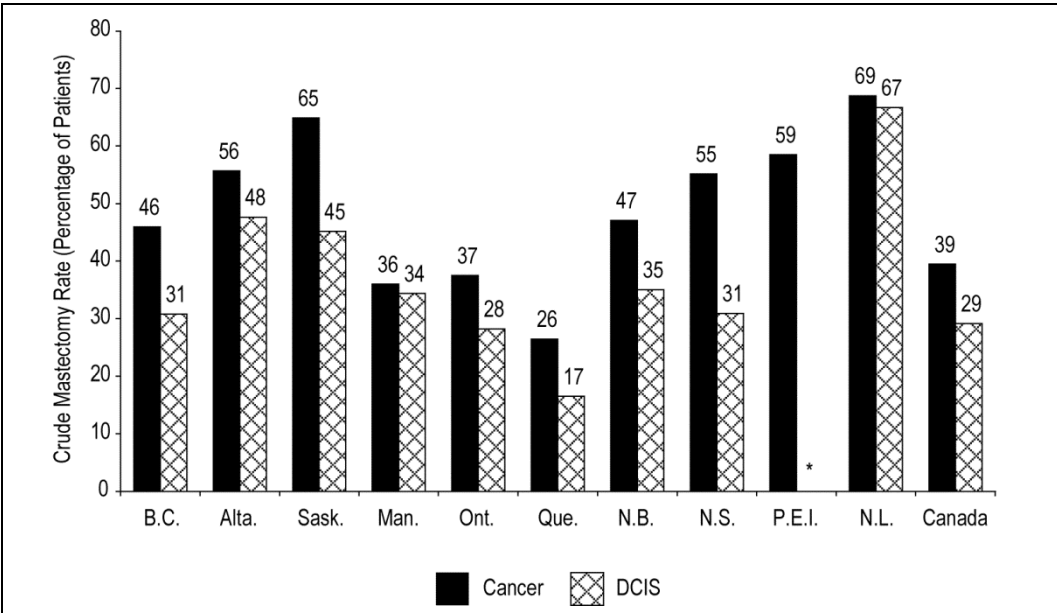
Each year from 2007–2008 to 2009–2010, an estimated 22,000 women in Canada were treated surgically for breast cancer. Most of these women (89%) were treated for invasive disease; the remainder were treated for DCIS. For each woman represented in the analysis, an index surgical procedure was identified, as were subsequent surgical procedures that took place within one year. For example, among women originally treated for DCIS, 8% were treated surgically for a diagnosis of invasive breast cancer within a year.

Among women treated surgically for breast cancer, how many undergo mastectomy or BCS?

Two treatments—BCS plus radiation therapy and mastectomy—offer equivalent long-term survival for women with early-stage breast cancer. BCS is generally recommended over mastectomy because it is less invasive and associated with fewer morbidities. Women with breast cancer are able to consider their clinical circumstances with their health care providers and make decisions about their surgery based on their personal values and preferences.

The use of mastectomy among women with breast cancer varies greatly across Canada. As shown in Figure 1, the crude rate of mastectomy among women with unilateral breast cancer varied from 26% in Quebec to 69% in Newfoundland and Labrador. Among women with DCIS, the mastectomy rate ranged from 17% in Quebec to 67% in Newfoundland and Labrador. These figures pertain to the final procedure received within a year of a woman’s initial surgery (some women who initially had BCS had a mastectomy within the year). The rates in Figure 1 pertain to the province of patient residence, not the location of surgery.

Figure 1: Crude Mastectomy Rates Among Women With Unilateral Invasive Breast Cancer Versus DCIS Only, Whose First Surgery Took Place Between 2007–2008 and 2009–2010



Notes

* Rate for DCIS in P.E.I. was suppressed due to limited sample size.
Data relates to patients who received their index procedure between 2007–2008 and 2009–2010.
Data for the three territories was suppressed due to limited sample size.

Sources

Hospital Morbidity Database and National Ambulatory Care Reporting System, Canadian Institute for Health Information; Alberta Ambulatory Care Reporting System, Alberta Health and Wellness.

How do mastectomy rates vary by age, income and travel time to the nearest cancer centre that has a radiation facility?

- **Age:** Younger (age 18 to 49) and older women (age 70 and older) had significantly higher rates of mastectomy than women age 50 to 69. Factors that vary by age and potentially explain this association include characteristics of the tumour, perceptions of risk, the value placed upon body image, and attitudes toward radiation therapy and breast reconstruction.
- **Income:** Women residing in the least affluent neighbourhoods had significantly higher rates of mastectomy than women in more affluent ones. Financial considerations, such as lost income associated with the need for lengthy radiation treatments, may influence treatment decisions.
- **Travel time:** Mastectomy rates increased as travel time to a radiation facility increased. These rates exceeded 50% for women with travel times of 1.5 hours or longer (each way). Radiation treatment following BCS involves multiple trips to a cancer centre, typically five days per week for three to six weeks.

How often do women who undergo BCS for their breast cancer require a re-excision within a year of their initial surgery?

Some women who initially undergo BCS require subsequent operations to excise additional tissue (re-excision) if, for example, pathologic examination of the tissue initially removed does not show clear margins (an area of cancer-free tissue surrounding the tumour). The rate of re-excision within one year for women who had BCS as their index procedure varied greatly by province—from an estimated 17% in Manitoba and Quebec to 56% in Newfoundland and Labrador. In many of these cases, women who initially underwent BCS had a mastectomy within a year.

How often do women undergo a contralateral prophylactic mastectomy?

Some women with unilateral breast cancer who opt for mastectomy decide to have the other (contralateral) healthy breast removed through mastectomy. While this strategy, known as contralateral prophylactic mastectomy (CPM), is clinically indicated for consideration for a very small number of women at very high risk of contralateral breast cancer, its use is controversial because there is little evidence of its benefits in terms of long-term survival for women who are not at high risk for contralateral disease. Concerns have arisen, especially in the U.S., that women without clear indications are opting for CPM.

The rate of CPM in Canada was 6% among women who underwent a mastectomy for unilateral invasive breast cancer between 2007–2008 and 2009–2010; this was lower than one published estimate from the U.S. (11% when assessed in 2003).¹

How often do women who undergo mastectomy have immediate reconstructive surgery?

Seven percent of Canadian women who underwent mastectomy for unilateral invasive breast cancer had immediate breast reconstruction following their surgery. This estimate appears to be significantly lower than the one published from the U.S. (24% when assessed from 1999 to 2003).²

How often do complications arise from breast cancer surgery?

Complications of breast cancer surgery that are recognized and treated in hospital appear to be relatively low. Both 7-day and 30-day complication rates were 2% or less for BCS and 6% or less for mastectomy for both invasive breast cancer and DCIS. When a complication occurred and was treated in hospital, it was most often for bleeding/hematoma or infection. Most post-surgical complications are minor and can be treated on an outpatient basis; these complications are not reflected in the hospital-based estimates in this report.

How is breast cancer surgical care provided—as day surgery or on an inpatient basis?

Most mastectomies for women with invasive breast cancer (80%) and DCIS (79%) were performed on an inpatient basis. The use of day surgery for mastectomy varied greatly by province. One-third (33%) of mastectomies in Ontario were performed as day surgery. No mastectomies were performed as day surgery in Saskatchewan and only 1% were performed as day surgery in Alberta.

Most BCS for women with invasive breast cancer (70%) and DCIS (92%) was performed as day surgery. The use of day surgery for BCS ranged from 41% in Prince Edward Island to 86% in Newfoundland and Labrador.

Conclusions

The treatment received by Canadian women who undergo surgery for breast cancer varies significantly by province/territory of residence. In general, clinical practice guidelines have recommended BCS and radiation therapy for the majority of women diagnosed with breast cancer, both because it is less invasive and because it is associated with fewer morbidities and equivalent survival as mastectomy. In the current analyses, wide differences are seen in mastectomy rates by province/territory among women with unilateral invasive breast cancer. In addition, large jurisdictional differences are evident in rates of re-excision and the location of care (day surgery versus inpatient care).

Further research is needed to understand these sources of variation; however, these findings raise questions about how Canadian women are exercising their treatment options and the resultant quality of care. More in-depth studies using supplementary data sources and designs with a longitudinal component would contribute to an improved understanding of the variation observed.

Introduction

Female breast cancer takes a heavy toll in Canada. In 2012, an estimated 22,700 women will be diagnosed with invasive breast cancer, and 5,100 women will die of the disease.^{i, 3} With the advent of population-based screening programs, most women are diagnosed with early-stage breast cancer and have a very good prognosis following treatment. In the majority of cases, treatment involves surgery.⁴

This report reviews the surgical care of women with invasive breast cancer and those with a non-invasive cancer, ductal carcinoma in situ (DCIS).ⁱⁱ To date, there have been few published descriptions from a pan-Canadian perspective of the surgical care provided to women with breast cancer. This report examines trends in the following areas:

1. Treatment-related surgical procedures:
 - a. Breast-conserving surgery (BCS) and mastectomy
 - b. Re-excision following BCS
 - c. Contralateral prophylactic mastectomy (CPM) among women having mastectomy for unilateral disease
 - d. Reconstructive surgery after mastectomy
2. Location of surgical care (day surgery or inpatient care) and hospital length of stay
3. Complications of surgery
4. Surgery for contralateral disease

Also included in this report is a description of the extent of variation in these practice patterns by province/territory. Factors that are explored that might explain variation in treatment include patient age, income of area of residence and geographic access as measured by travel time to the nearest radiation treatment centre.

Breast Cancer Surgical Treatment

The treatment of breast cancer has progressed significantly over the last three decades, and outcomes have improved. Clinical trials conducted in the 1980s demonstrated that women with early-stage invasive breast cancer had an equivalent chance of survival following breast-conservation therapy (lumpectomy plus breast irradiation) as following total mastectomy.⁵ These findings radically altered breast cancer treatment around the world, giving women a surgical option that spares part of the breast. In addition, knowledge gained about an individual's breast cancer tumour characteristics and biology has been harnessed to better target both surgical and post-

i. See Appendix A: Epidemiology of Female Breast Cancer for statistics on breast cancer in Canada.

ii. DCIS is a non-invasive condition in which abnormal cells are found in the lining of a breast duct. The abnormal cells have not spread outside the duct to other tissues in the breast. In some cases, DCIS may become invasive cancer and spread to other tissues; however, which lesions will become invasive cannot currently be predicted (www.cancer.gov/dictionary). DCIS accounts for up to 30% of all breast cancers.⁴

surgical adjuvant treatments.ⁱⁱⁱ Furthermore, advances in plastic surgery have improved breast appearance following surgery. Treatment for invasive breast cancer has steadily evolved to embrace multimodal approaches that often include a combination of surgery, radiation therapy, chemotherapy and endocrine therapy (such as tamoxifen). The specific therapies provided depend on the type and extent of the cancer.

Management of non-invasive breast cancer, specifically DCIS, has also evolved.⁶ Historically, DCIS was detected by physical examination, diagnosed by open surgical biopsy and treated by mastectomy and removal of axillary lymph nodes (the nodes found in the armpit). Widespread use of screening mammography has led to a marked increase in the identification of DCIS over the past 30 years, and DCIS is now being detected earlier when it is clinically undetectable and much smaller in size. For many cases of DCIS, mastectomy has been replaced with the much less-invasive lumpectomy procedure.

The treatment of breast cancer is increasingly being driven by a growing body of evidence from clinical trials and rigorous research, synthesized for clinicians into guidelines and surgical standards. In the Canadian context, *Clinical Practice Guidelines for the Care and Treatment of Breast Cancer* were initially released in 1998, with updates following in 2001 and 2003.^{iv, 7} Provincial cancer agencies have also issued evidence-based guidelines; more information is available at www.cancerview.ca. The extent to which these guidelines are being followed by Canadian cancer care providers is not well documented. This is due, in part, to the fact that while provincial cancer agencies are responsible for cancer care in general, many are not directly responsible for providing all modalities of that service. For example, surgery is frequently provided in local or regional hospitals by general surgeons who may or may not be part of formal or informal oncology networks. Monitoring compliance with evidence-based guidelines and standards can contribute to adherence and thereby improve outcomes for women with breast cancer.⁸ Limitations in data systems, however, can impede effective monitoring of clinical practices and implementation of clinical improvement programs.

Efforts are under way to improve data systems and monitor adherence to guidelines. From a national perspective, the Canadian Partnership Against Cancer (CPAC) and provincial/territorial partners have ongoing initiatives to improve the reporting of cancer stage and tumour pathology.⁹ CPAC has also published system performance reports to identify gaps in measurement capabilities and gauge the performance of Canada's cancer system.^{9, 10} Provincial cancer agencies are also actively monitoring cancer-related practice patterns. For example, Cancer Care Ontario has implemented a Cancer System Quality Index that tracks Ontario's progress against cancer and points out where cancer service providers can make quality and performance improvements; more information is available at www.cancercare.on.ca. The Institute for Clinical Evaluative Sciences has published detailed analyses of cancer-related surgery in Ontario.¹¹

iii. Adjuvant therapy is treatment administered following surgery to eliminate any microscopic tumour cells that might remain in the body. Examples of adjuvant therapy for breast cancer include radiation therapy, chemotherapy, targeted therapies (for example, trastuzumab) and endocrine treatments (for example, tamoxifen and aromatase inhibitors).

iv. The guidelines can be viewed on the website of the *Canadian Medical Association Journal* at www.cmaj.ca. The steering committee that wrote the guidelines has been disbanded.⁷

Data Sources and Definitions

This section describes data sources, how breast cancer patients were identified and how related surgical procedures were defined (see Appendix C for further information on methods).

Data Sources

Three sources of information were used to identify all inpatient and outpatient surgical procedures that took place between 2006–2007 and 2010–2011, inclusive:

- Hospital Morbidity Database, CIHI
- National Ambulatory Care Reporting System, CIHI
- Alberta Ambulatory Care Reporting System, Alberta Health and Wellness

Identifying Cancer Patients and Surgical Procedures

Women who received surgical treatment for primary breast cancer and DCIS were defined as those with hospital discharges with a most responsible diagnosis of primary breast cancer or DCIS and a cancer-related surgical intervention indicated anywhere on the abstract (see appendices B and C for a list of codes and methods).^v All patient records were linked over time. A woman's first-known index surgical procedure for breast cancer was the first discharge meeting the inclusion/exclusion criteria with no record of surgical treatment of breast cancer in the past year and no recorded history of breast cancer.^{vi}

After this index surgical procedure was identified, one-year treatment episodes were constructed to include all inpatient and day surgery records. These treatment episodes could include re-excision (either wider BCS or mastectomy), breast reconstruction, complications and readmissions for other breast cancer–related indications (such as CPM or contralateral recurrence). The laterality of the index breast cancer (left, right or bilateral) was identified using the diagnostic code recorded for the index hospitalization. Laterality was not coded for DCIS, according to current coding rules. The window used to define a single surgical episode was 365 days. The coding of procedures was hierarchical. For example, if a woman underwent BCS for primary breast cancer in the left breast and within 365 days had the breast surgically removed, she was coded as having a mastectomy for analytic purposes.

v. As women may present with both DCIS and invasive disease at the same time, DCIS cases in these analyses represent women with pure DCIS without a co-occurring primary breast cancer.

vi. Women whose potential index record indicated a past history of cancer were excluded; however, coding past history of cancer is optional. Therefore, to the extent that past history was not coded, women included in the study cohort may have experienced cancer in prior years (before 2006–2007); thus the study cohort cannot be considered as representing a cohort of incident cases of breast cancer.

Box 1: Study Limitations

1. We cannot be certain that treatment episodes truly indicate patients' first treatment for breast cancer (because surgical treatment one to three years before the index breast cancer surgery was not captured).
2. Data is limited to administrative records. Important information from cancer registries, such as date of diagnosis and stage of disease, was not available for these analyses.
3. Available diagnostic and procedure codes cannot be used to distinguish between BCS and open excisional biopsy.^{vii} Both of these procedures involve making an incision in the breast and removing some tissue with the intent of removing a lesion. When BCS is performed, the lesion is known to be invasive or pre-invasive breast cancer. However, when an open excisional biopsy is performed, a diagnosis of cancer has not yet been established. If pathology confirms a diagnosis of breast cancer following open excisional biopsy, the case is included in these analyses as an index BCS. This has two implications for the results presented in this report:
 - a. If the whole tumour was completely removed and the cancer did not recur, the open excisional biopsy was the final procedure the woman received within the year and was classified as a BCS. If the assumption is made that these women did not have an opportunity to make a decision between BCS and mastectomy because they did not have a diagnosis of cancer prior to their procedure, these cases should be removed from the cohort. Because they are included, the index and final mastectomy rates may be underestimated.
 - b. If tumour tissue remained following the open excisional biopsy and either BCS or mastectomy was subsequently performed within the year, the BCS or mastectomy performed was classified as a re-excision when, in fact, it was the index treatment procedure. Rates of re-excision reported here may therefore be overestimated.

Variation in the use of open excisional biopsy by jurisdiction and, when used, variation in the extent of clear margins that are achieved can contribute to observed variations by jurisdiction in mastectomy rates and rates of re-excision.

Open excisional biopsy is not generally recommended as an initial diagnostic procedure for breast cancer (see www.eusoma.org and <http://napbc-breast.org/standards> for more information). Since the early 1990s, evidence has accumulated to show that, relative to open excisional biopsy, needle biopsy procedures are less invasive, are associated with fewer complications, reduce the need for re-excisions and are less costly.^{12–15} The use of open excisional biopsy has declined in light of this evidence.¹⁶

A chart review study and subsequent analyses are planned to better understand procedures used to diagnose and treat breast cancer.

Results for Newfoundland and Labrador should be interpreted with caution due to a potential data quality issue.

vii. Excluding all women who may potentially have been undergoing open excisional biopsy would reduce the overall re-excision rate by five percentage points, according to preliminary analyses.

The Study Cohort

Over the three-year study period (2007–2008 to 2009–2010), 65,067 women, roughly 22,000 per year, were treated surgically for breast cancer (Table 1). The vast majority of these women (57,840; 89%) were treated for invasive disease. Among women with invasive disease, almost all (56,892; 98%) were treated for unilateral disease. Women treated for DCIS represented a relatively small fraction of those treated surgically for breast cancer in Canada (7,227; 11%); however, this varied by province (see Appendix D). Eight percent (548) of the women originally treated for DCIS were subsequently treated surgically for a diagnosis of invasive breast cancer within a year.

Table 1: Breast Cancer Study Cohort, by Year of Index Procedure

		Fiscal Year of Index Procedure			
		2007–2008	2008–2009	2009–2010	Total
Invasive Breast Cancer	Unilateral	18,658 (98%)	18,983 (98%)	19,251 (98%)	56,892 (98%)
	Bilateral	301	295	352	948
DCIS		2,249	2,420	2,558	7,227
	Women Originally Treated for DCIS Who Were Treated Surgically for Invasive Breast Cancer Within a Year	155 (6.9%)	169 (7.0%)	224 (8.8%)	548 (7.6%)

Note

Data relates to patients who received their index procedure between 2007–2008 and 2009–2010.

Sources

Hospital Morbidity Database and National Ambulatory Care Reporting System, Canadian Institute for Health Information; Alberta Ambulatory Care Reporting System, Alberta Health and Wellness.

Breast-Conserving Surgery and Mastectomy

Background

With the refinement and expansion of treatment options, women with breast cancer and their physicians are now able to consider evidence of the relative effectiveness of available treatments in developing a treatment plan. Long-term survival following breast-conserving therapy (partial mastectomy plus radiation therapy) is at least equivalent to (and, according to one meta-analysis, better than) mastectomy for early-stage breast cancer, although there may be a minimally increased risk of local recurrence with breast-conserving therapy.^{17–21} As well, breast-conserving therapy has been associated with improved quality-of-life outcomes compared with mastectomy.²²

Clinical practice guidelines (Box 2) recommend mastectomy for certain women, such as those with multicentric breast cancer,^{viii} those with a history of or contraindication to chest wall radiation therapy, those with very large tumours and those diagnosed in early-stage pregnancy who wish to continue the pregnancy.⁵

Box 2: Clinical Practice Guidelines

From *Clinical Practice Guidelines for the Care and Treatment of Breast Cancer: A Canadian Consensus Document Developed by the Steering Committee on Clinical Practice Guidelines for the Care and Treatment of Breast Cancer*.

“For patients with stage I and II breast cancer, breast-conserving surgery followed by radiotherapy is generally recommended. In the absence of special reasons for selecting mastectomy, the choice between breast-conserving surgery and mastectomy can be made according to the patient’s circumstances and personal preferences.”¹⁹

The type of breast cancer surgery performed is determined in large part by the interplay between the surgeon’s and other providers’ provision of information and counselling regarding treatment options and the patient’s preferences. According to one large U.S. study of decision-making among women with non-metastatic breast cancer, 73% of women reported either a shared surgical treatment decision or a patient-based decision. The remainder (27%) reported that their decision was based on the recommendation of their surgeon.²³ Patient concerns about recurrence, radiation and body image were key determinants of choice of surgery in this study. Not well documented is how well informed women are of their options prior to surgery. According to one U.S. study, breast cancer survivors were found to have major knowledge deficits regarding treatment options. In addition, many women reported that their surgeon did not ask about their preferences.²⁴ When fully informed of treatment options and their associated risks and benefits, a woman may apply her own personal values and preferences in making a decision about treatment. For example, some women with early-stage breast cancer may opt for breast-conserving therapy, while others with a similar risk profile may choose mastectomy.

viii. Multicentric breast cancer is characterized by the presence of more than one tumour, each arising independently, often in different quadrants (sections) of the breast; see www.cancer.gov/dictionary.

Historically, some women may have chosen mastectomy in an attempt to avoid the side effects and financial costs of radiotherapy. Radiation treatment involves multiple trips to a cancer centre, typically five days per week for three to six weeks. This may be particularly difficult for women living in rural or remote areas with limited geographical access to care. Since the late 1990s, however, there has been increasing evidence^{25–27} that some women who undergo mastectomy will benefit from post-mastectomy radiotherapy, so this may be a less-prominent factor in decision-making by both patients and physicians. As well, in the era of improved outcomes for breast reconstruction after mastectomy, and as access to plastic surgery improves, body image issues may become less important in making a decision to have either breast-conserving therapy or mastectomy.

Women who opt for mastectomy may choose to have a CPM in an effort to reduce the risk of developing contralateral breast cancer (cancer in the other breast) in the future; in an average patient, this risk would plateau at approximately 5% to 10% at 10 years. (See the related section below for more details.)

Although mastectomy was frequently used to treat DCIS in the early 1990s, its use has declined significantly, primarily due to earlier detection related to screening mammography. Up to 70% of women with newly diagnosed DCIS can be treated with breast-conserving therapy.²⁸ Mastectomy is appropriate for women with DCIS if the disease is extensive, multifocal or involves more than one quadrant of the breast. For some women, there may be a greater risk of local recurrence with breast-conserving therapy compared with mastectomy (10% to 15% versus 1% to 2% with long-term follow-up, respectively); however, there is no difference in cancer-specific survival by type of surgery.²⁸

The surgical treatment of breast cancer is not always limited to a single operation. Some women who initially undergo BCS require subsequent operations to excise additional tissue (re-excision) if, for example, pathologic examination of the tissue initially removed does not show clear margins (an area of cancer-free tissue surrounding the tumour). In some cases, women who initially have BCS subsequently undergo mastectomy as definitive local treatment.

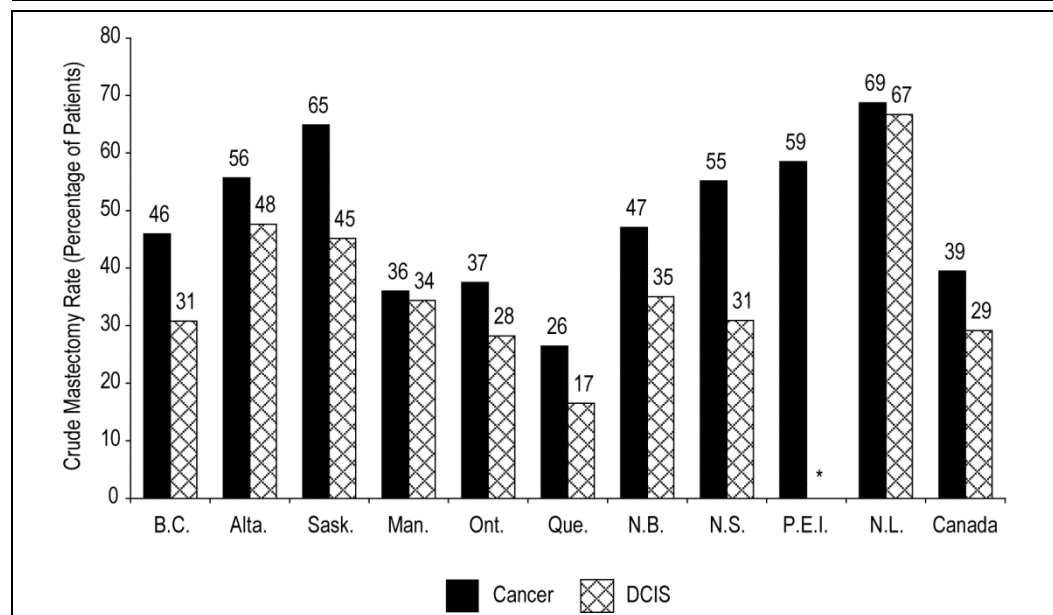
As part of the current analysis, a treatment window of one year was established, and all surgical interventions during this period were identified. This approach permitted an analysis of re-excisions occurring over the course of a year and the influence that these re-operations had on the mastectomy rate.

Results

The experience of each woman who underwent a surgical procedure for breast cancer was tracked for one year. Ten percent of women with unilateral invasive breast cancer who initially had BCS subsequently underwent a mastectomy within a year of their initial procedure. This resulted in an increase in the use of mastectomy from 32% as measured initially to 39% as measured within a year of the initial surgery. Likewise, 16% of women with DCIS who initially had BCS subsequently underwent a mastectomy within one year of their initial procedure. This resulted in an increase in the use of mastectomy from 17% as measured initially to 29% as measured within a year of the initial surgery.

Figure 1 shows the rate of mastectomy among women with unilateral breast cancer and DCIS in terms of the final procedure received within a year of a woman's initial surgery. Results for the index and final procedure by province are available in Appendix D. The crude rate of mastectomy among this group of women varied from 26% in Quebec to 69% in Newfoundland and Labrador. Please note that the rates in Figure 1, and subsequent rates shown by province, pertain to the province of patient residence, not the location of surgery.

Figure 1: Crude Mastectomy Rates Among Women With Unilateral Invasive Breast Cancer Versus DCIS Only, Whose First Surgery Took Place Between 2007–2008 and 2009–2010



Notes

* Rate for DCIS in P.E.I. was suppressed due to limited sample size.

Data relates to patients who received their index procedure between 2007–2008 and 2009–2010.

Data for the three territories was suppressed due to limited sample size.

Sources

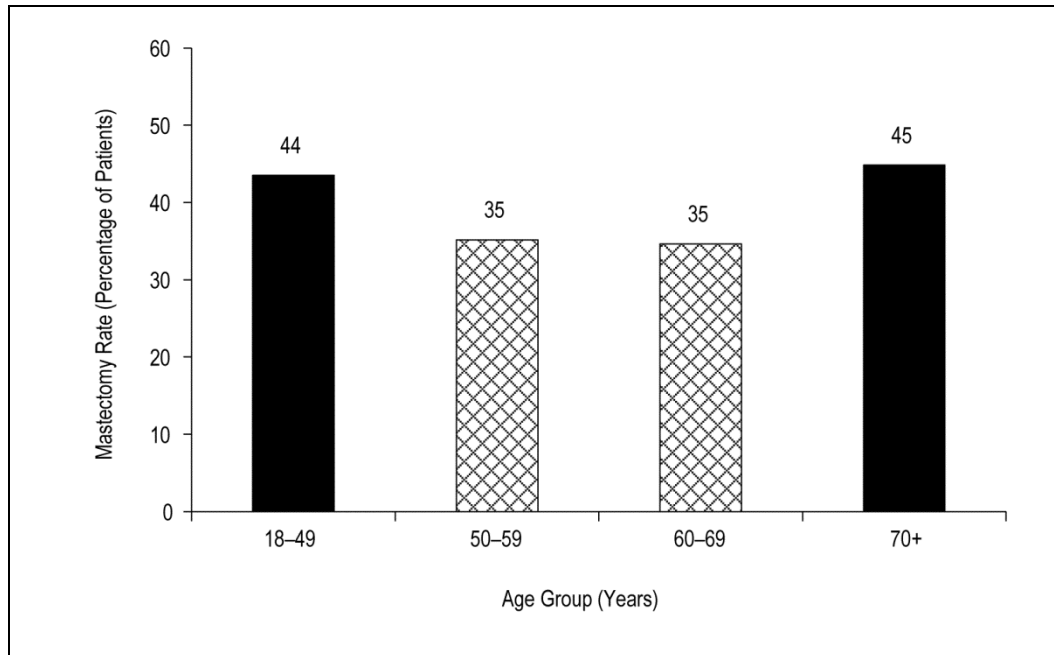
Hospital Morbidity Database and National Ambulatory Care Reporting System, Canadian Institute for Health Information; Alberta Ambulatory Care Reporting System, Alberta Health and Wellness.

Mastectomy Rates by Age

A woman's age can influence her choice of surgery for breast cancer in several ways.^{29, 30} The presentation of breast cancer varies by age, but aside from biological factors, age may influence perceptions of risk, the value placed upon body image, and attitudes toward radiation therapy and breast reconstruction. All of these factors can contribute to the influence of age on choice of procedure.

There is a U-shaped relationship between age group and mastectomy rate among women with invasive breast cancer (Figure 2). Mastectomy rates are relatively high (44%) among women age 18 to 49, decline to 35% from age 50 to 69 and then rise to 45% at age 70 and older. Each bar shown in Figure 2 represents approximately 25% of the population of women with unilateral invasive breast cancer. Bars with different shading illustrate groups that are statistically different from one another. The rates shown for the youngest and oldest age groups are statistically higher than the rates for women age 50 to 69.

Figure 2: Mastectomy Rates Among Women With Unilateral Invasive Breast Cancer, by Age Group, 2007–2008 to 2009–2010



Notes

Data relates to patients who received their index procedure between 2007–2008 and 2009–2010.

This figure excludes patients for whom age, income or travel time could not be calculated in the regression model.

Sources

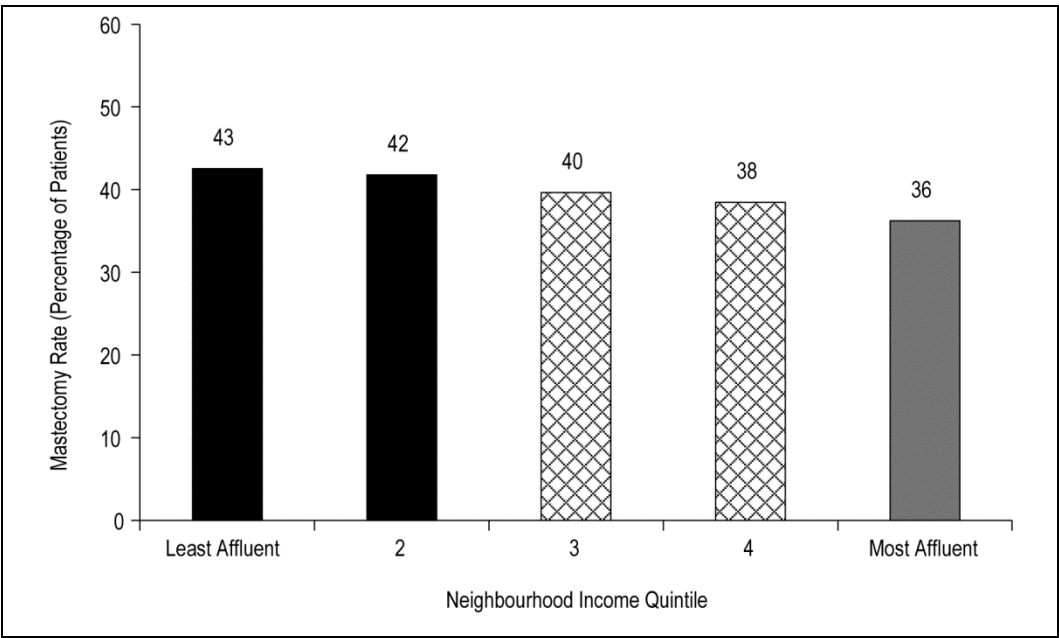
Hospital Morbidity Database and National Ambulatory Care Reporting System, Canadian Institute for Health Information; Alberta Ambulatory Care Reporting System, Alberta Health and Wellness.

Mastectomy Rates by Neighbourhood Income

Socio-economic status is a complex construct composed of factors such as education and income that may have direct and indirect effects on a woman's choice of surgical treatment. For example, loss of income associated with treatment duration may cause lower-income women to choose mastectomy over BCS. Socio-economic status is also correlated with such factors as health literacy and other personal attributes that can influence health care decision-making.^{23, 31} Much of the data necessary to examine these complex relationships is not available in administrative records; however, the records available for this analysis include information that allows for the calculation of the average income level within a woman's neighbourhood.

Figure 3 shows a gradual and modest decline in the use of mastectomy by income, as measured within a woman’s neighbourhood. Women living in the least affluent, as compared with the most affluent, neighbourhoods had a higher mastectomy rate (43% versus 36%, respectively). Each bar in Figure 3 represents women with unilateral invasive breast cancer within the same neighbourhood income quintile. The income quintile bars in different shades are statistically different from one another.

Figure 3: Mastectomy Rates Among Women With Unilateral Invasive Breast Cancer, by Neighbourhood Income Quintile, 2007–2008 to 2009–2010



Notes
Data relates to patients who received their index procedure between 2007–2008 and 2009–2010.
This figure excludes patients for whom age, income or travel time could not be calculated in the regression model.

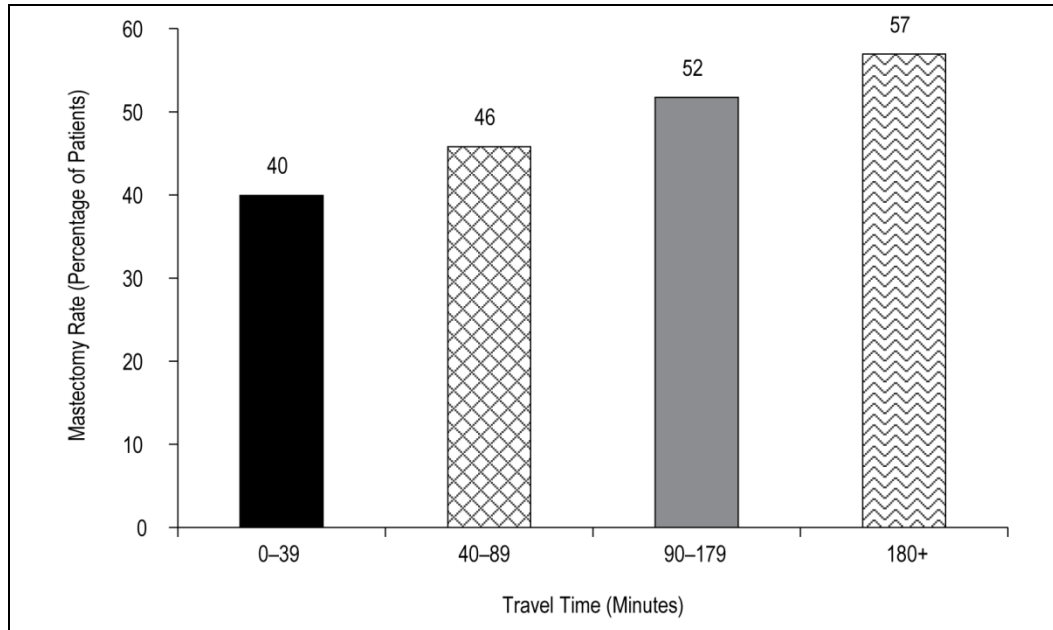
Sources
Hospital Morbidity Database and National Ambulatory Care Reporting System, Canadian Institute for Health Information; Alberta Ambulatory Care Reporting System, Alberta Health and Wellness.

Mastectomy Rates by Travel Time to a Cancer Centre That Has a Radiation Facility

Women may factor logistical and other practical considerations into their decisions regarding breast cancer surgery. Women electing BCS are usually offered post-surgical radiation therapy. This treatment is provided in certain cancer centres only and may involve daily treatment for several weeks. If the time and resources needed to get to such a centre are problematic, a woman may be more likely to opt for a mastectomy, a procedure that is less likely to require post-surgical radiation therapy.

Once the one-way travel time from a woman's residence to a cancer centre that has a radiation facility exceeded 40 minutes, there was a general increase in mastectomy rates as the time needed to travel increased. Mastectomy rates exceeded 50% for women with travel times of 1.5 hours or longer (each way) (Figure 4). Each bar in Figure 4 represents women with unilateral invasive breast cancer who were homogeneous in terms of travel time. All bars are shown in different degrees of shading because the differences between travel times were all significantly different.

Figure 4: Mastectomy Rates Among Women With Unilateral Invasive Breast Cancer, by Time to Travel One Way From Her Residence to the Nearest Cancer Centre That Has a Radiation Facility, 2007–2008 to 2009–2010



Notes

Data relates to patients who received their index procedure between 2007–2008 and 2009–2010.

This figure excludes patients for whom age, income or travel time could not be calculated in the regression model.

Sources

Hospital Morbidity Database and National Ambulatory Care Reporting System, Canadian Institute for Health Information; Alberta Ambulatory Care Reporting System, Alberta Health and Wellness.

Given the effects of age, neighbourhood income and travel time seen here, adjusted mastectomy rates controlling for these three variables were calculated; they are available in Appendix E.

Discussion

The significant geographic variation in rates of mastectomy use among Canadian women who were surgically treated for invasive breast cancer has been documented in earlier research. Significant variation in mastectomy rates by province was observed in Canada in the period 1997 to 2000.³² In these analyses, as in the current analysis, women with unilateral invasive breast cancer in Quebec had much lower use of mastectomy than women in Newfoundland and Labrador (Quebec had half the rate of Newfoundland and Labrador). Significant geographic variation in mastectomy rates has also been observed in the U.S.³³

Many factors could account for this variation, including geographic differences in stage of disease, access to care, women's personal values and preferences, and physician preferences and practice patterns. Variations in early detection related to the use of population-based screening mammography programs may contribute to differences in stage at presentation.

The choice between mastectomy and BCS is heavily influenced by the stage of a woman's disease at presentation. This important variable, as well as other clinical and tumour-specific information, was not available for analysis. It is unlikely that the stage distribution alone varied enough across Canada to account for the very different rates of mastectomy observed. Analyses published recently by CPAC show that stage distribution is generally comparable across provinces.³⁴

Women's choice of surgical procedure may be influenced by access to therapeutic interventions; for example, women with ready access to plastic surgeons with experience in breast reconstruction may be more inclined to choose mastectomy. Women living in proximity to a cancer centre with a radiation facility may consider BCS to be preferable and feasible. The results reported here show that women with lengthy travel times to a radiation facility were much more likely to have had a mastectomy. Geographic access to these interventions, and the clinical expertise associated with them, may vary by province and account for some of the variation observed. Research conducted in Ontario in the mid-1980s and 1990s found breast reconstruction rates to be associated with the availability of resources and expertise;³⁵ within Canada, the availability of immediate breast reconstruction surgery is extremely variable.³⁶ As breast reconstruction surgery in Canada is still relatively uncommon, it is unlikely to account for large variations in mastectomy rates.

It may be the case that women's perceptions of the risks and benefits associated with the different surgical approaches vary significantly by province, perhaps in relation to regional racial/ethnic or cultural factors. But it is unlikely that such preferences would vary to a degree that would account for the differences in mastectomy rates observed. Regional variation in surgeon preference for either BCS or mastectomy under differing clinical circumstances, perhaps as a result of training experiences, could also account for variation by province.

There has been some speculation that the use of certain imaging procedures performed during the diagnostic process may be increasing the use of mastectomy.³⁷ Magnetic resonance imaging (MRI) is a sensitive technology that may suggest more extensive disease and contribute to women's decisions to have more invasive surgery. Some provincial variation in use of mastectomy could be explained if the use of this imaging technique varied by province. Evidence from Ontario suggests that MRI use among women treated surgically for breast cancer was low (12% from the 12 months before to 12 months after their definitive surgery) in 2003–2004 but varied by patient residence, with greater use among women living in the Toronto region.⁴

The finding of relatively high rates of mastectomy among younger women is consistent with the results of U.S. population-based studies, where a recent trend has been observed toward increased mastectomy use among relatively young women living in socio-economically advantaged neighbourhoods.³⁸ One explanation for the high use of mastectomy among younger women is that they have a higher risk of breast cancer recurrence over their lifetime.³⁹ The availability of immediate breast reconstruction may also contribute to a younger woman's decision to undergo mastectomy, although it is still relatively uncommon in Canada compared with the U.S. In addition, younger women (younger than age 40) typically do not have their breast cancer diagnosis made through screening and thus overall have larger tumours at presentation; larger tumour size can be a relative indication for mastectomy. Furthermore, younger women are more likely to present with BRCA 1/2 tumours and are thus more likely to choose mastectomy, often combined with CPM.

The higher rate of mastectomy among older women may be related to the presence of more advanced disease. Alternatively, it could reflect a greater acceptance of the loss of a breast and change in body image. In addition, older women may have comorbidities that would make radiation treatments difficult. It may also be the case that older women may simply want to avoid radiation treatments or the possibility of a repeat operation in the case of positive margins.

Differences in mastectomy rates by neighbourhood income may reflect differences in the stage distribution of the disease. Women of lower socio-economic status are more likely to have their disease detected at later stages, when mastectomy may be a more clinically appropriate option.⁴⁰ Lower-income women may also choose mastectomy if they do not have easy access to a cancer centre that has a radiation facility. Transportation and financial barriers may constrain the option of BCS for some women with limited incomes.

The higher rate of mastectomy found with longer travel time to a cancer centre may be explained by access-to-care issues. With BCS, women must be able to travel to a cancer centre for radiation treatment after their surgery is done.

Re-Excision Following BCS

Background

Surgical re-excision, in the context of the present analysis, is surgery following the index breast cancer procedure that was performed on the same breast and occurred within 365 days of the index surgery. Re-excision may be indicated if the initial surgery did not remove all cancerous tissues. In some cases, the re-excision may simply be a wider excision in the context of BCS, while for others it may be a mastectomy.

There have been recent reports from the U.S. of relatively high rates of re-excision. According to a multicentre U.S. study of 2,206 women with invasive breast cancer who underwent partial mastectomy from 2003 to 2008, 22.9% underwent a re-excision procedure.^{ix, 41} Another U.S. study followed women with DCIS who had undergone BCS from 1990 to 2001. Within six months of surgery, 51.5% of women had had ipsilateral (same-side) invasive procedures. After 10 years of follow-up, 61.5% of women had undergone ipsilateral invasive procedures.⁴² Unknown is whether the findings from this study from the 1990s reflect current practice. However, concerns have been raised that women are choosing mastectomy because of the substantial risk of subsequent invasive procedures following BCS.⁴³

Results

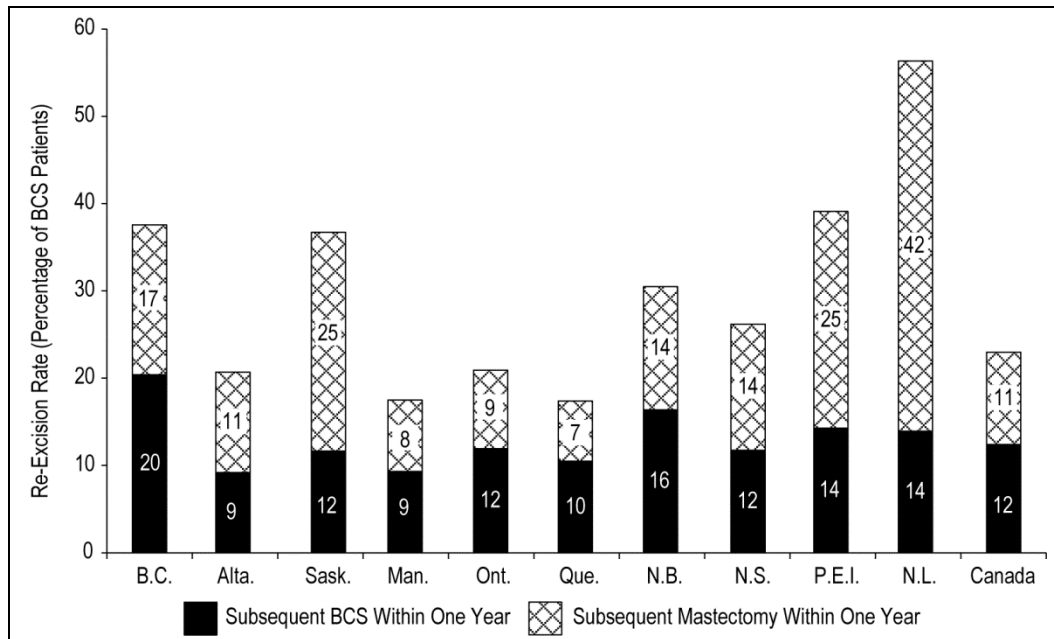
Re-excisions were relatively common among women undergoing BCS for invasive breast cancer (23%) and for women undergoing BCS for DCIS (36%).

Figure 5 provides provincial rates of re-excisions performed for women who underwent BCS for invasive breast cancer as their index procedure. A significant proportion of re-excisions among this group were mastectomies. For example, in Canada, the rate of re-excision was 23% (see bar on the far right in Figure 5). Of these re-excisions, roughly half were for women who initially had BCS and then underwent mastectomy within a year (12% of the re-excisions represent subsequent mastectomies; 11% represent further BCS). More than three-quarters (77%) of patients who underwent initial BCS who subsequently underwent mastectomy did so within 90 days of the initial surgery, indicating that the mastectomy was likely performed as treatment for the index cancer and not for a recurrence.

The rate of re-excision varied by province, as did the composition of the re-excisions (that is, the relative proportion of re-excisions that were subsequent mastectomies versus BCS). The highest rate of re-excisions overall was seen in Newfoundland and Labrador (56%) and the lowest rates were in Manitoba and Quebec (17%). Whereas roughly half of re-excisions in Canada were accounted for by women initially having BCS and subsequently undergoing mastectomy, in Newfoundland and Labrador, these cases represented three-quarters of that province's re-excisions.

ix. Among the women who underwent additional surgery, most (89.2%) underwent a single re-excision, 6.9% underwent two re-excisions and 1.4% underwent three re-excisions.

Figure 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



Note

Data relates to patients who received their index procedure between 2007–2008 and 2009–2010.

Sources

Hospital Morbidity Database and National Ambulatory Care Reporting System, Canadian Institute for Health Information; Alberta Ambulatory Care Reporting System, Alberta Health and Wellness.

Discussion

The relatively high rates of re-excision in some provinces may explain some of the geographic variation in mastectomy rates. A substantial number of women who initially had BCS eventually underwent mastectomy within one year. This was particularly common in Newfoundland and Labrador, Prince Edward Island and Saskatchewan, provinces with relatively high final rates of mastectomy.

The pan-Canadian results reported in Figure 5 on hospitalizations for re-excisions are consistent with findings reported in the literature.^{44, 45} A study of reoperation following BCS for early-stage breast cancer at one Ontario cancer centre found that 128 of 489 patients (26%) who underwent surgery from 2000 to 2002 had a second operation, primarily because of a positive margin found in the specimen obtained at the initial surgery.⁴⁴

The rates of re-excision presented here may be somewhat overestimated because of the inability to distinguish BCS from open excisional biopsy (see Box 1).

Contralateral Prophylactic Mastectomy Among Women Having Mastectomy for Unilateral Disease

Background

Evidence from the U.S. suggests that an increasing number of women with breast cancer are electing to have CPM.^{1, 46–51} The use of CPM is controversial because there is little evidence of its benefits.^{x, 52} While the risk of developing contralateral breast cancer is nearly eliminated with CPM, it is not clear whether CPM improves long-term breast cancer–specific survival rates.^{55, 56} For many women with breast cancer, the risk of contralateral breast cancer is outweighed by the risk of distant metastatic disease (spread of cancer beyond the breast, for example, to the bones, lungs, liver or brain).^{57, 58} CPM does not reduce the risk of distant metastatic disease.

Only two relatively small groups of women who are at a substantially increased risk of contralateral breast cancer would be candidates for CPM based on risk: those with BRCA mutations^{xi} and those with a history of chest irradiation during childhood and adolescence.⁵⁶ The majority of women with unilateral breast cancer do not face a high risk of contralateral breast cancer. According to a large U.S. population-based study of women with unilateral DCIS or stage I and II breast cancer, the 10- and 20-year actuarial rates of contralateral breast cancer were 6.1% and 12.0%, respectively.⁵⁹ Adjuvant therapy greatly reduces these risks. For example, tamoxifen reduces contralateral breast cancer incidence by 50% in women with specific types of breast cancer. Newer therapies, such as aromatase inhibitors and trastuzumab, also result in similar dramatic reductions in risk for specific types of cancer.⁵⁷

Why women are choosing CPM even when they are candidates for breast-conserving therapy may be related to misperceptions regarding the risk of a second cancer.⁶⁰ Women opting for CPM tend to be young, well-educated and to have a family history of breast cancer or other clinical risk factors.^{51, 61–63} A number of clinical management factors also influence women's decisions to undergo CPM. For example, higher rates of CPM have been observed among women who have immediate breast reconstruction and who had MRI at diagnosis.⁶⁴ MRI is sensitive and identifies potentially cancerous lesions in the contralateral breast in approximately 3% of women initially diagnosed with unilateral invasive breast cancer.³⁷ However, MRIs are associated with a relatively high false-positive rate. Some women may undergo biopsies only to find that the MRI result was not confirmed. Increased anxiety associated with the MRI finding may lead some women to opt for CPM even though their risk is not truly elevated. There is some evidence that women with an abnormal MRI forgo biopsy and proceed with mastectomy for what is ultimately a benign finding.⁶⁴ Pathology studies of breast tissue following CPM have shown relatively low rates of contralateral breast cancer (1% with invasive cancer; 5% with DCIS).^{64, 65} Some women opt for CPM even after testing negative for BRCA mutations.⁶⁶

x. Recent evidence suggests that CPM may confer improved overall survival and disease-free survival among women with stage I or II breast cancer and a family history of breast cancer.⁵³ Another report of a survival benefit among certain women following CPM⁶⁴ has been called into question on methodological grounds.⁵⁰

xi. Women with harmful mutations in either the BRCA1 or BRCA2 gene have a risk of breast cancer that is about five times the normal risk, as well as a risk of ovarian cancer that is about 10 to 30 times normal (see www.cancer.gov). BRCA stands for “breast cancer susceptibility gene.”

The Society of Surgical Oncology has issued a position statement to specify the circumstances under which CPM may be considered (Box 3). It advises physicians to counsel patients because of the unclear benefit of CPM in terms of mortality and because breast cancer patients may overestimate their risk of developing contralateral breast cancer.⁶⁷

Box 3: Potential Indications for Prophylactic Contralateral Mastectomies

In patients with a current or previous diagnosis of breast cancer:

- For risk reduction in patients at high risk of contralateral breast cancer.
- For patients in whom subsequent surveillance of the contralateral breast would be difficult (for example, patients with dense breast tissue or diffuse indeterminate micro-calcifications in the contralateral breast).
- For improved symmetry in patients undergoing mastectomy with reconstruction.

Source

Society of Surgical Oncology. Position statement on prophylactic mastectomy. <http://www.surgonc.org>. Updated March 2007. Accessed December 3, 2011.

The complication rate after bilateral mastectomy and reconstruction is about 15% to 20%. Even without complications, the operations are long (often five to six hours), and they require two to three days of inpatient hospital care and three to four weeks to recover.⁶⁸

Results

Among women who underwent a mastectomy as their initial procedure for unilateral invasive breast cancer between 2007–2008 and 2009–2010, 6% received CPM within one year (Table 2).

Table 2: Rates of CPM Among Women Who Received a Mastectomy for Unilateral Invasive Breast Cancer as Their Initial Procedure, 2007–2008 to 2009–2010

	2007–2008	2008–2009	2009–2010	Total
CPM	289 (5%)	363 (6%)	414 (7%)	1,066 (6%)
Total	5,892	6,182	6,301	18,375

Note

Data relates to patients who received their index procedure between 2007–2008 and 2009–2010.

Sources

Hospital Morbidity Database and National Ambulatory Care Reporting System, Canadian Institute for Health Information; Alberta Ambulatory Care Reporting System, Alberta Health and Wellness.

Discussion

The pan-Canadian finding that 6% of women undergoing a mastectomy for unilateral invasive breast cancer underwent CPM is somewhat lower than estimates from the U.S. In one large U.S. study of women with stage I, II or III breast cancer, 11.0% of women who chose mastectomy underwent CPM in 2003.¹

Reconstructive Surgery After Mastectomy

Background

The willingness to undergo mastectomy, especially among relatively young women, may be affected by the availability of improved, and sometimes immediate, reconstruction following breast cancer surgery.⁶⁹ Women who do not have immediate reconstruction may decide to delay reconstruction, especially those who undergo adjuvant systemic and radiation therapy.

Results

Nine percent of women with unilateral invasive breast cancer had reconstruction within a year of their mastectomy (Table 3). Among those women who underwent reconstruction, 78% had immediate reconstruction (7% of all women undergoing mastectomy). The use of reconstructive surgery remained stable over the three-year study period.

Table 3: Reconstruction Among Women With Unilateral Invasive Breast Cancer Who Had a Mastectomy

		2007–2008	2008–2009	2009–2010	Total
Mastectomy	Total	5,892	6,182	6,301	18,375
Reconstruction	Immediate	370	410	416	1,196
	Delayed	123	128	124	375
	Any Reconstruction	493 (8%)	538 (9%)	540 (9%)	1,571 (9%)

Note

Data relates to patients who received their index procedure between 2007–2008 and 2009–2010.

Sources

Hospital Morbidity Database and National Ambulatory Care Reporting System, Canadian Institute for Health Information; Alberta Ambulatory Care Reporting System, Alberta Health and Wellness.

Discussion

The delayed reconstruction rates reported here are limited to one year, which most likely markedly underestimates the total number of delayed reconstructions that women experienced, because many delayed reconstructions would be expected to occur beyond the one-year window that was defined for the treatment episode. Women who experience complications or who need further surgery, chemotherapy or radiotherapy following their index procedure may undergo reconstruction more than one year after their initial diagnosis. If the reconstruction was delayed beyond a year of the index surgery, it would not be included in the rates reported here.

A study of mastectomy and reconstruction in Ontario found that use of reconstruction varied markedly by a woman's proximity to Toronto.³⁵ Breast reconstruction among women who had had a mastectomy from 1984 to 1995 was twice as high for those living in the Greater Toronto Area relative to all other regions of the province. Hospitals in the Greater Toronto Area accounted for 60% of the province's reconstruction procedures. Younger women were more likely than their older counterparts to receive breast reconstruction. The authors suggest that limited availability of expertise and regional attitudes toward breast reconstruction may function to limit access to and use of reconstruction.

The use of reconstructive surgery among women with breast cancer is not well documented in Canada, but its use appears to be lower than in other high-income countries.⁷⁰ For example, in the U.S., an estimated 24% of women with breast cancer who had mastectomies from 1999 to 2003 elected to have breast reconstruction at the time of the mastectomy (immediate reconstruction).² This published U.S. rate of reconstruction is more than three times as high as the more recent pan-Canadian estimate reported here (7%; 1,196 out of 18,375 had immediate reconstruction).

Location of Surgical Care (Day Surgery or Inpatient Care) and Length of Stay

Background

The adoption of less-invasive surgery and improved surgical care has led to shorter hospital stays for breast cancer surgery. Cost-containment efforts have also contributed to this trend.⁷¹ Some women undergoing breast cancer-related surgical procedures are not hospitalized at all. Instead, even complex procedures such as mastectomy are performed as day surgery.^{72–74}

Concerns about potential negative consequences of early discharge of breast cancer patients have been raised, but in general, these consequences have not been observed. When assessed, women experiencing shorter (as compared with longer) hospital stays have similar outcomes (such as in terms of rates of surgical complications and levels of patient satisfaction).^{72, 75} One study of the surgical outcomes of women undergoing mastectomy as part of a one-day-stay program at a large U.S. cancer centre found the procedure to be safe when a multidisciplinary team was involved in planning and implementation.^{xii, 73}

xii. In this study of 537 women undergoing unilateral mastectomy (444 with a one-day stay), none of the readmissions (five patients) and only two urgent care visits would have been prevented had the patients had longer inpatient stays.⁷³

Results

Most mastectomies for women with invasive breast cancer (80%) and DCIS (79%) were performed as inpatient procedures (Table 4). Most BCS for women with invasive breast cancer (70%) and DCIS (92%) was performed as day surgery.

Table 4: Location of Index Surgery for Breast Cancer, 2007–2008 to 2009–2010

			2007–2008	2008–2009	2009–2010	Total
Unilateral Cancer	BCS	Inpatient	4,151 (32%)	3,749 (29%)	3,564 (27%)	11,464 (29%)
		Day Surgery	8,615 (67%)	9,052 (70%)	9,386 (72%)	27,053 (70%)
	Mastectomy	Inpatient	4,868 (82%)	4,898 (79%)	5,000 (79%)	14,766 (80%)
		Day Surgery	1,024 (17%)	1,284 (20%)	1,301 (20%)	3,609 (19%)
	Total	Inpatient	9,019 (48%)	8,647 (45%)	8,564 (44%)	26,230 (46%)
		Day Surgery	9,639 (51%)	10,336 (54%)	10,687 (55%)	30,662 (53%)
DCIS	BCS	Inpatient	149 (7%)	162 (8%)	153 (7%)	464 (7%)
		Day Surgery	1,742 (92%)	1,841 (91%)	1,989 (92%)	5,572 (92%)
	Mastectomy	Inpatient	297 (82%)	321 (76%)	326 (78%)	944 (79%)
		Day Surgery	61 (17%)	96 (23%)	90 (21%)	247 (20%)
	Total	Inpatient	446 (19%)	483 (19%)	479 (18%)	1,408 (19%)
		Day Surgery	1,803 (80%)	1,937 (80%)	2,079 (81%)	5,819 (80%)

Note

Data relates to patients who received their index procedure between 2007–2008 and 2009–2010.

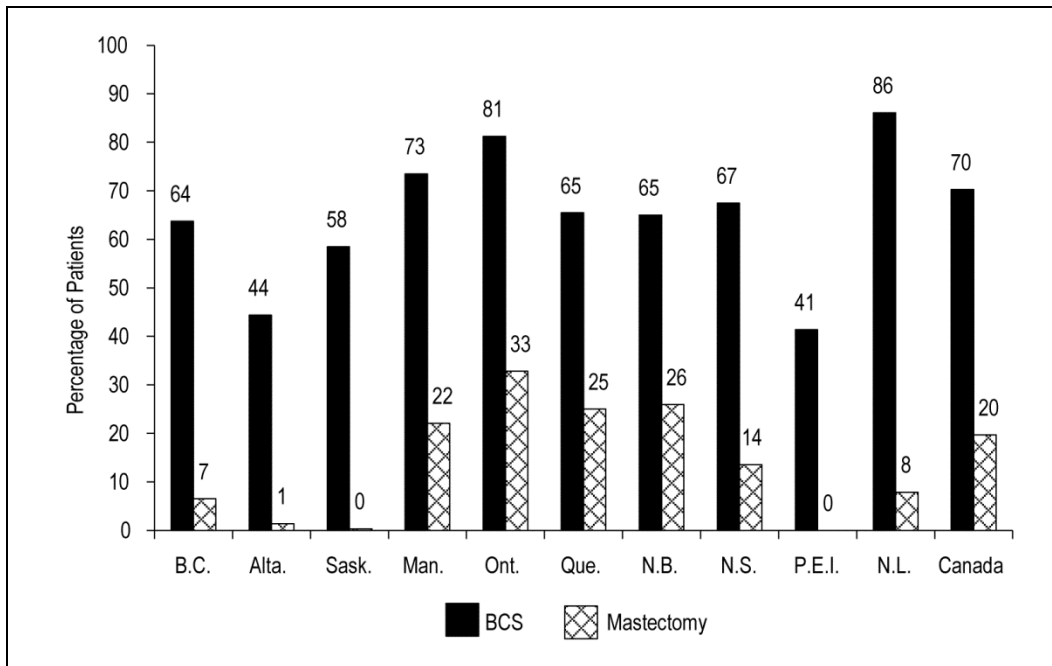
Sources

Hospital Morbidity Database and National Ambulatory Care Reporting System, Canadian Institute for Health Information; Alberta Ambulatory Care Reporting System, Alberta Health and Wellness.

The use of day surgery for breast cancer surgery varied greatly by province. One-third (33%) of mastectomies in Ontario were performed as day surgery (Figure 6). No mastectomies were performed as day surgery in Saskatchewan and P.E.I., and only 1% of mastectomies in Alberta were performed as day surgery.

The use of day surgery for BCS ranged from 41% in P.E.I. to 86% in Newfoundland and Labrador.

Figure 6: Percentage of Women With Unilateral Breast Cancer Who Received Day Surgery for Their Index Procedure, by Procedure and Province, 2007–2008 to 2009–2010



Note

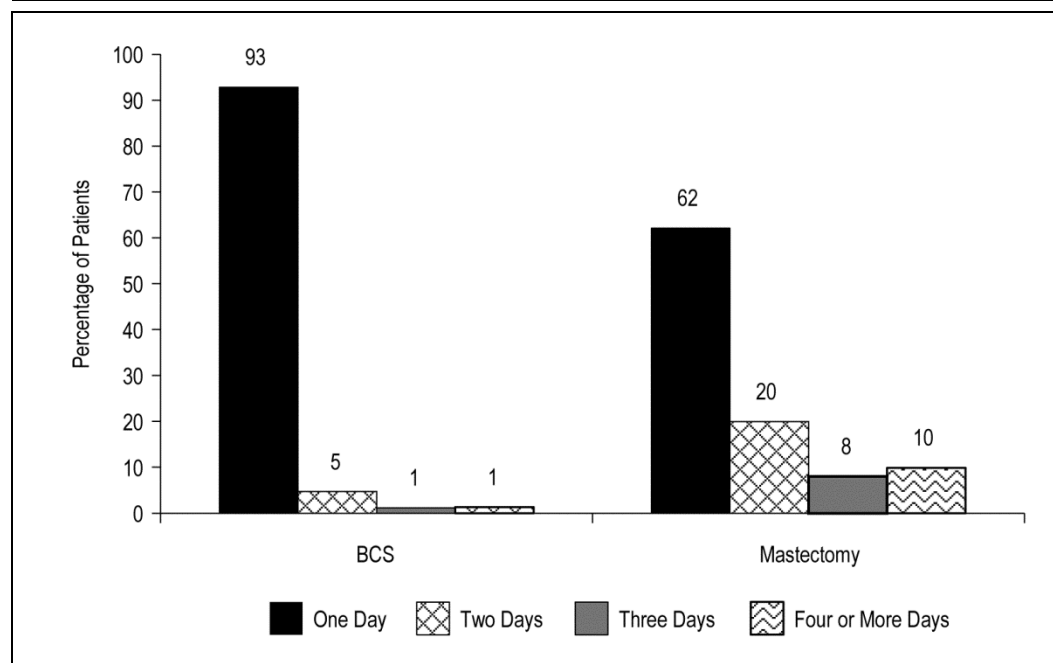
Data relates to patients who received their index procedure between 2007–2008 and 2009–2010.

Sources

Hospital Morbidity Database and National Ambulatory Care Reporting System, Canadian Institute for Health Information; Alberta Ambulatory Care Reporting System, Alberta Health and Wellness.

Mastectomy patients were more likely than BCS patients to spend three or more days in hospital (18% versus 2%, respectively) (Figure 7).

Figure 7: Length of Stay in Days for Index Surgery for Women With Unilateral Breast Cancer, by Procedure, 2007–2008 to 2009–2010



Note

Data relates to patients who received their index procedure between 2007–2008 and 2009–2010.

Sources

Hospital Morbidity Database and National Ambulatory Care Reporting System, Canadian Institute for Health Information; Alberta Ambulatory Care Reporting System, Alberta Health and Wellness.

Discussion

From a historical perspective, the shift in hospital care for women undergoing surgery for breast cancer in Canada has been dramatic. A woman hospitalized for breast cancer in Canada in 1981 was discharged after 15 days. By 2000, the average length of stay had dropped to 4.5 days.^{xiii, 75} This decline in length of stay was observed among all age groups, cancer stages and levels of comorbidity.⁷²

The current findings—that 93% of BCS patients and 62% of mastectomy patients went home from hospital within a day—reveal a further dramatic shortening of the duration 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 same-day surgery.⁴

xiii. This study was not confined to surgical cases (32% of women hospitalized with a primary diagnosis of breast cancer did not undergo surgery).

The implications of this trend of shortened length of stay and shift to day surgery on both cost and resource use are considerable. Given the variation in duration of hospital care across the provinces, one can infer that resource use varies considerably. Some jurisdictions may be substituting in-hospital care with home care or other community-based care.

Complications of Surgery

Background

Surgical procedures for breast cancer are complex and may result in complications. Some complications arise during the immediate post-surgical period, while others emerge later and require readmission. Wound infection, hematoma, cellulitis and pulmonary embolism are among the complications that may follow breast cancer surgery.^{72, 76} Problems relating to implants or grafts following breast reconstruction may also necessitate rehospitalization. Most post-surgical complications are minor and can be treated on an outpatient basis; these complications are not reflected in the data presented below.

Results

Complications

The following complications were included in the analysis:

1. Infection: This is usually identified and treated on an outpatient basis; however, some patients are re-admitted with chest wall cellulitis and/or abscess and treated with IV antibiotics.
2. Wound dehiscence: This involves the separation of the layers of a surgical wound that may require debridement of the wound (removing dead, contaminated or adherent tissue).
3. Deep vein thrombosis (DVT)/pulmonary embolus: This complication involving a blood clot that can travel to the lung is rare but potentially serious.
4. Bleeding/hematoma: This uncommon complication, if it occurs, usually presents within seven days of the initial surgery. It is treated aggressively and involves evacuations of the hematoma and control of bleeding in the chest wall.
5. Skin necrosis: This may require a debridement procedure within 30 days of the index procedure.

Both 7-day and 30-day complication rates were 2% or less for BCS and 6% or less for mastectomy for both invasive breast cancer and DCIS (Table 5). When a complication occurred and was treated in hospital, it was most often bleeding/hematoma or infection (Table 6).

Table 5: 7-Day and 30-Day Complication Rates for Unilateral Invasive Breast Cancer and DCIS (Combined), 2007–2008 to 2009–2010

			2007–2008	2008–2009	2009–2010	Total
7-Day	BCS	Complication	81 (<1%)	89 (<1%)	114 (<1%)	284 (<1%)
		Total	14,657	14,804	15,092	44,553
	Mastectomy	Complication	166 (3%)	176 (3%)	199 (3%)	541 (3%)
		Total	6,250	6,599	6,717	19,566
30-Day	BCS	Complication	244 (2%)	250 (2%)	306 (2%)	800 (2%)
		Total	14,657	14,804	15,092	44,553
	Mastectomy	Complication	366 (6%)	391 (6%)	399 (6%)	1,156 (6%)
		Total	6,250	6,599	6,717	19,566

Note

Data relates to patients who received their index procedure between 2007–2008 and 2009–2010.

Sources

Hospital Morbidity Database and National Ambulatory Care Reporting System, Canadian Institute for Health Information; Alberta Ambulatory Care Reporting System, Alberta Health and Wellness.

Table 6: Frequency of 7-Day and 30-Day Complication Rates Among Patients Undergoing BCS and Mastectomy, by Complication, 2007–2008 to 2009–2010

		7-Day	30-Day
Infection	BCS	<1%	1%
	Mastectomy	1%	2%
Infection (Reconstruction)	BCS	<1%	<1%
	Mastectomy	<1%	<1%
Wound Dehiscence	BCS	<1%	<1%
	Mastectomy	<1%	<1%
Deep Vein Thrombosis	BCS	<1%	<1%
	Mastectomy	<1%	<1%
Bleeding/Hematoma	BCS	<1%	1%
	Mastectomy	2%	4%
Skin Necrosis	BCS	<1%	<1%
	Mastectomy	<1%	<1%

Notes

Data relates to patients who received their index procedure between 2007–2008 and 2009–2010.

The post-operative complication seroma is classified with bleeding/hematoma unless it is specified as an infected seroma; then it is classified with infection.

Sources

Hospital Morbidity Database and National Ambulatory Care Reporting System, Canadian Institute for Health Information; Alberta Ambulatory Care Reporting System, Alberta Health and Wellness.

Discussion

There are few reports on complications of breast cancer surgery with which to compare results, but the rates presented here for Canada are similar to those reported elsewhere. A study of outcomes of breast cancer surgery in England from 1997 to 2005 found that approximately 5% of women were readmitted to hospital within 30 days of breast cancer surgery for wound infection, hematoma, cellulitis, pulmonary embolism or problems related to an implant or graft.⁷² Most of these readmissions were for infection related to a procedure. A study of breast cancer surgical outcomes in the U.S. Department of Veterans Affairs Medical Centers from 1991 to 1997 also found that infection was among the most common reason for readmission.⁷⁶ These study findings may not be strictly comparable with the results presented here due to differences in the period of study, methods and study populations (for example, 25% of the U.S. study population were male). This study was not able to estimate all complications, as many are managed outside of the hospital setting, but significant complications occurring in or requiring management in hospital were included.

Surgery for Contralateral Disease

Background

The risk of contralateral breast cancer is relatively low for women previously treated for unilateral early-stage disease, especially with the advent of adjuvant therapy (see the discussion in the section on CPM). Given the short period of follow-up (one year), few surgical procedures for disease in the contralateral breast would be expected in the study cohort.

Results

Within a year of the index surgery, 1% of women who had unilateral invasive breast cancer had surgery for a cancer in the contralateral breast (Table 7).

Table 7: Surgery Rates for Contralateral Disease Within a Year of Index Surgery, Among Women With Unilateral Invasive Breast Cancer, 2007–2008 to 2009–2010

	2007–2008	2008–2009	2009–2010	Total
Contralateral Breast Cancer	237 (1.3%)	222 (1.2%)	225 (1.2%)	684 (1.2%)
Total	18,658	18,983	19,251	56,892

Note

Data relates to patients who received their index procedure between 2007–2008 and 2009–2010.

Sources

Hospital Morbidity Database and National Ambulatory Care Reporting System, Canadian Institute for Health Information; Alberta Ambulatory Care Reporting System, Alberta Health and Wellness.

Discussion

The low rates of surgery for contralateral disease among women who underwent surgery for unilateral invasive breast cancer (2% among women who had BCS and less than 1% among women who had a mastectomy) was expected given short period of follow-up in this study (that is, surgery for recurrence would be unlikely within one year).

Key Findings

Each year, approximately 22,000 Canadian women undergo surgery for breast cancer, either BCS or mastectomy. From 2007–2008 to 2009–2010, most women across Canada received BCS for either invasive or non-invasive disease (DCIS). In general, clinical practice guidelines recommend breast-conserving therapy (BCS plus radiotherapy) for the majority of women diagnosed with breast cancer because it is less invasive and because it is associated with fewer morbidities and equivalent survival as mastectomy. A woman's choice of procedure is often based on the extent of her disease and her personal preferences after considering the benefits and risks associated with each procedure. Some women's choices, however, may be influenced by non-clinical factors, such as access to care or practice patterns that are not evidence-based.

In the current analyses, wide differences were seen in mastectomy rates by province/territory among women with unilateral invasive breast cancer. The crude mastectomy rate ranged from 26% in Quebec to 69% in Newfoundland and Labrador. This difference was only somewhat diminished when adjustments were made for age, income and travel time to a cancer centre. After such adjustments, a 26 percentage point absolute difference remained between provinces with the lowest and highest mastectomy rates (35% and 61%, respectively; see Appendix E). A number of factors could contribute to these differences; however, many potential explanations cannot be explored using the available data. Possible explanatory factors include differences by province in severity of disease, the relative health of women undergoing surgery, clinicians' surgical preferences and undocumented socio-economic factors.

The differences in mastectomy rates by province raise many questions. Additional analyses of clinical practices and patterns could provide some answers. In this regard, examining the wide variation in rates of reoperation and, in particular, the performance of mastectomy on women initially treated with BCS might be informative. The relatively high rate of mastectomy following initial BCS among women in certain jurisdictions appears to be contributing to the high rates of mastectomy in these jurisdictions.

Some of the variation in mastectomy rates reinforces findings from the literature, for example, that use of mastectomy varies significantly by age, with younger and older women more likely to have mastectomies. This trend likely reflects severity of disease, risk of progression and women's surgery preferences, which are known to vary by age.

The type of surgery a woman has for breast cancer also varies significantly by non-clinical factors, including income and proximity to a cancer centre. As reported here, women living in the least affluent neighbourhoods had the highest rates of mastectomy. Women whose residence placed them far from a cancer centre that has a radiation facility had higher rates of mastectomy. A lengthy course of radiation treatment is generally recommended following BCS. One of the challenges related to access to care—travel time—appears to significantly reduce the use of less-invasive surgery for breast cancer.

Breast cancer surgery was previously associated with lengthy hospital stays, but procedures are increasingly being performed as day surgery. The use of day surgery varied significantly by province. One-third of mastectomies in Ontario were performed as day surgery. In contrast, fewer than 2% of mastectomies in Alberta and Saskatchewan were performed as day surgery. The extent of this variation raises interesting questions regarding the organization of care and resource issues. The literature suggests that shorter lengths of stay for breast cancer surgery have not been shown to negatively affect outcomes when sufficient resources are available to support women upon discharge.^{72, 75} Whether shorter stays could be uniformly adopted would likely depend on the availability of appropriate community-based resources and organization of care.

Relatively few Canadian women have breast reconstruction immediately following surgery. Among women with unilateral invasive breast cancer, 7% had reconstruction immediately following their mastectomy. While studies of breast reconstruction in the U.S. are not strictly comparable, rates of immediate breast reconstruction appear to be lower in Canada than in the U.S. Whether this finding is due to women's preferences or to access issues cannot be determined by these analyses. However, findings from an earlier period in Ontario suggest that access to reconstruction facilities and expertise are strongly correlated with reconstruction rates.³⁵

Relatively few (6%) women who underwent mastectomy for unilateral invasive breast cancer had CPM. There is evidence from the U.S. that rates of CPM are increasing. Only three years of data are available for analysis, but the rate of CPM does appear to be modestly increasing in Canada (from 5% in 2007–2008 to 7% in 2009–2010). Monitoring this trend is important, because there are concerns that women choosing CPM may not fully understand the risks and benefits associated with this procedure.

Many women who initially have BCS have re-excisions within a year of surgery. Some of these procedures are indicated if pathology suggests that there may be residual tumour following the initial surgery. There are no standards with which to judge so-called clear margins,⁴¹ and this lack of a standard may, in part, account for the wide geographic variation observed in re-excision rates. Re-excision rates have been found to vary widely by surgeon and hospital.⁴¹ Examination of clinical practices by province/territory will be needed to better understand these variations. Re-excision rates may be overestimated here, and further analyses are planned to understand the extent of any overestimation.

Information Gaps

The finding of variation in use of treatment-related breast cancer surgery raises questions about how Canadian women are exercising their treatment options and the resultant quality of care. More in-depth studies using supplementary data sources and designs with a longitudinal component would contribute to an improved understanding of the variation observed and how it might relate to quality of care. Augmenting present data sources with information available in cancer registries would allow for analyses by stage of disease. If information on disease stage was available, much more refined analyses could be conducted, because stage of disease is central to treatment planning.

Integrating information on radiation therapy into the present analyses would permit studies of the extent of its use following BCS. Its use following surgery improves outcomes. The results of laboratory data on the status of hormone receptors (for example, estrogen and progesterone receptors) and other biomarkers could help to refine analyses of the appropriateness of care. For example, with pharmaceutical interventions, in particular, decisions regarding the appropriate use of adjuvant therapies depend on results of laboratory tests of hormone receptor status.

Collaboration with data and research partners could permit an integration of these data sources and contribute to an improved understanding of the status of breast cancer care in Canada. This report by CIHI and CPAC represents a collaborative approach to making use of the best available data and expertise in quality to assist clinicians and decision-makers in improving cancer care to benefit patients in Canada.

Opportunities for Quality Improvement

A number of key stakeholders, including hospitals, surgeons and consumer groups, will find the results of these analyses of great interest and will be motivated by findings of significant variations in care to initiate efforts to understand local practices and improve the quality of surgical care for women with breast cancer. With the evidence at hand, what can stakeholders consider in the short term to improve surgical breast cancer care in Canada?

- Health authorities and hospitals could initiate internal audits of surgical practices and examine the use of evidence-based practice guidelines. Resource-use issues could be examined (for example, use of day surgery). In addition, tools designed to improve surgical quality, such as the surgical synoptic reporting tool supported by CPAC, could be implemented.
- Provincial cancer agencies could pursue collaborative quality improvement education and training initiatives with surgical colleagues.
- Professional societies representing surgeons could establish formal or informal groups to review the status of evidence-based guidelines in their jurisdiction and how such guidelines are disseminated. These organizations could also determine if new clinical practice guidelines in specific care areas could be developed to improve practice. Inclusion of patient representatives in these guideline groups would ensure that the guidelines are patient-oriented. Development of patient decision aids could also be included in the guideline dissemination process.

Finally, although surgical care is an important component of breast cancer care, the system of care extends from screening through palliation. A recent CPAC report, *Breast Cancer Control in Canada: A System Performance Special Focus Report (2012)*, examines the performance of the entire system of breast cancer care in Canada and will be of interest to those seeking to improve quality of care in this area.³⁴

Appendix A: Epidemiology of Female Breast Cancer

Table A1: Epidemiology of Female Breast Cancer, Canada, 2012

Province/Territory	Number of New Cases (Incidence)	Age-Standardized Incident Rate*	Number of Deaths	Age-Standardized Mortality Rate*
B.C.	3,000	92	630	17
Alta.	1,950	88	390	17
Sask.	690	98	160	21
Man.	800	97	210	22
Ont.	9,100	100	2,000	20
Que.	5,500	94	1,350	20
N.B.	550	95	110	17
N.S.	740	100	160	20
P.E.I.	95	89	30	24
N.L.	330	84	90	22
Canada	22,700	96	5,100	19

Notes

* Rates are age-standardized to the 1991 Canadian standard population (per 100,000).

Canada totals include provincial and territorial estimates. The territories are not listed separately due to small numbers.

Source

Canadian Cancer Society. *Canadian Cancer Statistics 2012*. Toronto, ON: Canadian Cancer Society; 2012. <http://www.cancer.ca>.

Accessed June 11, 2012.

Trends in Breast Cancer

Breast cancer incidence rates rose from 1983 through the early 1990s, in part because of increased mammography screening. Reasons for the pattern of modest declines and increases observed since then are unclear but likely relate to factors such as the continuing rise in mammography screening throughout the 1990s, along with the fluctuating patterns of hormone replacement therapy use among post-menopausal women during this time.

Female breast cancer mortality rates have been declining since the mid-1980s. The mortality rate has fallen by almost 40% since peaking in 1986, from 32.0 to 19.5 per 100,000. The downward trend has accelerated to 2.2% per year in recent years. This is likely the result of a combination of increased mammography screening and the use of more effective adjuvant therapies following breast cancer surgery. The breast cancer mortality rate is the lowest it has been since 1950.

Appendix B: Surgical and Diagnostic Codes

Table B1: Breast Cancer as Diagnosis Type (M) and Procedure

	ICD-10-CA
Primary 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
Ductal Carcinoma in Situ	D05.1
	ICD-10-CA
Mastectomy	1.YM.89–1.YM.92
Breast-Conserving Surgery	1.YM.87, 1.YM.88

Table B2: Prophylactic Mastectomy

	ICD-10-CA	Note
	Z40.00	Flag Z85.3 (coding is optional)

Table B3: 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 B4: Complications

	ICD-10-CA	Notes
Post-Mastectomy Bleeding/Hematoma	T81.0 and Y83.6	
Infection	[T81.4 and Y83.6] (Post-mastectomy wound infection) or [T85.7 AND Y83.1] (Post-mastectomy with reconstruction infection due to breast implant)	
Skin Necrosis Post-Mastectomy	R02	In ICD-10-CA, a post-operative skin necrosis is equivalent to gangrene.
Post-Mastectomy Seromas	N/A	Post-operative seromas are classified to post-operative hematoma. If seromas or hematomas are infected, they are classified to post-operative infection.
Wound Dehiscence	T81.3 and Y83.6	
Deep Vein Thrombosis/ Pulmonary Embolus	T81.7 and [I26 (Pulmonary embolism), I80 (DVT, including phlebitis and thrombophlebitis)] and Y83.6	I80.2 = Phlebitis and thrombophlebitis of other deep vessels of lower extremities.

Appendix C: Methods

Data Sources

Three sources of information were used for hospital surgical care:

- Hospital Morbidity Database (HMDB), CIHI
- National Ambulatory Care Reporting System (NACRS), CIHI
- Alberta Ambulatory Care Reporting System, Alberta Health and Wellness

The HMDB is a national data holding that captures administrative, clinical and demographic information on inpatient separations from all acute care hospitals. All provinces and territories (with the exception of Quebec) submit discharge data to CIHI's Discharge Abstract Database (DAD). Quebec's ministère de la Santé et des Services sociaux submits a data file to CIHI at the end of each year. This data file is mapped, processed and finally merged with the DAD acute care data to create the national HMDB. For these analyses, HMDB data from five fiscal years (2006–2007 to 2010–2011) was used. NACRS and the Alberta Ambulatory Care Reporting System replaced outpatient submissions to the DAD for selected provinces and years, providing coverage of all inpatient and outpatient surgical procedures from 2006–2007 to 2010–2011.

Methods Used to Define Patient Treatment Episodes

Index surgical interventions and subsequent one-year treatment episodes were constructed using the following steps:

1. Select all inpatient and day surgery records from 2006–2007 to 2010–2011 meeting the following inclusion/exclusion criteria for surgical treatment of breast cancer:

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 or ductal carcinoma in situ (DCIS) 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
2. Link records to identify all inpatient and day surgery records associated with individual patients.
 - a. Construct unique patient ID based on encrypted health card number and person's birth year.
 3. Identify patient's index surgery. Sort records by procedure, location of care (inpatient versus day surgery), admission date and discharge date.
 - a. When multiple procedures are coded in the same record, prioritize mastectomy over BCS.
 - b. When multiple procedures of the same type occurred on the same day in different locations of care, prioritize inpatient records over day surgery records.
 4. Remove patients who do not meet the criteria for first treatment.
 - a. Exclude patients with a discharge in 2006–2007.
 - b. Exclude patients whose first discharge indicates a past history of breast cancer.
 5. Select all index records from the treatment episodes.
 - a. The index record contains each patient's first surgical intervention for breast cancer.
 6. Extract all records linked to index patient that include admission dates on or after the date of the index surgery.
 7. Exclude records with discharge dates greater than 365 days after the discharge date for the index surgery.

Methods Used to Define Travel Time

To assess the importance of geographic proximity to a radiation treatment facility, the location of all cancer centres in Canada (from 2007–2008 to 2009–2010) was used to gauge travel time from each patient's residence at the time of her index procedure to the closest cancer centre that has a radiation facility that was open at the time of the initial index procedure.

Patients and cancer centres were mapped (geocoded) using postal codes, with latitude and longitude (lat/long) derived from Statistics Canada's Postal Code Conversion File (PCCF+) Version 5G, which provides automated geographic coding.

- 11,330 patient postal codes received lat/long and were included in the travel time analysis.
- 64 patient postal codes were deemed "improbable residence" and did not receive lat/long from the PCCF+.
- All 41 cancer centres were included in the analysis.

The proximity analysis was performed using the closest facility feature of the Network Analyst extension of Esri's ArcGIS 10 software program. This feature can calculate travel time for a set of origins (patient residence) and the closest destinations (cancer centre), with travel time being a function of posted speed limit and road length. Parameters used for the calculation of travel time included the following:

- A 2 km threshold was used to eliminate patient lat/long that could be slightly inaccurate. If accurate, they should be near an existing road network.
- The road network data used was produced by Statistics Canada, current as of 2010. Speed limit assignments were carried out by Earth-To-Map GIS Inc., a geographic information system (GIS) consulting company located in Ottawa.
- Travel time results were reported in minutes; distance was reported in metres.
- U-turns were enabled at all road junctions.
- A Lambert conformal conic projection was used for the analysis. This projection's strengths include preserving distance and direction relationships, which is important for this type of analysis.

Travel times were generated for 11,073 out of 11,330 patient postal codes. Thus, 257 patients' postal codes could not be used to estimate a travel time to the nearest cancer centre.

- Of the 257, 71 were unlocated (that is, further than 2 km from a road network) and 186 were located but were not near a complete road network-based route to a cancer centre.
- For the 11,073 cases for which travel time could be estimated, about 15 results were randomly selected and checked against Google Maps, some with long travel times and some with short travel times. Most Google Map estimates were quite close to the results obtained using ArcGIS Network Analyst. Those that varied were found to be a result of differences in lat/long associated with the patient postal codes or differences in road speed assignments. For example, in some cases Google Maps may have used a speed of 80 km/h for certain road segments, whereas the ArcGIS software used a travel speed of 60 km/h.

Appendix D: Index and Final Procedure Rates, by Province

Table D1: Mastectomy and BCS Among Women With Unilateral Invasive Breast Cancer and DCIS, Index Versus Final Procedure

Index Procedure												
		B.C.	Alta.	Sask.	Man.	Ont.	Que.	N.B.	N.S.	P.E.I.	N.L.	Canada
Unilateral Cancer	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
DCIS	BCS	1,110	329	151	197	2,428	1,417	110	194	20	74	6,036
	Mastectomy	150	175	66	59	480	145	27	42	5	40	1,191
	Total	1,260	504	217	256	2,908	1,562	137	236	25	114	7,227
Final Procedure												
		B.C.	Alta.	Sask.	Man.	Ont.	Que.	N.B.	N.S.	P.E.I.	N.L.	Canada
Unilateral Cancer	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
DCIS	BCS	872	264	119	168	2,087	1,304	89	163	9	38	5,119
	Mastectomy	388	240	98	88	821	258	48	73	16	76	2,108
	Total	1,260	504	217	256	2,908	1,562	137	236	25	114	7,227

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.

Sources

Hospital Morbidity Database and National Ambulatory Care Reporting System, Canadian Institute for Health Information; Alberta Ambulatory Care Reporting System, Alberta Health and Wellness.

Appendix E: Adjusted Provincial Mastectomy Rate

A logistic regression model was estimated for the mastectomy rate using all eligible cases for women in Canada, excluding residents of Quebec and the three territories.^{xiv} Age group, neighbourhood income quintile and travel time to the closest cancer centre were specified as important factors that were expected to influence mastectomy rates and that could be computed from available data. The overall effect of each of the three variables in the model significantly improved the model fit. The regression coefficients for the overall model are presented in Table E1.

Table E1: Analysis of Maximum Likelihood Estimates

	Estimate	Standard Error
Intercept	-0.3216	0.0281
Travel Time 40–89	0.2403	0.0264
Travel Time 90–179	0.4405	0.0318
Travel Time 180+	0.6352	0.0366
Age Group 50–59	-0.3643	0.0298
Age Group 60–69	-0.3745	0.0297
Age Group 70+	-0.0282	0.0287
Income Quintile 1	0.2429	0.0338
Income Quintile 2	0.1792	0.0319
Income Quintile 3	0.1285	0.0309
Income Quintile 4	0.0775	0.0301

Predicted mastectomy was calculated for each patient using the regression coefficients from Table E1. Predicted mastectomies were averaged across each province's eligible patients to yield a provincial predicted mastectomy rate. Adjusted mastectomy rates were calculated for each province using this formula:

$$\text{Adjusted Mastectomy Rate} = (\text{Crude Mastectomy Rate} / \text{Predicted Mastectomy Rate}) \times \text{Canada Crude Rate}$$

The Canada adjustment factor normalizes the provincial adjusted mastectomy rate to the Canada average mastectomy rate. This method of calculating an adjusted mastectomy rate for provinces takes into account variations between provinces in age group, neighbourhood income quintile and travel time to closest cancer centre.

xiv. Women for whom age, neighbourhood income quintile and/or travel time could not be calculated were excluded. As a result, crude rates reported in Table E2 differ slightly from those reported in Figure 1.

Table E2: Crude and Adjusted Mastectomy Rates Among Women With Unilateral Invasive Breast Cancer, by Province, 2007–2008 to 2009–2010

	Crude Rate	Adjusted Rate	Canada
B.C.	46%	45%	44%
Alta.	56%	56%	44%
Sask.	65%	60%	44%
Man.	36%	35%	44%
Ont.	38%	39%	44%
N.B.	47%	41%	44%
N.S.	56%	52%	44%
P.E.I.	59%	56%	44%
N.L.	69%	61%	44%

Notes

Data relates to patients who received their index procedure between 2007–2008 and 2009–2010.

Excludes data for residents of the three territories and Quebec.

Adjusted rates control for age group, neighbourhood income quintile and travel time to closest cancer centre.

Crude rates in this table differ from those presented in Figure 1 due to calculations of denominators for each province included in the analysis.

Sources

Hospital Morbidity Database and National Ambulatory Care Reporting System, Canadian Institute for Health Information; Alberta Ambulatory Care Reporting System, Alberta Health and Wellness.

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