UNIVERSITY OF CALGARY

Treatment of Ductal Carcinoma In-Situ (DCIS): Evaluation of a Multidisciplinary Disease Specific Approach

by

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A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF SCIENCE

DEPARTMENT OF COMMUNITY HEALTH SCIENCES

CALGARY, ALBERTA

MAY, 2005

THE UNIVERSITY OF CALGARY

FACULTY OF GRADUATE STUDIES

The undersigned certify that they have read, and recommended to the Faculty of Graduate Studies for acceptance, a thesis entitled "Treatment of Ductal Carcinoma In-Situ (DCIS): Evaluation of a Multidisciplinary Disease Specific Approach" submitted by May Lynn Quan in partial fulfillment of the requirements for the degree of Master of Science.

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Abstract

Objective: To apply a structure process and outcome framework of measuring quality to evaluate the effect of a formal multidisciplinary clinic approach to the treatment of ductal carcinoma (DCIS) in Alberta.

Methods: A population based retrospective chart review of women with a new diagnosis of DCIS from January 1, 1999 to December 31, 2000 was performed to determine quality indicators and adherence to clinical practice guidelines (CPGs) in a cohort with access to a formal, multidisciplinary DCIS clinic and in a cohort that did not. A Delphi process of consensus was undertaken to select quality indicators in treatment of DCIS.

Results: There was a trend towards improved adherence to CPGs in the DCIS clinic population. The radiation oncology referral quality indicator was improved in the DCIS clinic cohort.

Conclusion: The structure, process and outcome framework to measure quality of care can be used to evaluate treatment of DCIS in Alberta using defined process outcomes.

Acknowledgments

I would like to acknowledge the support of the Departments of Surgery at the Foothills Medical Centre in Calgary, Alberta and at Sunnybrook & Women's College Health Sciences Centre in Toronto, Ontario for their support and encouragement during my work on this thesis.

I would like to thank Bill Ghali and Peter Craighead for their encouragement and assistance in broadening my scope of thinking on this project and their help in guiding me towards its completion. I would like to thank and acknowledge the support of my supervisor Heather Bryant who provided excellent guidance and direction in the shaping of this thesis, as well as providing additional insight into the research process and my personal learning along the way.

Finally, I would like to acknowledge the financial support of the Alberta Cancer Board, the Community of Health Sciences Department and the School of Graduate Studies that I have received during my master's program.

Dedication

To my husband Rob,

whose support, advice and patience made completing this project possible.

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I. INTRODUCTION

1. Overview

Measuring the quality of health care has become increasingly relevant in an era of evidence based medicine and accountability not only to patients, but to policymakers, government and health care providers alike [1]. In 1990 the Institute of Medicine defined quality in health care as "the degree to which health services for individuals and populations increase the likelihood of desired health outcomes and are consistent with current professional knowledge"[2]. A series published in the New England Journal of Medicine in 1996 highlighted some of the issues surrounding the assessment of quality in health care. How is good quality of care defined? What are strategies that can be used to improve quality of care? Once implemented, how can changes in quality be measured? [1, 3-6]. Nearly a decade later these questions are still relevant as physicians and health care providers struggle to synthesize the best available evidence from the literature and incorporate it into their daily practice in an attempt to provide the best possible care to their patients. While strides are being made, the development of methods by which to measure the quality of health care is a process in evolution [3].

The assessment of quality in the care of patients with breast cancer has unique challenges due in part to the heterogeneity of the disease process as well as the multidisciplinary approach to its treatment. Approximately 30% new breast cancer cases detected by screening mammography will be of ductal carcinoma in situ (DCIS), a premalignant lesion of the breast that exhibits variable biologic behaviour[7]. Measuring

quality in the delivery of care for women with DCIS poses inherent problems due to its distinctively different clinical behaviour when compared to invasive breast carcinoma. Studies examining the treatment of DCIS have revealed wide regional variations in practice patterns that are not infrequently at odds with what is considered acceptable good practice [8].

The treatment of DCIS provides an example of a common entity for which measures of quality are not well described and definitive standards supported by evidence are not available. As a result, the evaluation of any strategies used to improve the quality of treatment in DCIS is complicated by the lack of established tools with which to measure it. Before quality of care can be assessed, a framework and definition of the outcomes of interest need to be developed.

2. Background and literature review

A. Treatment of ductal carcinoma in situ (DCIS)

Ductal carcinoma in situ (DCIS) of the breast is a proliferation of malignant ductal cells limited to existing ductal and lobular units without invasion through the basement membrane [9]. Initially believed to be an entirely benign entity with no malignant potential, women who were found to have this lesion on biopsy did not undergo further treatment and were simply observed. In a classic biopsy study by Page et al. [10, 11] 25 women with an incidental finding of low grade DCIS on biopsy were observed untreated for an average of 20 years. Approximately 30% of the women developed an invasive breast cancer after 3 to 30 years of follow up, with 60% of these

women developing distant metastases after treatment with mastectomy. Other biopsy studies evaluating lesions of varying nuclear grade have found similar results, suggesting that all grades of DCIS have a significant risk of malignant transformation to invasive breast cancer [12, 13].

In contrast, autopsy studies of women who were not known to have had breast cancer while they were alive revealed DCIS in 0.2 -18% of cases [14, 15]. These findings would suggest that some DCIS lesions do not behave aggressively and are unlikely to ever become an invasive breast cancer in some women. It is now known that DCIS is a premalignant, non-invasive lesion of the breast, with diverse biologic behaviour and varied risks of subsequent recurrence and invasive transformation [9, 16]. The unpredictable natural history of the lesion has resulted in the treatment of DCIS being among the most controversial areas in the treatment of breast cancer today [17, 18].

Complicating the issue is the lack of pathologic standardization [19]. While no universally accepted classification system exists presently, DCIS has conventionally been described by the presence or absence of comedo type necrosis, the degree of nuclear atypia (nuclear grade) and its morphologic subtypes; solid, cribiform, micropapillary and papillary [19]. Holland et al.[20] and Lagios [21] developed two of the classifications schemes that are commonly used in daily practice. These highlight the importance of the presence or absence of necrosis and the nuclear grade in predicting biologic behaviour and prognosis. In addition, studies have shown that lesions treated with lumpectomy (with or without radiation) that have certain pathologic characteristics such as necrosis and high nuclear grade have a greater tendency to recur [22, 23]. In spite of these markers

of more aggressive disease, the ability to identify with accuracy those at greatest risk of recurrence and invasive breast cancer remains imperfect.

Historically DCIS was an uncommon lesion detected clinically as a palpable mass, bloody nipple discharge, or Paget's disease of the nipple, comprising less than 2% of all breast cancers [7]. Simple mastectomy was the treatment of choice as it provided excellent long term local control with recurrence rates ranging from 0 – 4% [24]. In parallel during the same time period, mastectomy and axillary node dissection for the treatment of invasive breast cancer was considered standard of care [25].

The introduction of screening mammography over the last two decades has dramatically increased the incidence of DCIS through detection of subclinical lesions manifesting as non palpable microcalcifications, resulting in a 200% increase in incidence from 1983 to 1992 [7]. DCIS now accounts for 12 – 15% of all new breast cancers and approximately 30% of breast cancers detected by mammography in both the United States and Canada [7, 26]. It is unclear whether these lesions detected by mammography behave in the same biologic fashion as their clinically detected counterparts.

The transition from mastectomy and axillary lymph node dissection to breast conserving surgery (BCS) followed by radiotherapy for the treatment of invasive breast cancer has prompted use of the same strategy in the treatment of DCIS. Two large multicentre randomized controlled trials conducted in North America and Europe both recently reported 20 year follow up data on the equivalency of treatment between mastectomy and BCS followed by radiation for invasive breast cancer with respect to

mortality in North America and in Europe (OR 0.97; p=0.74 and 24.3% vs, 26.1%; p=0.8) [27, 28]. Evidence from these trials has provided support for the use of BCS followed by radiation for those eligible women with invasive cancer who elect to preserve the breast. It is now considered standard that women should be offered the choice of BCS for treatment, provided that the margins of the resected specimens are free of tumour and an acceptable cosmetic result can be obtained [29, 30].

No prospective randomized controlled studies have directly compared breast conservation to mastectomy in DCIS. Data from retrospective series found no difference in survival between mastectomy and BCS followed by radiotherapy, in spite of significant differences in local recurrence (98% vs 81%, p = 0.0004) [31]. Other studies have shown that DCIS has a risk of mortality of 1.6 – 1.9% after 8 – 10 yrs following treatment [22, 32]. These non randomized data collectively support treatment of DCIS with BCS, providing good local control with equivalent survival. BCS should be offered to women with DCIS as a treatment option given the very low mortality rate and the lack of additional benefit with more aggressive therapy. Mastectomy in DCIS should be used in lesions not amenable to BCS such as multicentric disease, large lesions precluding good comesis with BCS, or a personal preference for mastectomy.

Large randomized controlled trials in DCIS have compared treatment with BCS alone to BCS followed by radiation [22, 33]. Overall these trials have demonstrated a decrease in the local recurrence rates by 50%, the greatest benefit being seen in those patients with high grade lesions and positive margins. A meta-analysis of patient, tumour and treatment factors as predictors of local recurrence found that having a positive

margin, a high grade tumour or the presence of necrosis was predictive of higher local recurrence rate. These patients were more likely to benefit from radiotherapy after breast conservation [34]. Results from these studies has lead to the recommendation that all women undergoing BCS for the treatment of DCIS should have clear surgical margins, and then undergo radiation to the breast to minimize recurrence, particularly in lesions marked by the presence of necrosis or that are high grade.

There are two large randomized controlled trial studies that have examined the effect of tamoxifen on further reducing the risk of recurrence after BCS and radiotherapy for DCIS [35, 36]. The benefit of adding tamoxifen was small but significant in the NSABP 24 [35] study (11.1% vs 7.7%, p= 0.04) with the greatest reduction seen in those with positive margins. This study has elicited the criticism that tamoxifen should not be used in place of inadequate surgery. In addition, side effects of tamoxifen included increased incidence of thromboembolic events and endometrial cancer. The United Kingdom Coordinating Committee on Cancer Research (UKCCCR) randomized controlled trial evaluated women with negative margins only, and found no benefit with the addition of tamoxifen [36]. The discrepant results in these trials has led to the recommendation that women be given the option of taking tamoxifen following definitive surgical management.

More recently, retrospective series have suggested that low risk lesions with sufficient margins are adequately treated with wide excision alone [37]. Silverstein et al. have developed the Van Nuys prognostic index to predict which women would be most likely to benefit from the addition of radiation after BCS. A retrospective analysis of

their experience identified pathologic grade, the presence or absence of necrosis and margin status as the key determinants of prognosis [37]. A recent update to the index suggested that margin status alone is highly predictive of local recurrence and that lesions resected with margins greater than 10mm gain no benefit from radiotherapy [31]. This data has suggested that BCS in low grade lesions with no evidence of necrosis and with margins of greater than 10 mm may not require radiotherapy. Some consider omission of radiotherapy after BCS acceptable provided that the low risk conditions are met. It is important to note that the Van Nuys prognostic index has not been prospectively validated.

DCIS is a noninvasive lesion with no potential for spread to axillary nodes [7]. As such, there is no role for axillary node level I/II dissection in its treatment. The role of sentinel node biopsy in DCIS where the suspicion of invasion is high (such as large lesions requiring mastectomy, palpable lesions and those with suspicious pathology) continues to evolve. It has been accepted that routine axillary staging of any sort is unwarranted in pure DCIS [38, 39].

Over the past two decades, DCIS evolved from an uncommon entity treated exclusively by mastectomy to a much more commonly detected lesion with the advent of screening mammography. Decisions about the appropriate management of the disease are complicated by the fact that no treatment regimen has been clearly demonstrated to offer a survival advantage and the inability to accurately predict which lesions will recur in an invasive manner.

In spite of the above, there is some guidance from clinical trials. To summarize,

treatment of DCIS with BCS requires attainment of clear surgical margins and acceptable cosmetic result. Radiation therapy has been shown to reduce the risk of recurrence in all patients, although there is some non prospective evidence supporting omission of radiation if the lesion is small, has low nuclear grade and no necrosis. Radiotherapy should not be omitted in cases with factors associated with local recurrence such as high nuclear grade and necrosis. Mastectomy is warranted in lesions that are not amenable to BCS due to large size precluding acceptable cosmesis or multicentricity, a failure to obtain clear margins on repeated attempts at BCS, or a personal preference by the patient. There is no role for axillary dissection in pure DCIS, although staging with sentinel node biopsy in lesions at high risk for invasive breast cancer is controversial. Also controversial is the addition of tamoxifen after BCS with or without radiotherapy. Overall, management of DCIS should avoid overtreatment with unnecessary surgery and undertreatment of disease characterized by factors known to be associated with higher recurrence.

B. Variations in the treatment of DCIS

Population based studies have found wide variations in the management of DCIS, which in part is expected due to the array of treatment options [8, 26, 40-43]. Although some variation is expected as a result of differences in judgment and preference, the wide variation in treatment patterns may also reflect treatment choices that fall outside the realm of accepted practice. Five studies have used population based data to document the patterns of variation in treatment and to look at rates of certain treatments such as

mastectomy and radiation after lumpectomy. In addition, predictors for overtreatment (ie. use of axillary dissection) and undertreatment (ie. BCS alone for high risk lesion) of DCIS were examined.

a. Baxter, N et al. 2004

Given the rising incidence of the DCIS and concerns about overly aggressive treatment, Baxter et al. [8] looked at the rates of mastectomy, radiation therapy after lumpectomy and axillary node dissection (AND) to evaluate the use of surgery and radiation therapy in the treatment of DCIS. A review of the Surveillance, Epidemiology and End Results (SEER) database was undertaken to identify women 18 years of age or older diagnosed with any histologic type of in situ carcinoma of the breast from January 1, 1992 to December 31, 1999. Patients with lobular carcinoma in situ (LCIS) alone, evidence of microinvasion or prior history of malignancy were excluded. A total of 25,206 patients met inclusion criteria and were evaluated in the study.

Data collected included patient characteristics, primary tumour site, morphologic features, stage at diagnosis, first course of treatment and follow up for vital status. Treatment was coded as the most invasive within the first year of diagnosis, therefore those having had initial lumpectomy followed by mastectomy would have been recorded as having had mastectomy.

Rates of mastectomy and AND were calculated as a proportion of the total number of DCIS cases. Radiotherapy rates were calculated as proportion of the total number of lumpectomies performed. Logistic regression was then used to evaluate if

mastectomy, radiation therapy or AND was dependent on tumour size, comedo histology, race, age, year of diagnosis and geographic location.

The study found that those patients who were younger with comedo necrosis histology and tumours > 1 cm were more likely to undergo mastectomy ($p < 0.001$) which would be considered reasonable given the higher rates of local recurrence seen in patients with these prognostic factors. The proportion of patients that chose mastectomy is unknown, therefore it is difficult to identify the number that were necessary compared to those that simply reflect patient preference. Rates of radiation after lumpectomy rose significantly from 45% in 1992 to 54% in 1999 ($p < 0.001$), which is in accordance with evidence that radiotherapy decreases local recurrence. However 33% of patients with comedo necrosis in 1999 did not undergo radiation therapy after lumpectomy. The lack of radiotherapy in this group with higher risk of recurrence represents undertreatment of disease. Multivariate modeling found patients with larger tumours and comedo necrosis were more likely to have radiation therapy than those with smaller tumours and no comedo necrosis (OR 2.15, 95% CI 1.94 to 2.36) which is in accordance with evidence. The rates of axillary node dissection decreased over time, but occurred in 15% of patients in 1999; a number which is higher than expected given that guidelines were published during that time period recommending against AND in DCIS. Mastectomy was a strong predictor of AND, which had also declined during the same time period. The use of AND in DCIS that required mastectomy due to tumour factors may have explained the high rates, however none of these tumour factors were significant predictors of mastectomy on multivariate analysis.

Interestingly, geographic location by cancer registry was predictive of breast conserving surgery, radiation after lumpectomy and axillary node dissection on univariate and multivariate analysis (all $p < 0.001$), independent of tumour and patient characteristics. The authors hypothesize that factors such as underlying practice patterns of individual surgeons or institutions may play an important role. More than 50% of lesions were excluded from the analysis due to lack of reported grade and 30% of lesions lacked tumour size reporting. This represents a major limitation of this study. Although multivariate analysis demonstrated no difference with the inclusion and exclusion of tumour grade as a predictor, interpretation of the overall results is difficult given that size of the tumour is known to be influential to determining eligibility for breast conserving surgery (BCS) and need for mastectomy. In addition, lack of information on tumour grade and margin status may potentially confound results.

Treatment location characteristics such as community versus academic setting, rural versus urban etc. which may influence treatment choices as well as knowledge of patient preference for treatment were unknown and may potentially be predictive factors. This study did however provide some evidence that variation does exist and supports the need for further research into other influential factors that are not available from registry data.

b. Ernster, V et al. [26]

This study was similar to that of Baxter et al. in that it used the SEER database to describe changes in the incidence of DCIS in a cohort of patients during the period from

1973 to 1992. Treatment data was only collected from 1983 onward. The proportion of patients treated with mastectomy was found to decline during the study period from 71% in 1983 to 43.8% in 1992, which is in keeping with the trend towards BCS during that time period. Marked geographic variation was also seen in this study with mastectomy rates ranges from 28.8% in Connecticut to 57.7% in New Mexico in 1992.

This study is limited by its descriptive nature and lack of adjustment for important predictive factors. The finding of treatment variation by geographic locale without controlling for factors known to influence treatment choices, such as tumour characteristics, local treatment characteristics and other potential confounders, makes interpretation of the authors findings impossible. This study provides no insight to the reasons for variation in treatment, but does provide evidence that the variation is longstanding given Baxter et al.'s findings using the same database in 1992 –1999. These findings support the need for further research to determine the reasons for the variation in treatment practices.

c. Taffet Gold, H & Dick, A.

Taffet – Gold et al. [40] identified women aged 65 or older in the SEER database who had a diagnosis of DCIS from 1991 to 1996. They attempted to identify the factors that explain treatment choice (mastectomy, breast conserving surgery (BCS) alone and BCS with radiation). Predictive factors analyzed from SEER data included geographic region, marital status, age, race, with the addition of poverty level, education and rural status obtained from linked census data and physician claims and matched to SEER –

Medicare data (available for patients over 65). The number of radiation oncologists per 100 000 population was also evaluated as a potential predictive factor, one of three studies to include any provider characteristics in the analysis.

Analysis of treatment type by geographic region was assessed using chi square methods and multivariate modeling was employed to identify factors that predicted treatment (BCS alone, BCS with radiotherapy and mastectomy)

The multivariate model found that BCS alone compared to BCS with radiotherapy was predicted by geographic area, year, marital status, age and percent rural population. The authors found that increasing age was predictive of BCS alone, and mastectomy was more likely in women who were not Caucasian, living in a zip code with lower education levels or in areas with a large rural population. The results were presented by the authors in tables listing the beta coefficient, standard error, p value and 95% CI for each of the covariates controlled for by treatment strategy which made the results confusing to interpret clinically.

This is the first study to included SES status, demonstrating a difference that should be further explored.

d. Kotwall, C et al.

This study by Kotwall et al. [43] evaluated rates of BCS and assessed patient and surgeon factors associated with treatment choices. Data from a single institution's database in North Carolina were analyzed on 211 women diagnosed with DCIS from 1990 to 2000 and compared with data from the Nationwide Inpatient Sample (NIS).

Patient age, race, tumour palpability, insurance status and surgeon's year of graduation from medical school were analyzed to see if they predicted a higher likelihood of BCS. Chi square methods was used for categorical variables, student's t test was used for continuous variables. None of the factors analyzed were significant predictors of the likelihood of BCS. Institutional data was then compared with NIS data showing a lower rate of BCS in the NIS cohort (19.9% vs 54.6%). However, no statistical analysis was reported for this comparison.

Limitations of this study included potential selection bias in the comparison population using the NIS database, as it only captures inpatient cases. The NIS data was likely to underestimate the number of BCS cases as these are done predominantly as outpatient procedures. In addition, confounding based on histologic tumour factors such as size, grade and presence of necrosis were not adjusted for.

e. Verkooijen, H et al. [41]

This was a small study of 116 patients with DCIS identified from the Geneva Cancer Registry from 1995 – 1999. Variables included method of diagnosis, tumour size, histologic grade, social class, private or public system and the "experience" of the private surgeon based on caseload. BCS was performed in 78% of patients. Factors associated with use of BCS on multivariate analysis were tumour detected by mammography, non central breast location of tumour and smaller tumour size. These findings are congruent with evidence that BCS is a reasonable option in small tumours allowing for acceptable cosmesis. This was the only study to evaluate location of tumour and found that tumours

that were non central were predictive of BCS. The loss of the nipple areola complex and poorer cosmetic result associated with central tumours may play a role. Axillary dissection was performed in 15% of patients with method of tumour detection and tumour multifocality predictive of axillary node dissection on multivariate analysis. Interaction between mastectomy, the method of tumour detection and multifocality was not examined and may have been significant given that palpable tumours and those that are multifocal often require mastectomy, and that the rate of axillary dissection in mastectomy tends to be higher. This may reflect surgeon concerns regarding occult invasive disease.

The major weakness of this study was the sample size, making it underpowered to detected all but large differences. In addition, the authors do not report the rate of missing data rate for their variables, which may also influence analysis. The findings suggest that tumour characteristics are important predictors of treatment choices, and reinforces the need to adjust for these covariates in future research.

These 5 population based studies examined treatment patterns in DCIS and found consistently wide variation in the use of mastectomy, AND, and the rates of radiotherapy after BCS. All of the studies found variation by geographic location, however the majority of studies lacked complete tumour characteristic information and treatment site information that may have confounded the results. Further research is required to tease out the predictors of treatment choices while controlling for factors that are known to influence them.

C. The introduction of a multidisciplinary DCIS clinic in Alberta

Recognition of the variation in the treatment provided to women with DCIS in southern Alberta, and the lack of a formal mechanism for their assessment at the regional cancer centre prompted the development of a disease specific multidisciplinary DCIS clinic at the Tom Baker Cancer Centre (TBCC) in Calgary, Alberta. An audit performed of patients with DCIS in the TBCC catchments from 1974 to 1993 found a decline in the rate of mastectomy from 86% from 1974 – 1983 to 33% from 1986 – 1993. It also showed an increased use of BCS as recommended during that time, however also revealed that 67% of those having BCS did not have radiotherapy. In addition, only 50% of patients with a diagnosis of DCIS were being referred for a radiation onocology consultation at the TBCC [44].

The primary objective of the clinic was to provide improved access to multidisciplinary, comprehensive care for women with DCIS, to improve general knowledge among patients and referral physicians on current clinical practice guidelines (CPGs) and ultimately to improve the treatment of women with DCIS. In 1999, the clinic opened at the TBCC and was run by radiation and surgical oncologists, a pathologist, a radiologist and nurse practitioners who had special interest and expertise in treating women with DCIS.

All diagnoses of cancer are reported to the Alberta Cancer Board and are documented in the Alberta Cancer Registry. In this way, incident cases of DCIS diagnosed in the province are captured in the registry based on histologic diagnosis.

From the registry, each woman with a new diagnosis of DCIS residing in southern Alberta and the catchment area serviced by the TBCC was identified. A letter was sent to her primary care physician explaining the concept of the clinic and inviting the patient to attend for assessment and treatment. All women with an incident case of DCIS in the TBCC catchments area had a mammogram and film review, as well as a pathology review with the members of the team during a clinic meeting without the patient present. The patient was then generally seen in clinic in consultation by the radiation oncologist, with the surgical oncologist in attendance if needed in addition to the nurse practitioner.

The clinic was run on a biweekly basis at the TBCC until 2001. No similar clinic existed in the CCI catchment area servicing northern Alberta during the same time period. Although patients could be referred for assessment by a radiation or medical oncologist at the primary physician's request, no specific notification or invitation was mailed to women with a new diagnosis of DCIS and treatment was carried out with no formal organization. Similarly, pathology and film review could be provided at the consulting oncologist's discretion, but no formal review was performed as a matter of routine.

The DCIS clinic altered the process through which patients interacted with the treating physicians through a number of methods; each women in the catchment area was invited to attend the clinic specifically on a population basis – without relying on a referral from her surgeon or primary care physician, all patients had a multidisciplinary review of their case with experts in the field before the clinic appointment and, the results of the consultations were presented to the patient at one time. The characteristics of the providers

were changed to those with a special interest or expertise in the treatment of DCIS.

While the clinic was felt to be a success by those who provided services to the DCIS clinic, whether or not the goal of improving the quality of treatment for women with DCIS was attained based on objective criteria is unknown. Part of the problem in determining the effect of such a formal, organized clinic is the lack of objective measures with which to judge improvement.

D. Multidisciplinary clinics in breast cancer care

Although there is enthusiasm for treatment of breast cancer by a multidisciplinary team in a "under one roof" or "one stop shop" concept [45, 46], there are no studies to support a particular model of multidisciplinary care or addresses ways in which it could be implemented effectively. There are two studies looking at multidisciplinary clinics in breast cancer and their effects on limited outcomes, which provide an example of the kind of descriptive research published in this area.

a. Gabel et al.

Gabel et al. [47] studied the impact of a multidisciplinary breast cancer clinic on timeliness of treatment and patient satisfaction. A retrospective cohort study was performed comparing data from patients who attended a multidisciplinary breast clinic to a control cohort of patients who were treated at the same hospital prior to the clinic's inception. In addition, a patient survey was conducted to determine the level of satisfaction with the treatment process. The study found time to treatment was shorter in

the multidisciplinary clinic, compared with the historical cohort (42.2 days vs 29.6 days, $p < 0.0008$). Patient satisfaction with regards to feeling the consultation helped them reach a treatment decision was significantly greater in the multidisciplinary clinic compared to the historical control group ($p < 0.001$).

No other outcome measures were evaluated with respect to the effect the clinic had on treatment patterns or appropriateness of treatment between groups. The authors suggested that facilitation of referral to all the specialists involved in the treatment process at a common site was instrumental in decreasing time to treatment. Further research in this area is needed as the outcomes measured were limited and the effect of the clinic on the treatment provided was not addressed.

b. Chang et al.

A study by Chang et al. [48] evaluated treatment recommendations provided to women in a multidisciplinary breast cancer clinic who had their initial treatment at an outside institution. The objective of the study was to determine if multidisciplinary clinic consultation had an impact on treatment recommendations. Descriptive analysis of 75 consecutive patients seen at the multidisciplinary clinic was performed comparing the outside treatment recommendation to those made by the clinic team. The multidisciplinary team disagreed with recommendations from the outside physicians in 43% of cases, 17% of which were patients with DCIS. Almost 50% of recommendations were for breast conserving surgery where mastectomy had been planned by outside physicians. In addition, the physicians providing treatment recommendations from the

multidisciplinary clinic were specifically noted to not use any established guidelines or decision aids, relying on consensus alone.

Limitations of this study included its observational design and small numbers. The population studied was 75 consecutive patients, with a median age of 49, of which 83% were self referred for a second opinion. This population may have characteristics that are different from the average breast cancer patient, resulting in a selection bias of self-referred, younger women seeking a recommendation for BCS.

The outcome measure in this study was unclear. Treatment recommendations made by a multidisciplinary clinic were compared to initial treatment recommendations made by other physicians, finding disagreement 43% of the time. Although the authors implied that the recommendations of the multidisciplinary clinic physicians were the more "appropriate" or "correct" ones, no objective measure was used to judge "appropriateness". Moreover, the authors state that no attempt to use a best practice standard of any sort, such as accepted CPGs in breast cancer, or consensus statements on breast cancer treatment were used in the multidisciplinary clinic, merely the consensus of the multidisciplinary team. Even if the multidisciplinary clinic recommendations truly were more "appropriate" than the outside recommendations, the lack of an objective indicator prevents the reader from knowing if the clinic provided better or worse care. As there was no defined outcome or measure of "appropriateness" for the treatment recommendations, the only plausible interpretation of the findings in this study is that the multidisciplinary clinic experts differed in opinion from other experts at other outside institutions.

Another possible outcome measure is treatments the patients actually had after their consultation at the multidisciplinary clinic. Although different treatment recommendations were made in 43% of patients, it is unknown whether they proceeded with the new recommendations from the multidisciplinary clinic. Collection of this information would have made results from the study more interpretable.

These two studies highlight some of the challenges physicians and health care providers face in evaluating what impact a purposeful intervention such as a multidisciplinary cancer clinic has on objective measures in the quality of care. A definition of what outcomes are being measured is needed so that useful comparisons can be made. In the study by Chang et al., evaluation of a defined outcome may have assisted in determining whether or not the multidisciplinary clinic model actually changed care. Another step would have been to define objective criteria by which "improved" could be evaluated, such as quality indicators specific to the care of women with breast cancer.

Although the need for quality indicators in oncology has been recognized, the development of specific indicators for common disease processes is still in evolution [49, 50]. The challenge of measuring improvements in health care will continue until defined measures are established and are widely available.

E. Measuring quality in health care

Global outcomes such as mortality and infection rates have long been used by hospitals and health care administrators as a measure of quality [3]. While providing objective and simple measures of the ultimate result of care provided to patients, no

information regarding the processes that resulted in death or infection can be ascertained from such measures. A framework for the measurement of quality is needed to help define the relationships between the components that result in the outcome of interest, such as death or recurrence of cancer.

Donabedian proposed the concept that quality in health care can be measured on the basis of structure, process and outcomes over 20 years ago [51]. Structure variables refer to characteristics of health care providers and the health care system. Common structure variables include characteristics such as specialist certification or hospital teaching status [52, 53]. Structure variables in the context of the treatment of cancer and DCIS could be care through an organized multidisciplinary DCIS clinic or care by physicians who do not work within a formal organized clinic designed to specifically see only women with DCIS.

Within this framework, measures of process and outcome can be stratified by structural variables. Credibility of criteria based on structural data relies on the premise that variations in the attribute it is measuring lead to differences in outcome [3]. For example, in the structure variable clinic status, presence or absence of the clinic must be related to an outcome, like local recurrence. If the attribute that clinic status is measuring is the formal organization of specialist physicians providing multidisciplinary care, then evaluation of clinic status would reflect the effect of such organized care on local recurrence, or some other outcome of interest.

Outcome variables reflect the impact on the health status of the patient or population on clinical variables [3]. Crude measures of outcome in oncology include

mortality and local recurrence rates of cancer. The use of other clinical outcomes as intermediate measures are often used in lieu of such final outcomes as they occur with higher prevalence and can be measured prior to the event occurring [54]. The mortality from DCIS is a rare occurrence and while local recurrences rates are not negligible, they may not occur for many years, making such outcomes impractical to use. Studies have shown that adherence to evidence based clinical practice guidelines (CPGs) does influence outcomes [55], which provides support for the case to use adherence to CPGs as an intermediary measure.

Most commonly used in assessment of quality are measures of process. Process variables or quality indicators include the subjective and objective experiences of patients as they interact with members of the health care team. Ultimately, alterations to processes that are under the control of health care providers should influence outcomes [3].

The most established quality indicator in oncology is mammography screening rate [54]. Screening mammography has been shown to reduce mortality from breast cancer [56], therefore measure of the steps throughout the process leading to a successful screening program can be performed to ensure a screening program is on the right track [57].

Aside from mammography screening program quality indicators, there is a recognized lack of established quality indicators in oncology [54]. Currently quality indicators in breast cancer are being developed [54, 58], however there are no established quality indicators in DCIS. Proposed indicators in invasive breast cancer include the

rates of use of services or treatments, such as rates of chemotherapy. In the treatment of DCIS, an example of a potential quality indicator could be documented discussion around treatment with tamoxifen, for which there is some evidence that it reduces local recurrence [35].

A criticism of process measures is that selected quality indicators do not reflect appropriateness of care [54]. Use of adherence to evidenced based CPGs may also function as an advanced process measure which takes into account appropriateness of care based on accepted practice standards.

The premise of Donabedian's model is that modification of structure and process variables will ultimately result in improvement in patient outcomes. Applying the model to the treatment of women with DCIS would suggest that altering the current structure of care would result in process change and eventually patient outcomes, both directly and indirectly through changes in process. (see figure1)

Applying the structure, process and outcome model to treatment of DCIS in Alberta, the structural change is the introduction of a formal, organize, population based access to a multidisciplinary DCIS clinic located in a tertiary care, academic facility, staffed by specialists with expertise and interest in treatment of women with DCIS. The effect of the clinic on process can be measured using quality indicators in the treatment of DCIS, if they were available. Finally, adherence to CPGs in the treatment of DCIS can be an intermediary measure of outcomes, or, an advanced process measure of appropriateness of care.

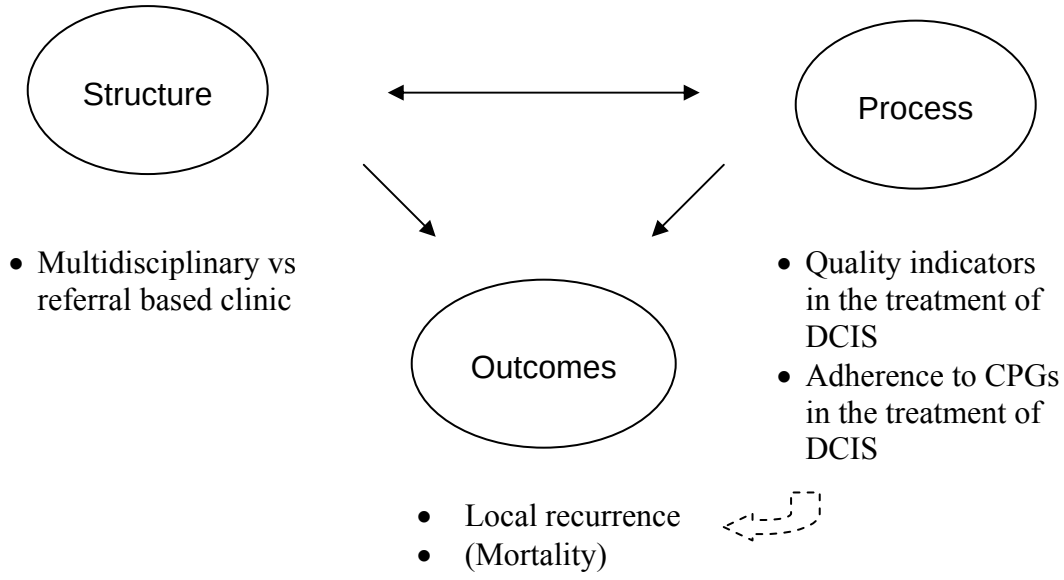

Figure 1. The relationship between structure, process and effects on outcomes based on Donabedian theory using treatment of DCIS as a model.

F. Measures of quality – using quality indicators

The ability to measure the effect of a new multidisciplinary DCIS clinic on the quality of treatment provided to women with DCIS can be done by assessing process variables in the treatment of DCIS. The assessment of process variables can be performed using explicit criteria that are defined a priori that would be considered good quality of care [3]. One method is the use of pre defined "quality indicators" that would be considered good or appropriate care. The presence or absence of that quality indicator would then be measured as a proportion of all the patients who are being treated.

In the treatment of DCIS, a quality indicator, such as having a documented discussion around the use of tamoxifen would be decided upon as being criteria for good

quality care. The chart would then be reviewed to determine if such a discussion was documented. The number of patients who had documented discussion around tamoxifen as a proportion of all the patients treated would be used to then provide a benchmark against which comparisons within the practice or between practices can be made.

$$\text{Quality indicator: documented discussion around tamoxifen} = \frac{\text{\# patients having discussion}}{\text{total \# of patients treated}}$$

In the case of DCIS in Alberta, the proportion of patients who had a documented discussion around tamoxifen with access to the multidisciplinary clinic in the TBCC DCIS catchments can be compared to the same proportion of patients in the CCI catchments who did not have access to the DCIS clinic. Alternatively, if a value is set as the ideal proportion of patients who should have had the documented discussion, such as 90%, then measurement of the quality indicator can be made against an explicit ideal.

The development of quality indicators in health care is an evolving process and the subject of ongoing discussion and research [3, 54, 59, 60]. A lack of defined quality indicators in the treatment of DCIS contributes to the difficulty in assessing treatment processes. While there has been work on the development of valid quality indicators in the treatment of invasive breast cancer in Canada [58], these generally have not been applied to DCIS due to differences in biologic behaviour. Most variables therefore are selected based on face validity as reasonable measures of the interaction between the health care provider and the patient. Use of variations in rates of treatment is often used as a surrogate of appropriate management in patients with DCIS [8].

G. Development of quality indicators

The consensus method has been used to determine quality indicators in oncology by the RAND Corporation in the assessment of quality in breast, cervical, colorectal and lung carcinoma [61] and more recently in the development of quality indicators in breast and colorectal carcinoma as well as system level performance measures in Ontario [58, 62, 63]. The lack of established quality indicators in DCIS can be addressed by using a consensus method among expert panelists to determine quality indicators in the treatment of DCIS in Canada. The most commonly described methods of consensus are the development conferences, the nominal method, the Delphi process and the modified Delphi process [64].

Consensus development conferences involve a select group of individuals who are provided evidence, such as studies from the literature, by individuals or an organization that is not part of the decision making process. A meeting is held and a consensus statement is then produced through discussion among members who may use a majority vote to resolve unclear items. Consensus meetings have been used to develop and update CPGs in DCIS [65] with success, however requires coordination and organization, skilled moderators, incurs considerable financial costs, especially if members have to travel distances and may require more than one day to resolve issues.

The nominal method of consensus involves a highly structured meeting of experts where each panelist contributes their opinion to group, the group discusses and evaluates each idea which is followed by an anonymous ranking process [66]. The results are presented to the group for discussion, followed by a re-ranking of ideas for the

final consensus. Unlike the consensus method, explicit definitions are made to determine the decisions that are generally mathematical in nature such as the median rank, or the highest average of rankings. The nominal group method has been used in health care and in determining appropriateness of interventions [66], however like the consensus method requires skilled moderators, considerable financial costs, willing participants and organization for a physical meeting.

The original Delphi process is a structured approach for developing consensus and making a group based decision that does not require a physical meeting, rather participants are surveyed by mail over a series of stages that enables each panelist to ”vote” on the issue at hand. The responses are then analyzed and reported back so participants can compare their own responses to those of the overall group. Participants can then re-vote based on the group feedback. A new report is generated and the process is repeated with a modified series of questions until a decision has been reached [64]. This method can be particularly useful for geographically disparate groups of expert individuals who otherwise would be unable to convene without incurring considerable cost and effort.

The modified Delphi process incorporates all of the elements of the Delphi process, with the addition of a panel discussion generally at the end of the voting process to allow interaction among members to reach final consensus [64]. The use of an in person discussion with members of the group can facilitate resolution of topics that have not received strong consensus or are unclear, as well as allow individual members to voice and address concerns arising from the survey process. The disadvantages are

similar to those incurred by the consensus and nominal methods requiring face to face meetings – organization and co-ordination of meeting times and locations among the panel members, and may involve considerable financial cost.

Two examples of using a modified Delphi process to develop quality indicators in oncology have been published. The study by Malin et al. illustrates the RAND criteria for characteristics of a good quality indicator and its use in a broad evaluation of a disesase process from diagnosis to palliation. Gagliardi et al. utilizes a modified Delphi to develop quality indicators specifically to look at surgery in colorectal cancer.

a. Malin et al.

The modified Delphi process has been used to develop quality indicators in oncology (including breast), coronary artery disease, diabetes and HIV by Malin et al. [49] to as part of a larger initiative to compare quality of care across the spectrum of the disease process between managed care facilities in the United States. Draft quality indicators were determined based on the following criteria as previously described by the RAND Corporation [61]:

1) the indicator measures an intervention or treatment with potential health benefits for the patient
2) the indicator is supported by adequate scientific evidence or professional consensus
3) the elements of the indicator are under the control or influence of the health care provider
4) the elements of the indicator is information typically found in the medical record, where absence would be considered poor quality

Nine member panels were assembled using experts nominated from the

appropriate organization relevant to the field, such as the American Society of Clinical Oncology and the American Cancer Society for the cancer panel. A list of quality indicators was generated from the literature and panelists were asked to rate each quality indicator for validity and feasibility based on the above criteria using a 9 point scale. The panelists then met for a two day meeting to discuss the results and re vote on each quality indicator based on feedback from the first vote and discussion amongst the group.

Explicit criteria for inclusion and exclusion were used to drop indicators with substantial disagreement as evidenced by three votes in the 1 – 3 range, or to accept indicators with three votes in the 7 – 9 range. Quality indicators were grouped by type of care (prevention, acute, chronic), function (diagnosis, treatment, follow up) and modality (history, laboratory, radiology) as the overall goal of the selected indicators was to develop an aggregate score across the range of the treatment process.

The authors were able to develop quality indicators using the modified Delphi process over a broad spectrum of diseases, including breast cancer. Limitations of this method include using feasibility of obtaining information on the quality indicator from the patient record, as documentation may not be reflective of care provided. In the example of breast cancer, documentation stating mastectomy vs BCS was discussed may mean a lengthy discussion was engaged regarding the patients specific circumstance, or that it was mentioned that some surgeons perform BCS. This limitation however is forced by the need to use existing patient records as opposed to a prospective collection of information, which is likely reflective of the constraints in the proposed method of obtaining data for quality assessment.

b. Gagliardi et al.

Gagliardi et al. [62] utilized a three step modified Delphi process to establish quality indicators in colorectal cancer surgery in Ontario. A panel of 15 practicing experts who treated patients with colorectal cancer and demonstrated leadership in quality improvement through research, committee membership or administration were nominated by Hospital CEO's and Regional Vice Presidents of Cancer Services in Ontario. The resulting panel consisted of two co-chairs (methodological and surgical), nine surgeons, one medical and one radiation oncologist, one pathologist and one nurse. Forty three percent of the panelists were from one urban centre (Toronto) with the remaining residing around the province.

A literature review was performed to select proposed quality indicators from articles describing colorectal indicators developed by others, or best practice (guidelines, consensus statements, evaluation studies, systematic reviews or meta-analyses). A total of 45 indictors were selected for assessment by the panel. Each panelist received a questionnaire by mail asking them to rate each indicator on a 7 point Likert scale (1 = disagree, 7 = agree), to provide comments and suggest other indicators for consideration.

Results were compiled and provided in a report to the panelists prior to an "in person" meeting to discuss the indicators further. Indicators requiring further consensus were complied for a second round questionnaire, which was also followed by a panel teleconference to discuss the selected indicators. A third round questionnaire was then compiled asking panelists to rank the selected indicators from the previous two rounds in order of importance for improving the quality of cancer surgery. Those indicators

receiving 7 or more votes were considered high priority. A comparison of the 15 final quality indicators determined by the panel was then made to indicators in colorectal cancer as selected by the RAND Corporation, and others.

Some limitations of the study include using a panel with almost 50% of respondents from an urban and academic community (Toronto) that may have biased the panel towards treatment of patients in such a setting. The generalizability of the quality indicators for colorectal cancer care overall may be limited due to the panel selection of predominantly surgeons, however the authors had stated beforehand that they were interested primarily in the surgical aspect of care alone. The survey also took place over the course of one year, which may have limited the momentum obtained from a shorter time frame for panelists to consider previous responses throughout the process.

Overall, the modified Delphi process as outlined in this study was successful in selecting quality indicators relevant to colorectal cancer surgery in Ontario, demonstrating the feasibility of this method for the development of quality indicators in cancer treatment. Utilizing a multidisciplinary panel of experts from more than one province may increase the generalizability of the results if the indicators are meant to measure more than just the surgical portion of the treatment path.

The use of quality indicators as a process measure in the treatment of DCIS is hindered by the lack of established indicators specifically for DCIS. The use of invasive breast cancer quality indicators is less appropriate given the differences in treatment objectives and modalities. The lack of quality indicators in DCIS can be addressed by using a consensus method to develop them. Delphi processes have been shown to be

effective in determining quality indicators in oncology obtainable from chart review using representative expert panelists in the field and the criteria put forward by the RAND Corporation to promote validity and feasibility.

H. Measures of quality – use of adherence to CPGs

The use of outcomes in the measurement of quality care in breast cancer treatment has generally been focused on mortality and disease recurrence. The common outcomes of mortality and recurrence are not suited to measure quality in the treatment of DCIS. Mortality in DCIS occurs infrequently and the rates of recurrence while not negligible occur over long periods of time, which make it in impractical measure.

Research has found that the implementation of CPGs can impart significant improvements in either process of care or in clinical outcomes. In an extensive and rigorous systematic review by Grimshaw et al., [55] 59 studies were reviewed to determine effect of the implementation of CPGs on the process of care in specific clinical situations such as treatment of strep throat, prevention strategies, prescribing practices, and laboratory or radiologic procedures. Nine of 11 studies evaluating patient outcomes as a result of adherence to CPGs found significant improvements. The authors review of a study of the treatment of hypovolemic shock in the emergency department found that the group of resident physicians who had active implementation of CPGs had 82% adherence to CPGs and the patients they treated had only a 14% ventilation requirement whereas the control group with no active implementation of CPGs were adherent in only 42% of cases and had a 33% ventilation requirement.

Other studies in the review found that adherence to CPGs reduced complications in the treatment of burns in the emergency department, improved diastolic blood pressure with adherence to hypertension guidelines, improvement in 15 prevention and prescribing activities in the treatment of patients in an internal medicine clinic, reduced smoking with adherence to smoking cessation programs (3 studies) and reduced hospital admissions after adherence to CPGs regarding influenza vaccination.

None of these studies evaluated the use of a multidisciplinary clinic in improving adherence to CPGs nor were any of the outcome studies evaluating the care and treatment of cancer. This review does however, provide evidence that adherence to CPGs improves both process of care and clinical outcomes, and it is also clear that CPGs likely have an impact on outcomes through both the effects on process and in some cases, directly on outcomes themselves.

The use of CPGs to improve care in cancer has become an increasingly common method of attempting to standardize care and ultimately, improve outcomes. Consensus statements and CPGs in North America and abroad have been published in an effort to define best practice based on current evidence [38, 65, 67-69]. The Canadian guidelines on the management of DCIS developed by the Steering Committee on Clinical Practice Guidelines for the Care and Treatment of Breast Cancer were initially published in 1998, with an update released in 2001 for DCIS reflecting clinical trial data published in the interim. The primary goal of the CPGs was to help clinicians and patients arrive at the most clinically effective approach to the management of DCIS based on review of the current literature or expert consensus where no evidence was available. [70] The

development of the guidelines grew from the recognition of variations in treatment beyond that expected from reasonable differences and a desire to minimize unwanted differences outside accepted practice [71, 72].

Support for the association between CPGs and improvements in standardization of practice has been shown in observational studies in the treatment of invasive breast cancer [73, 74]. A Canadian study by Sawka et al. [73] compared the consistency of adjuvant treatment in breast cancer between British Columbia which had province-wide CPGs, and Ontario, which did not prior to the study period in 1991. Incident breast cancer cases in British Columbia (BC) were compared with a random sample of Ontario cases based on distribution of treatments received by patients according tumour characteristics. The study found the consistency of care was uniformly greater in BC than in Ontario. The authors conclude that the presence of CPGs played a role in standardizing adjuvant treatment. Weaknesses of this study include a retrospective design without adjustment for potentially confounding factors such as demographics, characteristics of the location of treatment/care providers and access to cancer centres or presence of multidisciplinary cancer clinics.

In a sister study of adjuvant treatment practice in BC alone, Olivotto [75] measured compliance with CPGs in all incident breast cancer cases in BC during 1991. The study found that the odds of receiving CPG compliant treatment was 10.7 (95% CI 7.0 – 16.4) times higher if the patient had been seen by a oncology specialist compared to those who had not. Overall, non-compliance was associated with not being referred to a oncology specialist or being treated in the community as opposed to a cancer centre. This

study is also limited by its retrospective design and lack of adjustment for other confounding variables. It does however demonstrate an association with improved best practice as measured by adherence to CPGs for those who were referred to an oncology specialist or were treated in a cancer centre. No details were provided with respect to the structure of the systems in BC by which care was delivered, or if the oncology specialist practiced in a multidisciplinary setting or not.

These studies provide support for the utilization of adherence to CPGs as measure of process in quality of care according to accepted best practice in breast cancer. The use of adherence to CPGs as markers of appropriateness of care will allow objective determination if improvement or better care is provided in one population versus another. Due to the infrequency of mortality and local recurrence rates in DCIS, use of these common outcome measures in oncology is impractical. There is some evidence to support the effect of CPGs on improving outcomes outside of the oncology realm and to improving best practice for adjuvant chemotherapy in breast cancer, which is believed to ultimately improve outcomes. Determination of adherence to CPGs in the care and treatment of women with DCIS in Alberta can also be used as an intermediary outcome measure.

I. Summary

Studies have shown that there is wide variation in the treatment of DCIS due in part to its evolution from a rare entity treated by mastectomy to a common finding as a result of screening mammography. In addition, contributing to the wide variations in

treatment is suggestive of practice that is felt to be outside the realm of good care given the evidence available from randomized trials: the need for clear margins in BCS; the use of radiotherapy after BCS, particularly in lesions with markers of risk for recurrence like necrosis and high grade; the inappropriateness of AND.

A multidisciplinary DCIS clinic was established in Alberta to address perceived unwanted variations in care, however no assessment of the impact of the clinic on the quality of treatment provided after the implementation of the clinic has been done. In order to measure the impact of the multidisciplinary DCIS clinic on the quality of treatment for women with DCIS in Alberta, Donabedian's model of structure, process and outcomes can be used as a framework for evaluation.

The intervention of a change in the structure of care in DCIS is represented by the implementation of a multidisciplinary DCIS clinic in the TBCC catchment area in southern Alberta, where no change has occurred to CCI catchment in northern Alberta. The impact of such a change on the processes of care and intermediary measures of outcomes is unknown.

Process measures such as quality indicators have been used in measurement of quality in oncology and other disease processes. While no published quality indicators currently exist for the treatment of DCIS, potential examples of quality indicators may include having a core biopsy for diagnosis; having a complete pathology report after surgery for DCIS or documenting a discussion around the use of tamoxifen. Quality indicators in cancer have be developed using consensus methods such as the Delphi and the modified Delphi process and have seen success in the measure of quality in both

breast and colorectal cancer.

The common outcome of 5-year mortality in oncology is rare in DCIS, making it an impractical measure of quality. The use of local recurrence in oncology while useful, is impractical in the short term as results may not be known for up to 30 years. There is evidence that adherence to CPGs does impact favourably on clinical outcomes, supporting the use of adherence to CPGs as an intermediary measure to clinical outcomes in DCIS. In addition, adherence to CPGs can function as advanced process measure of quality by providing a measure of appropriateness of care.

3. Conceptual framework

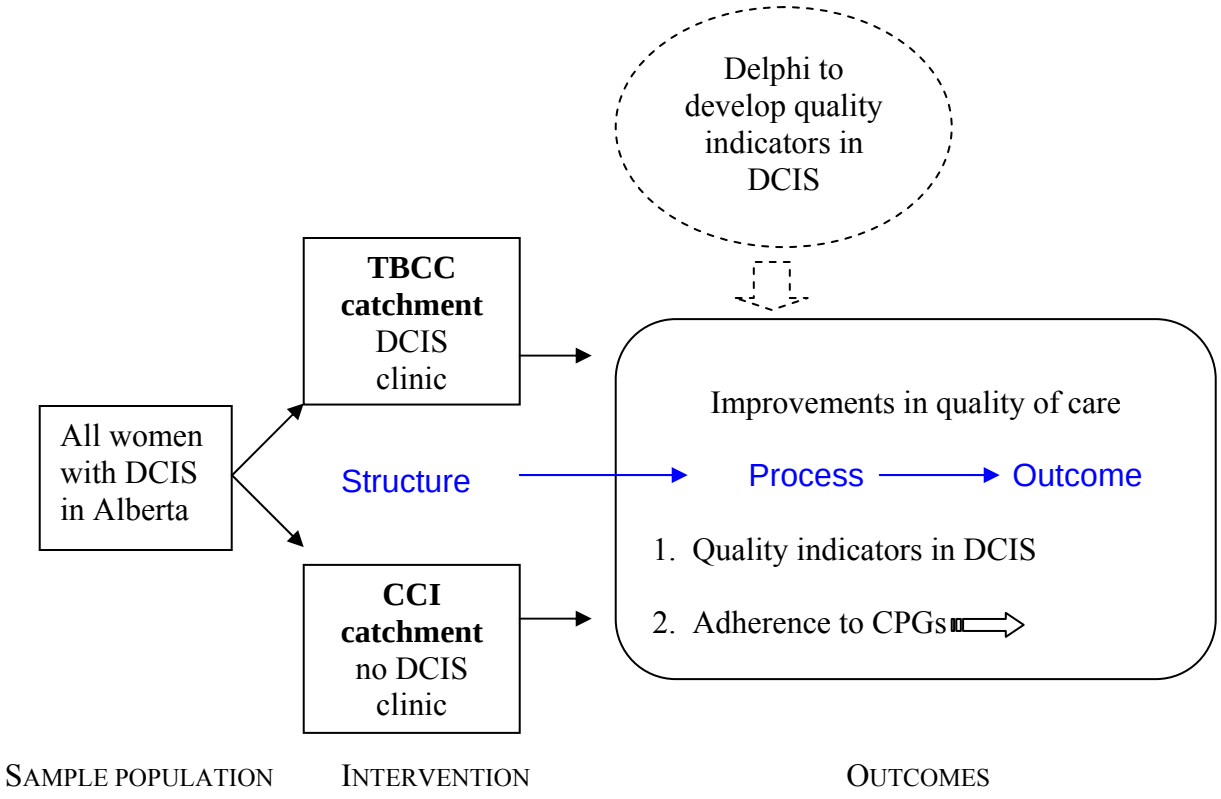

Figure 2. Flow diagram for a study on the effect of a multidisciplinary DCIS clinic on quality of care as measured by the structure, process and outcomes model.

4. Research question

Is there an association between the presence of a multidisciplinary disease specific clinic and the quality of DCIS treatment in Alberta as measured by process (quality indicators) and intermediary outcome measures (adherence to CPGs)?

5. Hypothesis

Improved quality indicators of patient care for women with DCIS and better adherence to accepted CPGs are associated with being treated in the catchment area for the TBCC DCIS clinic compared to patients treated in the CCI catchment area where there is no DCIS clinic.

6. Study objectives

The creation of the multidisciplinary DCIS clinic at the TBCC in Calgary provides a unique opportunity to evaluate its effect on the quality of cancer treatment.

Due to the lack of quality indicators in DCIS, a consensus method (Delphi process) to select indicator variables will be conducted to provide a measure of process in the treatment of DCIS. Therefore, the first objective of this study is:

1) To determine quality indicators in DCIS using a consensus method (Delphi process) among recognized Canadian experts

Thereafter, a population based cohort study of women in Alberta diagnosed with DCIS will be conducted:

2) To determine if there are variations in the treatment of DCIS in the province

of Alberta between southern part of the province (TBCC catchment) and the northern part of the province (CCI catchment)

3) To compare quality indicators in DCIS (determined in objective 1) between women treated in the TBCC DCIS clinic catchment area and those treated in the CCI catchment area with no formal multidisciplinary DCIS clinic
4) To compare adherence to national CPGs between women treated in the DCIS clinic catchment area and those treated in the CCI catchment area with no formal multidisciplinary DCIS clinic

7. Relevance and significance of the project

Breast cancer is the most common malignancy diagnosed in Canadian women, with over 21 000 new cases expected in 2005 [76]. The measure of quality in the care of patients with breast cancer has unique challenges due to the inherent multidisciplinary nature of treatment and the constant influx of new evidence on best practice from randomized controlled trials. Measuring quality in the delivery of care for women with DCIS poses additional problems due to its unique evolution over the last two decades and its distinctively different clinical behaviour from invasive breast carcinoma. DCIS provides an example of a common entity for which evaluation and performance indicators are not well described and reflects some of the challenges faced by those implementing changes to effect better care.

A population-based assessment of treatment patterns and of quality of care as measured by quality indicators and adherence to CPGs will establish a baseline from

which future research can be undertaken. Analysis of these measures stratified by the presence or absence of a multidisciplinary DCIS may shed light on the impact of a formal, organized multidisciplinary program requiring resources for implementation.

Determination of both quality indicators and adherence to CPG is important in the measurement of how well health services are provided to women with DCIS. The results of this study will help to establish if there is an association conveyed on process and outcome through alteration of the structure used to treat women with DCIS. This comparison of a disease specific multidisciplinary model of care as compared with usual care will confirm anecdotal evidence that such forms of care are associated with improved treatment of women with complex diseases such as DCIS. Information gathered from this study can also be used to reveal shortcomings in the quality of treatment provided for women with DCIS and may help to further identify modifiable variables in providing optimal care for women with DCIS in Alberta.

Finally, broader implications include gaining a better understanding of the framework within which measuring quality of care can be approached as well as some of the limitations.

2. RESEARCH METHODS

The methods discussion will be divided into two sections. This section will address the methodology for the first objective to determine quality indicators in the treatment of DCIS using a Delphi process.

The methodology for the second, third and fourth objectives to assess treatment of DCIS will be outlined in the second section, including data collection, data cleaning, sample sizes calculations, study outcomes and analysis methods.

1. Determination of quality indicators in DCIS

A. Study Design

Quality indicators in DCIS were developed using a Delphi process of consensus among experts in the care and treatment of women with DCIS from British Columbia, Alberta and Ontario. A pilot survey of local experts was conducted initially to obtain feedback on format, content and comprehensibility of the final survey used in the Delphi process.

B. Selection of Expert Panel

The goal of the selection process was to have a multidisciplinary panel comprised of surgeons, medical oncologists, radiation oncologists and pathologists that would be surveyed to determine quality indicators in the overall treatment of DCIS. In addition, panelists from across Canada were desirable to be most representative of general practice as opposed to from one geographic region. The provinces of Alberta, British Columbia

and Ontario have provincially organized disease site groups for breast oncology headed by the Alberta Cancer Board, the BC Surgical Oncology Network and Cancer Care Ontario respectively. The disease site groups are comprised of nominated individuals who are practicing physicians actively treating breast cancer patients in their province and have contributed to the care and treatment of breast cancer patients through clinical and/or research expertise. In addition, the disease site group members had participated in the development of clinical practice guidelines for the treatment of breast cancer in their respective provinces. Some disease site members were also part of the national steering committee on breast cancer in Canada. It was felt that membership in one of these groups satisfied criteria for recognized expertise in breast cancer treatment and would provide an ideal group to survey and select panelists for the Delphi process.

The precise number of members for a Delphi process has not been firmly established. The RAND Corporation has advocated a panel comprised of between nine and fifteen members as being effective and functional [77]. The total number of members of the three provincial disease site groups as mentioned was 25 + 9 + 11 = 45 from Ontario, Alberta and BC respectively. A nine member panel could be comprised with a 20% participation rate, which would be adequate for the Delphi process.

C. Selection of potential quality indicators

a. Initial selection using CPGs

A review of evidence based clinical practice guidelines developed nationally and provincially in Canada and the United States was performed to identify potential quality

indicators for the first round of the Delphi process [38, 39, 67, 78]. The recommendations among the CPGs was very similar, therefore the Canadian CPGs were used as model to determine indicators that would fulfill the criteria as outlined by Malin et al. [49] 1) the indicator measures an intervention or treatment with potential health benefits for the patient, 2) the indicator is supported by adequate scientific evidence or professional consensus, 3) the elements of the indicator are under the control or influence of the health care provider, 4) the elements of the indicator are information typically found in the medical record, where absence of the information would be considered poor quality. These criteria were selected given the similarities in obtaining data for the measurement of the quality indicators in this study and the study performed by Malin et al. for oncology and HIV quality indicators [49].

Potential quality indicators were proposed for the pilot survey based on their selection as a key summary point in the 2001 Canadian CPGs update on the care and treatment of women with DCIS [39]. During the time period for the study (January 2000 to December 2001) the 1998 Canadian CPGs would have been circulated which had the same recommendations as the 2001 update with the exception of those regarding tamoxifen. The 1998 CPGs stated "evidence is not available to support the use of tamoxifen" as the NSABP 24 study showing a small benefit and some adverse effects, and the UKCCCR study results showing no benefit had not been published at that time. The 2001 update states "the role of tamoxifen in the management of patients with DCIS continues to evolve. The potential benefits and risks should be discussed with patients", therefore it was felt not sufficiently different from the 1998 CPGs recommendation to

warrant omission. The selection of proposed indicators was undertaken by evaluating each key summary point in the 2001 Canadian CPGs update against the 4 criteria for validity and feasibility for a good quality indicator; the indicator measures a treatment that benefits the patient, there is support from scientific literature or professional consensus for benefit; the indicator is under control of the health care provider and the indicators is easily extractable from the medical record.

For each proposed quality indicator a paragraph including its definition (including the numerator and denominator for its calculation) an explanation for the indicator and a target ideal rate was created. In order to provide an ideal target rate for each of the proposed quality indicators, guidance was obtained from studies or published data where possible [8, 39, 43, 67, 79, 80] or consultation with local experts at the Toronto Sunnybrook Regional Cancer Centre when unavailable. There were a total of 10 proposed quality indicators for evaluation of process in the treatment of DCIS in Canada:

1. **Mastectomy rate**, defined as the number of mastectomies / total number of cases. The mastectomy rate should be < 75%.

Mastectomy is indicated when the DCIS is large (usually greater than 5 cm) which would preclude excision with acceptable cosmesis; when there is persistent positive margins after repeated attempts at BCS; the disease is multicentric (in more than one quadrant of the breast) or it is the patient's personal preference [39, 67]. The use of mastectomy is indicated in situations where there is high risk of recurrence, such as positive margins after BCS or clear margins are not possible, such as in the case of

multicentric disease. Although mastectomy may be the patients choice, it has been shown to be associated with greater psychological distress than BCS [81]. Very high rates of mastectomy may represent a lack of communication to women about the option of BCS or overly aggressive treatment. This indicator can be obtained from the patient chart and is under control of the health care provider.

2. **Lumpectomy rate**, defined as number of lumpectomies / total number of cases. The lumpectomy rate should be > 25%.

The use of lumpectomy allows breast preservation and equivalent survival outcomes compared to mastectomy. Women should be offered the option of BCS if they are suitable clinical candidates – ie. the lesion can be removed with a clear margin while providing an acceptable cosmetic result [39, 67]. It is recognized that women may have a personal preference for mastectomy, however the option of BCS is expected to be accepted by some women. This indicator can be obtained from the patient chart and is under the control of the health care provider.

3. **Clear margin rate**, defined as the number of lumpectomies with clear margins / total number of lumpectomies. The clear margin rate should be > 95%.

Positive margins have been associated with increased local recurrence if BCS is used [22, 82]. A clear margin when lumpectomy is performed is expected to confirm adequate removal of the lesion. The patient should undergo re-excision if this is not attained, and may require mastectomy. A low clear margin rate may indicate a lack of

knowledge of risk factors for recurrence or inadequate surgery. This indicator is available from the patient chart, and its absence would be considered poor quality. This is under the control of the health care provider.

4. **Complete pathology report rate**, defined as the number of cases with a complete pathology report / total number of cases. The complete pathology report rate should be > 90%.

A complete pathology report should include factors that are known to be associated with risk of recurrence to provide accurate risk assessment [39, 65]. The report should include tumour size, nuclear grade, presence of necrosis and margin width. Lack of a complete pathology report precludes assessment for adequate surgery and need for adjuvant therapy. This can be obtained from the patient chart and its absence would be considered a marker of poor quality. This is under the control of the health care provider.

5. **Radiation oncology referral rate**, defined as the number of patients referred to a cancer centre / total number of lumpectomy cases. The oncology referral rate should be > 80%.

Patients treated with BCS should generally receive post operative radiotherapy given the evidence for relative reduction in recurrence by 50%. Referral to a cancer centre can be an indicator of consideration of radiotherapy from the surgeon [39, 67]. This should be found in the patient chart and its absence would be considered poor

quality. This is under control of the health care provider.

6. **Radiation rate**, defined as the number of patients having radiotherapy / total number of lumpectomy cases. Radiation rate should be > 60%.

Radiotherapy after lumpectomy has been shown to reduce local recurrence by 50% in randomized controlled trials [22, 33, 36]. Patients should generally receive radiotherapy after BCS, although it is recognized that some favourable lesions without risk factors for local recurrence such as high grade or necrosis may not benefit. This would be found in the patient chart, however may not be entirely under the control of the provider if the patient declined therapy. Its ease of retrieval and reflection of the number of women being referred for oncology opinion resulted in its inclusion.

7. **Radiotherapy wait time**, defined as the number of weeks from surgery date to 1st radiotherapy treatment date. The radiotherapy should commence within 12 weeks of surgery.

The time to radiation can be an indicator of communication and facilitated referral for treatment. Evidence from the literature is limited [79], however this would be found in the chart and control of this variable is under the health care system.

8. **Discussion about tamoxifen**, defined as number of patients with a documented discussion about the use of tamoxifen after BCS / total number of lumpectomy cases. The tamoxifen discussion rate should be > 60%.

The role of tamoxifen in the treatment of DCIS continues to evolve based with two separate randomized controlled trials providing conflicting results [35, 36]. Discussion regarding the risks and benefits should be undertaken. This may be documented in the chart, its absence may be considered poor quality and it is under the control of the health care provider.

9. **Routine axillary node dissection**, defined as number of patients having routine axillary node dissection / total number of patients. The axillary dissection rate should be < 10%.

Routine axillary node dissection is not indicated in pure DCIS [29, 39, 67]. This is obtainable from the chart and its' presence would be considered poor quality. It is also under the direct control of the health care provider.

10. **Chemotherapy rate**, defined as the number of patients having chemotherapy after treatment of DCIS. The chemotherapy rate should be 0%.

Systemic chemotherapy is not indicated in DCIS [67]. This is obtainable from the chart and its presence would be considered poor quality. This is under the direct control of the health care provider.

b. Pilot survey to test selected indicators on a local group of experts

A pilot survey was undertaken to test the survey and to provide some validation for the proposed indicators amongst local experts in breast cancer, as well as gain a

broader opinion on comprehension, content (target ideals, wording and explanations) and format. The ten proposed variables were compiled into the pilot survey listing each potential indicator with the definition for measuring the variable (numerator / denominator), an explanation of the variable and the ideal target rate. A Likert scale (1 = definitely include, 2 = probably include, 3 = consider including, 4 = neutral, 5 = consider excluding, 6 = probably exclude, 7 = definitely exclude) for rating each indicator was preceded by the sentence " Do you think this variable should be used to measure the quality of care in DCIS?". A list of the 4 characteristics of a good quality indicator was also included along with an explanation of the purpose of the pilot study to determine which quality indicators should be used in the formal Delphi process in the future.

The pilot survey was circulated to a local group of physicians who treat breast cancer exclusively and are involved breast cancer research in Toronto, Ontario at academic teaching hospitals (4 surgeons, 1 radiation oncologist) as well as a cancer epidemiologist with expertise in breast cancer in Alberta. This group was asked to comment on the definition, idea target rate and explanation for each variable, as well as to make suggestions for other variables to be considered in the survey. The pilot survey was reviewed and comments from the local respondents were incorporated into the first iteration of the Delphi process. The end result was the final first iteration survey comprised of 9 potential variables to be considered as quality indicators in the treatment of DCIS. This study was approved by the University of Calgary ethics review board.

D. First Iteration

A cover letter introducing the purpose of the survey, an explanation of the Delphi process to determine quality indicators, a summary and rationale of the overarching study explaining the role of the Delphi process, criteria for determining a good quality indicator in health care, instructions for completing the survey, and an electronic version of the survey was sent to each member of the Alberta, BC and Ontario breast site groups via email. (Appendix A). A pre addressed FAX coversheet was included for each respondent to print the survey and FAX back his or her response, as well as to indicate which method of correspondence was preferred. A return date of two weeks from the day of the first email was requested in the accompanying introductory email. A reminder email was sent at the two week mark to those members who had not yet responded, with an attached fill-in version of survey in Word format for electronic response at the suggestion of a respondent. Survey results were tabulated in a Microsoft Access © database. Median, mean and range of scores were calculated for each potential quality indicator. Comments that the respondents had made regarding each indicator and new indicators that were suggested by respondents were reviewed and assimilated for the inclusion in the next iteration of the survey. New indicators suggested by at least two respondents were retained for the second iteration of the survey. Any indicator that received a unanimous score of 1 or 7, which was the criteria for immediate rejection or acceptance, was excluded from the next survey iteration.

E. Second Iteration

A second iteration of the survey was created in a similar format to the first iteration of the survey. All of the previous indicators were included from the first iteration. Under each potential quality indicator the mean, median and range of ratings was listed so each respondent could see what the rating distribution was amongst the other panelists and so they could compare to see how they rated each indicator with respect to other panelists. Submitted comments from the first iteration were assembled and anonymously listed under the relevant potential quality indicator, so the panelist could see what comments regarding the appropriateness or inappropriateness of the indicator the others made.

The panel members were asked to rate the indicators using a similar Likert scale (1 = definitely include, 2 = consider including, 3 = neutral, 4 = consider excluding, 5 = definitely exclude). A request for comments from the panelist was made if a rating of 2 or 4 was selected to clarify the reason for not including or excluding the variable outright. An electronic version of the survey was sent to each panelist with an option to print and FAX back with provided coversheet or open in Word, complete electronically and return via email. A response deadline of 1 week was set and a reminder email sent to non responders at that time.

Questionnaire results were again entered into the database and frequencies tabulated. Indicators were considered to have strong "consensus for acceptance" if >50% of the panelists rated it 1 or 2 or, "unclear" if 50% of the panelists rated it 1 or 2 while the other 50% rated it 3, 4 or 5. Variables with >50% of the ratings at 3, 4 or 5 were considered to have to have strong consensus for exclusion, and were excluded.

F. Third iteration

The variables in the second iteration felt to have strong consensus or unclear consensus based on the above criteria were formatted into a final survey asking panelists to rank each in order of importance. An anonymous list of comments made by group regarding each of the quality indicators was compiled from the second iteration and included for consideration by each individual panelist. The final survey was sent to panelists electronically in the form of an email with an attached copy of the survey which could be printed and FAX'd back with the attached coversheet, or opened in Word, completed and emailed back. A request for return within a week was made, and a reminder email was sent at that time to non responders.

G. Final determination of quality indicators

Rankings for each quality indicator were tabulated, averaged and ordered from lowest average score to highest average score to determine the indicators of highest importance. This final process was to obtain a sense of priority for the quality indicators that were obtained using the Delphi process. This objective of the final prioritization was allow better interpretation of where the emphasis should be placed on addressing any areas identified as being lacking in quality, and provided a sense of which quality measures the panelists felt were most important to address. These indicators were utilized in the second section of the study to measure the differences in the process of care between the TBCC DCIS catchment and the CCI catchment.

2. Analysis of the treatment of DCIS in Alberta

A. Study design

A population based retrospective chart review was employed to assess treatment strategies of women with DCIS in the province of Alberta. Quality indicators and adherence to CPGs were determined and compared between women treated in a catchment area with a formal multidisciplinary DCIS clinic to those treated in a catchment area without a formal multidisciplinary DCIS clinic.

3. Study population

A. Study cohort

All women living in Alberta with a new histologic diagnosis of any type of in situ carcinoma of the breast from January 1, 2000 to December 31, 2001 were included in the study (ICD-9 code 233). Patients with lobular carcinoma in situ, evidence of microinvasion (< 1mm of invasive cancer present), unknown pathology, were deceased prior to completing treatment or lived outside the province of Alberta were excluded. A total of 330 women comprised the final study population. Follow-up data for recurrence of DCIS or breast cancer ended at March 18, 2005.

B. Definition of TBCC DCIS catchments exposure

Women were considered to be in the catchment area of TBCC DCIS clinic if they had their surgical treatment at a health care facility that refers to the TBCC in Calgary. These facilities are in the southern part of the province whereas the CCI services facilities

in the northern part of the province. There was one facility geographically between the TBCC and the CCI and although technically is serviced by the CCI, refers patients to the TBCC depending on patient preference. In this circumstance, catchment area was determined by which cancer centre the patient had been seen in consultation regarding her DCIS diagnosis if she had one. If she was not seen in consultation, then catchment area was determined by which cancer centre received and kept the pathology report and other documents for the Alberta Cancer Registry.

4. Data set

A list of all incident cases of in situ breast disease reported to the Alberta Cancer Registry by legislation was obtained from the co-ordinator of the Cancer Registry. Charts of all patients seen at a cancer centre were then reviewed manually and the data was abstracted primarily from the respective cancer centre by the author. A similar review of all patients with a diagnosis of in situ disease who were not seen at a cancer centre was performed on the Alberta Cancer registry chart, which contains radiology, pathology and operative notes relevant to the diagnosis and treatment of DCIS. The variables were entered into a Microsoft Access © database for analysis.

5. Study outcomes

A. Treatment patterns

Treatment patterns were determined as the number of patients treated with mastectomy and axillary node dissection as a proportion of the total number of reported

DCIS cases in the Alberta during the study period. Radiotherapy rate after BCS was determined as a proportion of all patients having BCS. Treatment was stratified by age and catchments area. The number of local recurrences occurring by March 18, 2005 were recorded.

B. Quality indicators

The quality indicators in the treatment of DCIS were determined using a Delphi method of consensus among Canadian experts in the care and treatment of women with breast cancer. There were 8 final quality indicators selected:

1. Lumpectomy or BCS rate
    - The type of surgery was coded as either lumpectomy, needle localized lumpectomy or total mastectomy. A patient was considered to have had "lumpectomy" or BCS if she had either of the first two procedures.

2. Final clear margin rate
    - The pathology report was reviewed for a statement of the margin status as measured in mm or cm. If the tumour was not at the margin, the final margin status was considered clear. If the patient had a positive margin on lumpectomy but then went on to have mastectomy, the final margin rate was coded as clear. In addition, if the patient had no residual disease after a core biopsy on lumpectomy, the final margin was coded as clear.

3. Complete pathology report rate
    - The pathology reports were reviewed for reporting on the following factors; size in mm or cm, tumour grade as I, II, III, necrosis as present or absent. The pathology report was considered complete if all of the factors listed above were reported.

4. Referral to radiation oncology rate for patients having BCS
    - The chart was reviewed for the standardized intake form used at both the TBCC or CCI centres indicating a request for referral, or the presence of a consultation letter when the patient was seen at the centre. The referral to radiation oncology was considered yes, if either of these were present. If the patient had no cancer centre chart and only a Alberta Cancer Registry file, then the radiation oncology referral was considered as no.

5. Complete level I/II axillary node dissection rate
    - The operative reports were evaluated for each patient to determine if lymph nodes had been removed. A complete axillary node dissection was considered yes if the surgeon had dictated they had done one. Corroboration with the pathology reports confirming the removal of lymph nodes was obtained.

6. Specimen x ray rate for mammographically detected lesions
    - The chart was reviewed for a specimen x ray report if the patient had a

"needle localized lumpectomy", or pathology report stating the specimen was accompanied by a specimen xray. Specimen x ray was considered yes if either of these were present.

7. Pre operative core biopsy rate
    - The method of diagnosis was determined by the first pathology report identifying the histologic diagnosis of DCIS. Patients who had a core or "mammotome core" reported they were considered to have a preoperative core biopsy. If the patient had a FNA as their first investigation, then went on to have a core biopsy, they were considered to have a preoperative core biopsy.
8. Pre operative bilateral mammogram rate
    - The chart was reviewed for a radiology report of a bilateral mammogram within 6 months of the histologic diagnosis. If the report was present, the pre operative bilateral mammogram was coded yes.

The presence or absence of each of these indicators was obtained from the patient chart and entered into the database.

C. Adherence to CPGs

The 2001 Canadian CPGs on the care and treatment of women with DCIS was used to dictate the elements required to be considered adherent to CPGs [70].

Determining adherence to CPGs was classified into three aspects of DCIS treatment:

1) adherence to diagnosis recommendations

2) adherence to treatment recommendations

3) adherence to adjuvant therapy recommendations.

The adherence to CPGs was separated into 3 categories to recognize that each aspect of the treatment reflects a different stage of the treatment process, and to assist in determining which areas of treatment were adherent. There are elements of adherence to CPGs that are the same as the quality indicators. However, the adherence to each category of CPGs requires that all of the elements be present in ***combination*** to be considered appropriate. This reflects the appropriateness of the entire segment of the treatment process and not just one element in isolation.

a. Adherence to diagnosis CPGs

This category was developed to recognize that the diagnosis phase of treatment is done primarily at the community level, prior to when the patient is seen at the cancer centre for referral. Practitioners involved at this level would be family physicians and surgeons. The elements required to be considered adherent to diagnosis CPGs if the patient had all of the following interventions:

1) bilateral pre operative mammogram

2) pre operative core or surgical biopsy

3) a specimen x-ray to confirm removal of the radiologic abnormality if a needle localiazed lumpectomy was performed

Each patient chart was reviewed and the presence or absence of each of the elements documented. The patient must have had all elements listed above to be considered adherent to CPGs in diagnosis.

b. Adherence to treatment CPGs

This category was developed to reflect the surgery and radiation components of treatment that provide the best local control of disease to minimize recurrence. Although some elements would have been performed before cancer centre referral, these elements could be modified after being seen at the cancer centre. For example a patient who had a lumpectomy with a positive margin could be recommended to return to her surgeon for further surgery – either a re-excision lumpectomy or total mastectomy.

The adherence to treatment recommendations was determined using the following criteria by treatment type:

a. lumpectomy

1. complete pathology report
2. clear final margins
3. no axillary node dissection
4. post operative radiotherapy
5. if radiotherapy was excluded, the tumour must have been < 1 cm, margins > 10mm, have a low grade and necrosis absent

b. mastectomy

1. complete pathology report
2. no axillary node dissection

The operative report was reviewed in all cases with lymph nodes found on pathology to determine if an explanation for the axillary staging was justified. In cases where the initial preoperative core or biopsy pathology was reported as invasive cancer or no axillary surgery was dictated in the case of mastectomy and the number of nodes was less than 5, then the case was coded to have not had a purposeful axillary node dissection.

c. Adherence to adjuvant CPGs

This category was developed to reflect the treatment options discussed with women for their treatment of DCIS. This category was developed to capture discussion rates recognizing that actual rates of treatment will reflect that the patient's right to decline treatment after she has heard about the risks and benefits of a potential therapy.

Adjuvant treatment CPGs were considered adherent if the patient had all of the following based on treatment type:

1. lumpectomy
    a. documented discussion about radiotherapy
    b. documented discussion about tamoxifen
    c. no chemotherapy

2. mastectomy
    a. no radiation after mastectomy
    b. no chemotherapy

Patients that had chemotherapy with a concurrent diagnosis of invasive breast cancer on the contralateral side were not coded as having chemotherapy.

6. Sample size calculations

A sample size of 346 women (173 in each group) will be sufficient to detect a difference of 15% between groups using radiation after BCS as a surrogate quality indicator, with 80% power and a 5% significance level. This 15% difference represents the difference between a 46% rate of radiation after BCS in the CCI catchment group and a 61% rate in the TBCC DCIS catchment group based on similar treatment rates reported in SEER data and, reflects a clinically relevant effect size.[8]

Details of sample size calculation are shown below and table of powers is shown in Table 1.

1. primary outcome variable = presence/absence of radiation post lumpectomy (categorical variable – proportions)
2. size of clinically important difference = 15% (61%-46%) [8]
3. significance level = 5%
4. power = 80%
5. type of test = two - sided

The formula for the sample size calculation used was :
$n = [A + B]2 * [(p1*(1-p1)) + (p2 * (1-p2))]/[p1-p2]$ 2

Table 1. Sample size table by significance level, power and effect size for independent proportions.

$\alpha = 0.01$	Effect size 20%	Effect size 15%	Effect size 10%
0.80	143	257	583
0.90	181	327	742
0.95	216	391	887

$\alpha = 0.05$	Effect size 20%	Effect size 15%	Effect size 10%
0.80	96	173	392
0.90	128	231	524
0.95	158	285	647

Based on preliminary aggregate data obtained from the cancer registry, a sample of 330 women diagnosed during the study period was identified.

7. Data cleaning procedures

A. Anomalous values

Each variable in the database was examined for anomalous values. Examples of anomalous values included date of diagnosis or date of surgery listed as the same as the date of birth, and a patient age calculated to be over 100. Erroneous values were obtained from review of the cancer registry chart in question and corrected. Variables that were not reported were set to missing for analysis, and variables that were reported but the value unknown, unclear or uninterpretable were also set to missing. Examples include

pathology tumour size that was reported with descriptive phrases and no numeric value such as “involving 3 ducts”, which was coded as missing.

8. Analysis

Analysis was performed using the statistical software package SAS version 8.2 and 9.1 (SAS Institute Inc., Cary, North Carolina).

A. Characteristics of the study population

Patient, tumour and treatment characteristics were described between the TBCC catchment and the CCI catchment populations. Age of the patient was calculated by the difference between the date at diagnosis and date of birth. Mean age was determined and standard deviation calculated. Age was analyzed as a categorical variable with the following clinically relevant levels – less than 50, 51 to 70 and greater than 70.

Numbers of cases with pathologic reporting for tumour size, necrosis status, grade and margin status was determined. Mean and median tumour size was determined and standard deviation calculated. Tumour size was evaluated as a categorical variable stratified by clinically relevant categories: < 2cm, 2 – 5 cm and > 5 cm. Necrosis status was reported as present or absent. Final margin status was reported as positive or negative. Method of diagnosis was reported as fine needle aspiration (FNA), core biopsy or surgical biopsy, based on the first histologic report by date.

Surgery site was defined academic if the hospital or facility was a teaching hospital affiliated with either the University of Calgary medical school or the University

of Edmonton medical school, otherwise it was considered a community site.

DCIS clinic was recorded as yes if the patient had been seen personally for a consultation at the TBCC DCIS clinic, irrespective of their catchment area.

B. Treatment patterns

The treatment patterns for mastectomy, radiation after BCS and axillary node dissection stratified by age levels and catchment area was described. Characteristics associated with having a mastectomy, axillary node dissection and radiation after BCS by catchments area was compared for significant differences using chi square methods and reported with 2 sided p values. Multivariate analysis using logistic regression controlling for age, tumour size, grade, presence of necrosis, site of surgery and method of diagnosis was performed to examine for effect by catchment area. Potential interaction between catchment area and age, tumour size, necrosis status, tumour grade, method of diagnosis, surgery site and type of surgery was examined to look for any effect modification.

C. Quality indicators in the treatment of DCIS

The 8 quality indicators as selected and defined by the Delphi method previously described were determined for patients treated in the TBCC DCIS clinic catchment area and the CCI catchment area. Differences in the quality indicators between the two groups were evaluated using chi square methods and reported with two sided p values.

D. Adherence to CPGs

a. Unadjusted estimates

The crude proportions for adherence to CPGs for the diagnosis, treatment and adjuvant categories were reported for the entire study population, stratified by catchment area. Two sided p values for differences in the outcome measures between catchments were calculated using chi square methods to look for significant differences between the TBCC DCIS catchments and the CCI catchments.

b. Adjusted estimates

Univariate analysis of catchments area to each of the covariates (age, tumour size, necrosis status, grade, method of diagnosis, surgery site and type of surgery) was performed to examine for significant effect of each variable on adherence to CPGs for each category using logistic regression. Multivariate logistic regression was then performed for each of the CPG outcome categories to control for any effect of the covariates on the likelihood of adherence to CPGs. Modeling was performed fitting the catchment area and all of the covariates in the univariate analysis. Potential interaction between catchment area and age, tumour size, necrosis status, tumour grade, method of diagnosis, surgery site and type of surgery was examined to look for any effect modification.

c. Missing pathology covariates for CPGs treatment analysis

Patients with incomplete pathology reports will not be included in the multivariate

analysis using logistic regression for the CPGs treatment analysis due to the missing data. This cohort of patients will be examined to determine if they differ from those with complete pathology data in a systematic fashion. Specifically, age, catchment area, site of surgery, method of diagnosis and type of surgery performed will be examined.

III. RESULTS

1. Overview of results

The results section is divided into two parts. The first part will address the Delphi process for the determination of quality indicators in the treatment of DCIS. The results from the process will be described including panel member characteristics, selected quality indicators and final rankings of the quality indicators.

Results of the analysis from the two main objectives for the study, effect of catchment on quality indicators in the treatment of DCIS and adherence to CPGs are described in the following section. Analysis of the quality indicators stratified by catchment area is presented using descriptive statistics. Adherence to CPGs and the association with catchment area adjusted for age, tumour characteristics, diagnosis method and surgery site is modeled using logistic regression methods. An exploration of the relationship of missing pathology variable values to the covariates is performed using descriptive statistics.

2. Determination of quality indicators in the treatment of DCIS

A. Delphi panel selection

A total of 17 respondents comprised the final Delphi process expert panel. Panel membership was granted if the respondent replied to the first email introducing the study, inviting the respondent to participate. The initial deadline was extended from two weeks to 4 weeks to maximize responses and allow for reminder communications. Breakdown of the final expert panel members by province and specialty is presented in Table 2.

Table 2. Breakdown of the final Delphi panel experts by specialty and province.

Specialty	Alberta	British Columbia	Ontario	Number of members
Surgeons	0*	1	2	3
Medical Oncologists	0	0	7	7
Radiation Oncologists	5	0	1	6
Pathologists	0	0	1	1
Column totals	5	1	11	17

* Alberta had no surgeons in their disease site group

The final group mix had at least one member from each of the desired groups to ensure representation from all of the disciplines invited to participate in the study. The lack of surgeons was due in part to the number of surgeons on the Alberta panel available to be surveyed being zero, and the lack of response from the BC group that is comprised mostly of surgeons.

The initial target group for the Delphi panel consisted of 45 physicians based on an estimate of 20 – 33% response rate to obtain 9 – 15 panelists. From the Ontario breast disease site group listing on the Cancer Care Ontario website, 25 members were identified as doctors. Of these 25, four members declined participation or were excluded from invitation for the following reasons – not practicing clinically in breast cancer currently, on leave of absence, incorrect and unavailable contact information and not a medical physician (psychologist), leaving a total of 21 potential panelists from Ontario.

The Alberta disease site group consisted of 9 members, none of whom were surgeons.

The British Columbia group recruitment through the surgical oncology network was complicated by the use of a central network manager who facilitated contact through an internal email list. After the termination of the study, it was discovered that only the first mailing had proceeded forward, therefore none of the members of the BC group received any of the reminders for the invitation to participate, except for the network group leader. The potential recruitment for BC was set at 11 in any case, leaving the final potential group at 41. The overall response rate was 19 / 41 (46%) using the revised final potential group as the denominator. Two respondents returned the invitation to participate after the survey had completed, therefore they were excluded from the expert panel, leaving the final number for the Delphi process expert panel at 17 members.

B. Selection of proposed quality indicators

Review of established clinical practice guidelines and standards for best practice resulted in the development of 10 proposed potential quality indicators in the treatment of DCIS. The indicators selected were mastectomy rate, lumpectomy rate, clear margin rate, complete pathology report rate, referral to radiation oncology rate, radiotherapy rate, radiotherapy wait time, axillary node dissection rate, documented discussion on tamoxifen rate and chemotherapy rate. The 10 proposed quality indicators compiled in the pilot survey for the Delphi administered to the local expert group resulted in 9 potential quality indicators, minor adjustment to definitions / wording and the exclusion of the chemotherapy rate quality indicator. The final potential quality indicators for the Delphi process expert panel to rate in the first iteration are listed below.

1. **Mastectomy rate**: number of mastectomies / total number of cases

The mastectomy rate should be < 75%. Mastectomy is indicated when the DCIS is large (usually greater than 5 cm) which would preclude excision with acceptable cosmesis, when there is persistent positive margins after repeated attempts at BCS, the disease is multicentric or it is the patients' personal preference.

2. **Lumpectomy rate**: number of lumpectomies / total number of cases

The lumpectomy rate should be greater than 25%. The use of lumpectomy allows breast preservation and equivalent survival outcomes compared to mastectomy. Women should be offered the option of BCS if they are suitable clinical candidates.

3. **Clear margin rate**: number of lumpectomies with clear margins / total number of lumpectomies

The clear margin rate should be > 95%. Positive margins have been associated with increased local recurrence if BCS is used. A clear margin when lumpectomy is performed is expected to confirm adequate removal of the lesion. The patient should undergo re-excision if this is not attained, and may require mastectomy.

4. **Complete pathology report rate**: number of cases / total number of cases

The complete pathology report rate should be > 90%. A complete pathology report should include factors that are known to be associated with risk of recurrence to provide accurate risk assessment. The report should include tumour size, nuclear grade, presence of necrosis and measured margin width. Lack of a complete pathology report

precludes assessment for adequate surgery and need for adjuvant therapy.

5. **Radiation oncology referral rate**: number of patients referred to a cancer centre / total number of lumpectomy cases

The oncology referral rate should be > 80%. Patients treated with BCS should generally receive post operative radiotherapy given the evidence for reduction in recurrence by 50%. Referral to a cancer centre can be an indicator of consideration of radiotherapy from the surgeon.

6. **Radiation rate**: number of patients having radiotherapy / total number of lumpectomy cases

Radiation rate should be > 60%. Radiotherapy after lumpectomy has been shown to reduce local recurrence by 50% in randomized controlled trials. Patients should generally receive radiotherapy after BCS, although it is recognized that some favourable lesions without risk factors for local recurrence such as high grade or necrosis may not benefit.

7. **Radiotherapy wait time**: number of weeks from surgery date to 1st radiotherapy treatment date

The radiotherapy should commence within 12 weeks of surgery. The time to radiation can be an indicator of communication and facilitated referral for treatment.

8. **Discussion about tamoxifen**: number of patients with a documented discussion about the use of tamoxifen after BCS / total number of lumpectomy cases.

The tamoxifen discussion rate should be > 60%. The role of tamoxifen in the treatment of DCIS continues to evolve based with two separate randomized controlled trials providing conflicting results. Discussion regarding the risks and benefits should be undertaken.

9. **Routine axillary node dissection**: number of patients having routine axillary node dissection / total number of patients.

The axillary dissection rate should be < 10%. Routine axillary node dissection is not indicated in pure DCIS.

The pilot survey among local experts had resulted in discarding one potential indicator, chemotherapy rate. Pilot respondents had indicated through the comments section under each indicator that chemotherapy for DCIS was not a relevant issue and would be unlikely to add any new information. The use of the comments section was very useful in conveying opinions that each respondent had. It did raise the issue of how the comments would be assembled and made available to the Delphi group. It was decided that all comments would be included for others to see during the iterative process, unless they were very similar and could be grouped as one thought.

C. First iteration

The first iteration of the survey had by definition a 100% response rate, as the group was defined by those respondents who had agreed to participate and returned their completed survey. No potential quality indicator was unanimously rated 1 = definitely include or 7 = definitely exclude, therefore all of the indicators were retained for the

second iteration. In fact, the range of ratings for 5 of the indicators was from 1 to 6 or 7, suggesting a lot of disagreement among the panelists.

There were 4 suggested potential quality indicators by at least two panel members, which were added to the original 9 indicators for the second iteration. The new potential quality indicators suggested by the panelist are listed with their definition, target rate and explanation.

1. **Pre operative core biopsy rate**: number of cases with preoperative core biopsies / total number of cases

The core biopsy rate should be >75%. Use of pre operative core biopsy prior to definitive surgery can facilitate surgical planning and rule out invasive disease.

2. **Pre operative bilateral mammogram**: number of cases with a pre operative bilateral mammogram / total number of cases

The preoperative bilateral mammogram rate should be >95%. Work up of the patient with DCIS should include a pre operative bilateral mammogram to assess extent of disease, and to evaluate the other breast.

3. **Specimen x-ray rate for mammographic lesions**: number of specimen x rays / number needle localized lumpectomies

The specimen X-ray rate at the time of surgery should be > 75%. Imaging of non-palpable lesions at the time of surgery to ensure complete removal of calcifications may decrease the rate of positive surgical margins.

4. **Discussion around participation in clinical trials**: number of documented discussions around participation in clinical trials / total number of eligible patients

Ideally the clinic trial participation rate should be 10%. Participation in trials will advance knowledge about best treatments.

There were also a number of comments from the panelists regarding some of the indicators that were compiled and included for review in the second iteration. The comments in general provided rationale for the rating; a few suggested clarification of wording that was incorporated into the survey. Examples include addition of the word "final" to the clear margin rate and addition to radiation oncology referral with "after BCS" which added more specific criteria to both these indicators.

D. Second iteration

The response rate for the second iteration was 88%. Strong consensus as defined by greater than 50% of the panelists was achieved in 8 quality indicators; lumpectomy rate, final clear margin rate, complete pathology report rate, referral to radiation oncology after BCS, complete axillary dissection rate, specimen x-ray for mammographically detected lesions, pre operative core biopsy rate and preoperative bilateral mammogram rate. The last three indicators were those suggested by panel members.

Three of the original indicators, mastectomy, radiation rate and radiotherapy wait times and discussion about tamoxifen as well as one newly suggested indicator, discussion around clinical trials achieved strong consensus to not include and were

discarded. The use of a smaller Likert scale from 1 to 5 contributed to more definitive voting, with much fewer votes for "consider" including or excluding. None of the variables with a range of ratings between 1 – 4 were excluded, suggesting that the panelists felt strongly about some of the indicators and less so about others. One panelist wrote for each quality indicator comments on importance, such as "most important!", "less crucial", "not so important" which again suggested that among the selected indicators, some are considered much more important than others.

E. Ranking of indicators

The final iteration of the survey for ranking had an 80% response rate. This portion of the survey was performed to allow panelists to prioritize the indicators in order of importance. This ranking allowed the panelists to indicate which variables they felt were most important or crucial to measure in the treatment of DCIS. This may have future applicability when using these quality indicators to measure quality of care; if the top priority indicators were present, then that would be preferred than if the bottom priority indicators were present. In addition, concentration on the top indicators of priority could help focus health care providers on the areas that are thought to be the most important to address if there were shortcomings. The final order of priority and quality indicators is presented in Table 3.

Table 3. Final quality indicators in the treatment of DCIS in order of ranked importance.

Final clear margin	1
Complete pathology report	2
Radiation oncology referral after BCS	3
Lumpectomy	4
Specimen XR of mammogram lesions	5
Axillary node dissection	6
Bilateral pre op mammogram	7
Pre operative core biopsy	8

These final 8 quality indicators in the treatment of DCIS as determined by the Delphi method of consensus were then compared between the catchment areas with and without the DCIS clinic. Results are presented in the outcome measures analysis in the following section.

3. Analysis of the treatment of DCIS in Alberta

A. Characteristics of the study population

The total study population consisted of 330 eligible women diagnosed with DCIS as identified through the Alberta Cancer Registry during the study time period. The number of women who were treated in the TBCC DCIS clinic catchment area was 147, with 183 women treated in the CCI catchment area. Results of the comparison of patient and tumour characteristics by catchment area using chi square methods and t tests are shown in Table 4.

The age of women did not differ significantly between catchment areas. The distribution of tumour size between groups was significantly different between catchments areas with a greater proportion of smaller tumours in the TBCC DCIS clinics cohort, which was unanticipated. In addition, the presence of tumour necrosis and high grade was significantly greater in the TBCC DCIS cohort compared to the CCI cohort. The rates of reporting on all of the tumour characteristics, size, necrosis and margin status were not significantly different, which suggests that lack of reporting is not the cause of the differences seen between catchments on these variables. The distribution of diagnosis methods revealed a significantly higher proportion of patients being diagnosed on core biopsy in the CCI cohort, as well as a greater proportion being treated in an academic teaching hospital setting.

Women were more likely to actually attend the DCIS clinic if they lived in the TBCC DCIS clinic catchment area as expected, however 25% of the women in the TBCC catchment area did not attend the clinic.

Table 4. Characteristics of women with newly diagnosed DCIS in Alberta 2000 – 2001.

	TBCC	CCI	(p value, 2 sided)
N = 330	147	183	
Age (mean +/- SD)	57 (+/-12.70	58 (+/-12.1)	p = 0.39
< 50	42 (29%)	41 (22%)	
50 – 70	78 (53%)	106 (58%)	
>70	27 (18%)	36 (20%)	p = 0.438
Size of tumour reported	123 (84%)	168 (92%)	p = 0.026
Median	1.1 cm	1.9 cm	
Mean size	1.3 cm (+/-1.9)	2.3 cm (+/-1.0)	p < 0.0001
<2 cm	83 (71%)	83 (51%)	
≥ 2 – 5 cm	33 (28%)	67 (41%)	
≥ 5.1 cm	1 (0.8%)	12 (7%)	p < 0.0005
Necrosis status reported	133 (90%)	164 (90%)	p = 0.85
Present	119 (89%)	100 (61%)	
Absent	14 (10%)	64 (39%)	p < 0.0001
Tumour grade reported	140 (89%)	178 (94%)	p = 0.383
Low/intermediate	47 (33%)	116 (65%)	
High	93 (66%)	62 (35%)	P < 0.0001
Margin status reported	131 (89%)	169 (93%)	
Positive	1 (0.7%)	6 (3%)	
Negative	130 (99%)	163 (96%)	p = 0.147
Diagnosis Method	146	183	
FNA	7 (5%)	8 (4%)	
Core	84 (57%)	141 (77%)	
Surgical biopsy	55 (38%)	34 (19%)	p = 0.0004
Surgery site			
Academic	75 (51%)	122 (68%)	
Community	72 (49%)	57 (32%)	p = 0.0021
DCIS clinic attendance	110 (75%)	2 (1%)	
Local recurrence	4 (2.7%)	4 (2.2%)	
Invasive cancer	2	2	

50% of local recurrences were invasive as expected, however recurrence rate were equal between catchments. One of the invasive recurrences occurred in a patient in the TBCC catchment who declined treatment of her initial DCIS.

B. Treatment of DCIS in Alberta

On unadjusted analysis of the entire cohort of patients diagnosed with DCIS in Alberta during the study period, 99% of patients had treatment either with BCS or mastectomy. Four patients did not have treatment – one patient had contralateral invasive breast cancer and poor functional status, one patient had concurrent metastatic cervical cancer – both patients declined treatment and elected observation only. One patient elected holistic treatment and one patient had no explanation given.

Mastectomy was performed in less than half of all patients. BCS was followed by radiation therapy in 56% of patients. The use of radiation in lesions with necrosis was only 62% in spite if its marker of high risk. Axillary node dissection was performed in one quarter of patients who were over 70 years of age, which could represent overly aggressive treatment. Table 5.

Table 5. Treatment of DCIS in Alberta 2000 – 2001; frequency of mastectomy, radiation post BCS, full axillary node dissection

Age	Number of Cases	No Treatment	Mastectomy (%)	Radiation post lump (%)	Full axillary node dissection (%)
< 50	77	0	45 (14%)	20 (12%)	16 (5%)
50 – 70	186	2	82 (25%)	60 (35%)	34 (10%)
> 70	67	2	27 (8%)	16 (9%)	17 (5%)
Total cases	330	4 (1%)	154 (47%)	96 (56%)	67 (20%)

There was no statistical difference in the treatment of DCIS with mastectomy, radiation after BCS or axillary node dissection between the TBCC DCIS clinic catchment and the CCI catchment on unadjusted analysis. Table 6.

Table 6. Univariate analysis for treatment with mastectomy, axillary node dissection and radiation after BCS, by catchment area.

	TBCC	CCI	2 sided p value
Mastectomy	67 (46%)	88 (49%)	NS p =0.66
Radiation post BCS	45 (57%)	51 (55%)	NS p =0.878
Axillary node dxn	34 (23%)	33 (18%)	NS p =0.273

Analysis of mastectomy by catchment area, age, grade, presence of necrosis, site of surgery and method of diagnosis was performed. Interaction terms between each individual covariate and catchment area was examined for evidence of effect modification. Interestingly, tumour size was found to be an effect modifier for treatment with mastectomy. Therefore the analysis was performed again after stratifying by tumour size and adjusting for age, grade, presence of necrosis, site of surgery and method of diagnosis. For small tumours that were < 2cm, treatment with mastectomy was 3.42 times more likely in the CCI catchment compared with in the TBCC DCIS catchment area (95% CI 1.47 – 7.97) which is surprisingly high. No difference was found for tumours greater between 2 – 5 cm or for tumours > 5 cm, however the numbers were very small for the large tumours. Table 7.

Table 7. Comparison of CCI to TBCC for treatment with mastectomy, radiation post BCS and axillary node dissection adjusted for age, tumour size, grade, presence of necrosis, site of surgery and method of diagnosis

Model	OR	95% CI	p value
Mastectomy < 2 cm 2 – 5 cm > 5 cm	 3.42 0.98 n/a	 1.47 – 7.97 0.31 – 3.11 -	 p = 0.0043 p = 0.97 -
Radiation post BCS	1.16	0.47 – 2.89	p = 0.74
Axillary node dissection	1.28	0.62 – 2.63	p = 0.51

The odds of having radiotherapy after BCS in the CCI catchment area was 1.16 times higher when compared to the TBCC DCIS clinic catchment after adjusting for the potential confounders age, grade, necrosis, site of surgery or method of diagnosis. This was not statistically significant (95% CI 0.47 – 2.89).

No difference on the odds of axillary node dissection was found between the CCI and TBCC DCIS catchments areas after evaluating for effect modification with interaction terms and adjusting for the same covariates as potential confounders. There was however, a significant difference found based on site of surgery. The odds of having an axillary node dissection were much higher in community compared with surgery at an academic facility (OR 2.56; 95% CI 1.31 – 5.0).

4. Quality indicators

The quality indicator proportions obtained from patients in the TBCC DCIS catchment area were compared to proportions obtained from the CCI catchment using Fisher's exact test with 2 sided p values. Rate of oncology referral for patients having BCS was significantly greater in the TBCC DCIS catchment than for women in the CCI catchment area (91% vs 67 %; p = 0.0037). Rate of pre operative core biopsy was significantly lower in the TBCC DCIS catchment area than in the CCI area (58% vs 77%; p = 0.0002). No other significant differences were found in the other quality indicators. Results are presented in Table 8.

Table 8. Quality indicators in the treatment of DCIS by catchment area.

Quality Indicators	**TBCC DCIS (%)**	**CCI (%)**	**2 sided p value**
Final clear margin	163 / 169 (96)	130 / 131 (99)	P = 0.14
Complete pathology report	107 / 147 (73)	147 / 183 (80)	P = 0.12
Radiation oncology referral	72 / 79 (91)	69 / 91 (67)	P = .0037*
Lumpectomy	79 / 146 (54)	92 / 180 (51)	P = 0.66
Specimen XR of mammo lesions	40 / 64 (63)	45 / 72 (63)	P = 1
Axillary node dissection	34 / 147 (23)	33 / 183 (18)	P = 0.27
Bilateral pre op mammogram	142 / 147 (97)	177 / 183 (97)	P = 1
Pre operative core biopsy	84 / 146 (58)	141 / 183 (77)	P< .0002*

* by Fisher's exact test, 2 sided p value.

5. Adherence to CPGs

A. CPGs in diagnosis

Logistic regression was used to analyze adherence to CPGs in diagnosis as a function of catchment area. A comparison between adherence in the TBCC catchment and the CCI cathment was made to examine for effect of catchment area on likelihood of adherence to CPGs. On univariate (unadjusted) analysis, the odds of adherence to CPGs in diagnosis were 1.34 times greater in the CCI vs TBCC catchments however, given the range of the 95% CI could have been due to chance (95% CI 0.831 – 2.17). This analysis did not take potential confounding by factors known to influence treatment decisions such as age of the patient, tumour characteristics and surgery site characteristics. Therefore, adjusted analysis to account for such potential confounders on adherence to CPGs was undertaken using multivariate logistic regression. The effect of catchment area on CPGs in diagnosis was adjusted for the following covariates which were chosen based on clinical relevance; age, tumour size, necrosis status, tumour grade, site of surgery and method of diagnosis. Further analysis of all of the listed covariates as well as interaction terms between each individual covariate and catchment area was examined for evidence of effect modification. No interaction term was found to be significant nor was there effect modification by any of the covariates.

After adjustments the odds of having better adherence to diagnosis CPGs at the CCI was reduced from 1.34 in unadjusted analysis to 1.08 after controlling for potential confounders (95% CI 0.45 – 2.53), however falls within the range attributable to chance. None of the potential confounding factors were statistically significant, nevertheless

adjusting for them resulted in a markedly smaller difference in the odds of adherence to diagnosis CPGs based on catchment area. Removing factors from analysis in a more parsimonious model did not result in significant changes from the full model with all of the potential confounders. Table 9.

Table 9. Comparison of CCI to TBCC catchment area for odds ratio, 95% confidence intervals and p values for univariate and multivariate analysis of adherence to CPGs for diagnosis.

Model	OR	95% CI	2 sided p value
Univariate – catchments	1.34	0.83 – 2.17	0.23 NS
Full model adjusted for age, tumour size, grade, necrosis, diagnosis, surgery site	1.08	0.45 – 2.53	0.86 NS

B. CPGs in treatment

As in adherence to CPGs for diagnosis, univariate logistic regression was used to assess the effect of catchment area on adherence to CPGs in treatment. Without controlling for potential confounding by patient and tumour characteristics, adherence to CPGs in treatment was lower in the CCI catchment compared to the TBCC DCIS catchment (OR 0.83; 95% CI 0.53 – 1.28). This difference was not statistically significant.

Multivariate logistic regression analysis was again used to control for potential confounding by patient age, tumour size, grade, necrosis, method of diagnosis and surgery site to examine for effect of catchment on adherence to CPGs in treatment. No

effect modification was seen after modeling interaction terms between catchment area and all of potential confounding factors. After adjusting for confounding by tumour, diagnosis and site characteristics, the odds of adhering to treatment CPGs at the CCI was reduced further than the odds in the TBCC DCIS catchment than on the unadjusted, univariate analysis (0.57; 95% CI, 0.31 – 1.0). Although not reaching statistical significance, the trend towards significance was present (p = 0.08). None of the potential confounding variables influenced the model, nor did reduction of the model result in significant changes. Results are presented in Table 10.

Table 10. Comparison of CCI to TBCC catchment area for odds ratio, 95% confidence intervals and p values for univariate and multivariate analysis of adherence to CPGs for treatment.

Model	OR	95% CI	2 p value
Univariate – catchments	0.83	0.53 – 1.28	0.39 NS
Full model adjusted for age, tumour size, grade, necrosis, diagnosis, surgery site	0.57	0.31 – 1.06	0.08 NS

C. CPGs in adjuvant therapy

As with CPGs in diagnosis and treatment, both univariate and multivariate analysis was performed to evaluate for an association between catchment areas and adherence to CPGs in adjuvant therapy. Univariate analysis found the odds of adherence to CPGs in adjuvant therapy was less likely in the CCI catchment than adherence in the TBCC DCIS catchment (OR 0.63, 95% CI 0.35 – 1.15). No effect modification was

found on analysis of interaction terms between catchments and each of the covariates. On multivariate modeling using logistic regression after adjusting for the same covariates as the other CPGs analysis but with the addition of margin status, adhering in the CCI catchments was reduced even further when compared to adherence in the TBCC DCIS catchment (0.42; 95% CI 0.15 – 1.14). Again there was a trend towards statistical significance (p = 0.09). None of the covariates influenced the model significantly and a reduced model had no appreciable influence on the parameters. Results are presented in Table 11.

Table 11. Comparison of CCI to TBCC catchment area for odds ratio, 95% confidence intervals and p values for univariate and multivariate analysis of adherence to CPGs for adjuvant counseling.

Model	OR	95% CI	2 sided p value
Univariate – catchments	0.63	0.35 – 1.15	0.13
Full model adjusted for age, tumour size, grade, necrosis, margin status, diagnosis, surgery site	0.42	0.15 – 1.14	0.09

IV. DISCUSSION

1. Overview

The discussion has been divided into two main sections. The first addresses the Delphi process to determine quality indicators in the treatment of DCIS. Comparison will be made with other experiences in the literature for the development of quality indicators both in and out of the oncology context. Lessons learned from the process will be explored along with strengths and weaknesses of the study. Finally future applications and areas requiring further investigation will be described.

The second section will focus on the association between treatment in the TBCC DCIS clinic catchment compared to treatment in the CCI catchment area. An overview of the findings and possible explanations will be described, in addition to comparisons with published studies. Strengths and weaknesses will be addressed, followed by implications and future directions.

2. Delphi process to determine quality indicators

A. Panel selection process

The use of pre defined provincial breast disease site group members as the pool from which to draw panelists was effective in that the individuals were nominated from the governing bodies in each province respectively and had demonstrated expertise in the field through participation in other tasks such as clinical guideline development. Most other studies have relied on nominations from governing bodies relevant to the clinic

arena, which would have added another layer to the selection process [49, 62]. Additionally, the larger numbers of the disease site group increased the chances of the number of respondents agreeing to participate.

The drawback to using the provincial disease site groups from which to select the panel was the distribution of clinical specialties in their membership. The composition of the panelists has been known to influence results in a Delphi process. Leape et al. [83] found that in a Delphi process evaluating indications for carotid endarterectomy, the surgeons were more likely to find more indications for the surgical intervention than the non surgeon members. In a study rating the comprehensiveness of indicators for six surgical procedures by surgeons, specialists in related fields and primary care physicians, Kahan et al. [84] found that those surgeons performing the procedure had the highest appropriateness rating, followed by specialists in the same field and then the primary care physicians. The opinions of the specialists and primary care physicians were not influenced more than the surgeons during the group discussion, confirming that diverse groups do provide divergent opinions in spite of influence from others. Both studies found that panelists directly involved with the procedure or operation had different views than those who were less involved.

In a controlled study of managers and physicians using a Delphi process to determine quality indicators in primary care, Campbell et al. [85] found that ratings from a group of comprised of managers was significantly higher than the ratings from the group of comprised of physicians, demonstrating that panelists of similar groupings tend to rate as their peers. Combined feedback provided from both groups to the manager

only group and physician only group resulted in a moderation of ratings. This study and those by Leape and Kahan suggest that panelist composition does affect outcomes and supports the use of multidisciplinary groups in the panel, particularly if more than one group's interests are at stake. In this study use of a multidisciplinary panel was selected to reflect the various groups of physicians involved in the treatment of women with DCIS.

Alberta had no surgeons on their disease site group, which significantly decreased the number of surgeons invited to participate. Both of the two surgeons in the Ontario disease site group agreed to participate, along with one surgeon from the BC group. Given that the BC group is comprised almost entirely of surgeons a greater response rate from BC would have resulted in more surgeons on the panel.

In both Ontario and Alberta, a personalized email and survey was sent to each disease site member along with the invitation to participate. In contrast, a mass mailing occurred for the BC site group from the network administrator for their group, without personalized invitations. The higher response rate outside of the BC disease site group may due in part to the members being singled out personally for the Delphi as well as the direct communication provided by the author, which may have added some validity to the request.

Another limitation to using the provincial disease site groups was the lack of radiologists in their membership. Therefore, it was not possible for any radiologists to be on the final panel. Given that there were 3 quality indicators ultimately selected that fall under the auspices of radiology – specimen x-ray for mammographically detected lesions,

pre operative bilateral mammogram and pre operative core biopsy – the inclusion of radiologists on the panel may have influenced selection of those variables as quality indicators or their rankings of priority.

There were a disproportionate number of medical oncologists (7/17) on the final panel that may have influence the selection process, particularly with respect to some of the wide variation seen within ratings for specific variables. Medical oncologists typically do not see patients with DCIS clinically as a matter of routine as they do not receive chemotherapy. Some medical oncologists do see DCIS patients to discuss treatment with tamoxifen, however whether this is true for the members of this panel was unknown.

The greatest disparity in rankings was seen in the variable regarding axillary node dissection, with the majority of medical oncologists voting to exclude this variable, while the remainder of the panel voted to "definitely include" or "consider including". Similarly, in the variable regarding complete pathology reports the only two votes that were not strongly in favour of "including" were from medical oncologists. This may be due in part to medical oncologist not treating DCIS patients routinely and being less familiar with the actual process of deciding on therapies.

Inclusion of more pathologists, radiologists and surgeons may have had some influence in the findings, however the overall rankings were fairly congruent with each other. Through the process, movement by the group was towards greater agreement after the comments from other panelists were circulated during the 2nd and 3rd iterations of the Delphi process. The panel consisted of at least one member of each specialty making it a

truly multidisciplinary in nature and in addition, members from three provinces across Canada, which should improve generalizabiliy of the findings.

B. Selection of quality indicators

This is the only study describing the development of quality indicators in DCIS to date. The three round Delphi process used in this study was successful in selecting and prioritizing quality indicators in the treatment of DCIS using an expert panel. There are no previously published indicators in the treatment of DCIS to compare the actual selected indicators as determined from this study, therefore it is difficult to determine if those selected are congruent with others. Cancer Care Ontario is developing quality indicators in breast cancer surgery and released preliminary indicators of high priority [58]. Two of the CCO quality indicators were the same as ones selected by this panel. The first is the proportion of women treated with BCS who are referred to a radiation oncologist. The second in common with the CCO indicators was the proportion of patients for whom the pathology report includes tumour size, margin status, nuclear grade and the presence or absence of comedo necrosis, identified specifically for patients DCIS [58]. The focus of the CCO's quality indicators as evaluation of system level processes differs from this study's purpose to evaluate the processes of treatment. These differences highlight the importance of determining what level of the care process that is being evaluated, as indicators may differ depending on what is being assessed. All of the quality indicators were at the treatment level in this study, therefore it is not surprising that only two were in common with the those of the CCO.

The Delphi process used in this study had a number of limitations. Selection of the proposed quality indicators used in the consensus process was obtained from published guidelines and standards on the treatment of DCIS [38, 39, 57] as opposed to primary literature review. Because these guidelines were evidence based with supporting data outlined in each document, it was felt that the most applicable evidence based indicators could be selected from the published CPGs. It is possible that some potential indicators may have been missed, although each panelist who was an expert in the field was provided an opportunity to suggest other indicators during the survey to ensure a broad scope. In addition, the pilot survey of local experts failed to uncover further suggestions and resulted in excluding one indicator.

The selection process did not break the treatment of DCIS into functional groups, such as diagnosis, surgery and adjuvant therapy. This may have helped to direct the focus of the panelists when selecting quality indicators as in the study by Malin et al. [49] and the Ontario colorectal indicators [62]. Nevertheless, indicators that evaluate portions of the diagnosis process, as well as the surgery and adjuvant treatment components were selected by the panel in spite of keeping the variables under the auspice of "treatment".

One limitation of this study was the lack of truly interactive feedback that is possible only with group meetings. One of the panelists had questioned the target rate set for referral to radiation oncology, writing in the comments that they did not agree with the 80% target. No suggestion on an alternative target rate was made. In fact, the panelist rated the indicator as 1 "definitely include" making interpretation of their opinion regarding the indicator difficult. There was no opportunity to question the panelists on an

interactive basis about their comments. It is remains uncertain if any of the other panelists had concerns regarding any part of the definition or description of the indicators, which might have been addressed in a truly interactive setting.

C. Implications and future directions

The development of quality indicators in the overall treatment of DCIS was possible using a Delphi process. The panel was selected from a multidisciplinary group of experts from three provinces that should increase generalizability. The Delphi process also allowed for anonymous feedback to allow members to voice their opinion regarding specific indicators. The quality indicators ranked in order of priority were easily determined from chart review for each patient in the TBCC and CCI catchments and evaluated in the second portion of the study.

Future research into the validation and implementation of such quality indicators remains to be done. Definitions of what is being measured as well as from what perspective, as indicators at the system level will differ from those developed to assess quality of care at the treatment level [63]. On a broader level, determination of the role such indicators play in the overall measurement of quality in health care needs to be established.

3. Analysis of treatment by catchment area

A. Characteristics of the study population

Aside from age, the characteristics between the TBCC DCIS catchments and CCI

catchments varied significantly which was an unexpected finding. The size of the tumours in the TBCC catchments tended to be smaller than those at the CCI, with only one tumour reported greater than 5 cm, compared to 12 at the CCI. Tumour size has not been found to be associated with higher risk of local recurrence [22, 82, 86] but is associated with higher rates of mastectomy [8, 41]. Interestingly, no difference in mastectomy rates between the TBCC and CCI catchments areas was found in this study (46% vs 49%, 0 = 0.66).

Possible explanations for the larger tumours in the CCI catchments area may be related to method of detection. The majority of DCIS lesions are detected on screening mammography at a small size before clinical detection is possible. Therefore, differences in screening behaviours between the two catchments may play a role. Self reported rates of screening mammography in Alberta for 2000 were approximately 60%, with 13.1% of women aged 50 – 70 participating in the organized provincial screening program, ScreenTest [87]. The availability of ScreenTest to all women in Alberta aged 50 – 70 without a referral is spread across the province, with a mobile unit traveling to areas not serviced by the permanent locations in Calgary and Edmonton. As a result, access to some form of screening mammography independent of physician referral should be similar in both areas.

If a greater number of women performed screening mammography in the TBCC catchments area, they may be detecting tumours at a smaller size. Evaluation of the size of tumours found through ScreenTest may assist in determine if the lesions detected in southern Alberta are truly smaller than those in the north, or if another characteristic can

explain the size differential, such differences in screening intervals.

Tumours that are found by palpation tend to be larger in size [7]. It is unknown if a greater proportion of tumours in the CCI catchments area were palpable. Fine needle aspiration (FNA) biopsy is generally performed in masses that are palpable and similarly, lumpectomies do not require needle localization if they are palpable; both rates of which were the similar in both catchments areas (FNA 5% vs 4% and non imaged guided lumpectomy 56% vs 60%). Further information on both methods of detection and mammography screening patterns in both catchments areas is needed.

The tumour grade and presence of necrosis were greater in the TBCC catchments than in the CCI catchments area. This is surprising given tumours that are larger tend also to be of higher nuclear grade, and are more likely to have necrosis [7] which is the opposite of what we found in this study. One possible explanation is differences in pathologic interpretation and reporting. If the pathologists are using different criteria for assessing grade or necrosis, then a misclassification bias may be occurring with lesions systematically being assessed with different criteria. There is considerable disagreement surrounding the terminology which represents high nuclear grade and presence of central necrosis; "comedo necrosis", "comedo type necrosis", "comedo subtype" and "necrosis" which may account for differences in reporting of necrosis status even among experienced pathologists [7, 9, 88]

In addition, the determination of the size of the tumour is not standardized universally. The nature of the tumour cells to grow along the ducts often precludes the formation of discrete masses whose diameter can be measured. Tumour cells are often

interspersed with normal tissue and if transected perpendicularly to the ducts, the total size may be difficult to measure. Examples of measurement include counting the number of slides that contain tumour cells and multiplying the number of slides by the slide thickness to estimate total size [7]. Other reporting utilizes descriptions of the span of each foci, and reporting on the largest [21]. Although tumour size that was reported in descriptive terms without a numeric value were excluded, it is unknown exactly how each numeric value was calculated, which may influence values obtained in this variable.

A major limitation of most studies evaluating DCIS on a population level is the lack of consistent reporting of the pathology variables such as size, necrosis, grade an margin status. Interestingly the rate of reporting for pathologic variables was consistently high above 84% for all variables in both catchments, with no difference in reporting between the two groups. Given the low rates of missing pathology, it is unlikely that difference between groups can be accounted for by those not reported.

Women in the CCI catchments area were significantly more likely to have a preoperative core biopsy as opposed to an open surgical biopsy. Core biopsy for diagnosis of mammographic and palpable tumours has high rates of sensitivity and specificity, particularly with the large vacuum assisted devices available today. The Canadian CPGs for both invasive breast cancer and DCIS recommend that core biopsy is preferable to open surgical biopsy as better preoperative planning can be performed if invasion is found, and can allow the woman to have her definitive surgery under one anesthetic [39, 89]. In addition, the number of women having surgical biopsy with its' attendant risks and morbidity can be decreased. Differences may be related to access to

facilities that perform core biopsy, or that surgeons are choosing to perform lumpectomies for diagnosis either due to access issues to core biopsy or personal preference.

The number of women being treated at an academic facility associated with a teaching hospital is significantly greater in the CCI catchments compared with the TBCC. Calgary has only two teaching hospitals in the urban centre, with a large volume of cases being performed at the non teaching or "community" site. In contrast, there are 4 facilities in Edmonton that are associated with the University of Alberta medical school therefore the likelihood of being treated there is expectedly higher.

The number of women in the TBCC DCIS catchments area who actually attended the DCIS clinic was 75%. Further analysis of the predictors of DCIS attendance within the TBCC catchments after controlling for other factors such as age, tumor characteristics, method of diagnosis, type of surgery and surgery site found that treatment with mastectomy was highly correlated with not attending the clinic (OR 7.55, 95% CI 2.02 – 28.18). This is likely due to the fact that generally no further treatment is needed after mastectomy, therefore attending the DCIS clinic unlikely to add further benefit to the patient.

The significantly different populations that make up the TBCC DCIS catchments and the CCI catchments must be accounted for any analysis between groups. Ideally, both strata would be not significantly different from each other, however this study was a "natural" experiment using samples of convenience without the benefit of randomization or other matched control designs. These findings emphasize the need to adjust for these

factors when comparing groups.

B. Treatment of DCIS in Alberta

The distribution of treatments in Alberta compared to other population based studies evaluating treatment of DCIS during a similar period was not dramatically different. The proportion of treatment with mastectomy was higher in this study compared with proportions described in Europe by Verkooijen et al. and Baxter et al. in the US neither of whom reported size of tumours, which may have played an influential role. This study and Baxter's study found similar rates of radiotherapy after BCS, which were much lower than the 75% rate reported by Verkooijen in the small Geneva cohort. Similarities in findings with the American study may reflect shared guidelines and practice patterns, and a distinct pattern of practice in Geneva with high rates of BCS.

Baxter found 33% of patients treated with BCS who had necrosis on pathology did not undergo radiation therapy. Our findings were similar with 38% of not undergoing radiotherapy after BCS. These similarities may reflect common practice patterns and CPGs between the US and Canada.

Table 12. Treatment of DCIS with mastectomy, radiation post BCS and AND across 4 studies.

Treatment	Kotwall et al. 1999 - 2000	Baxter et al. 1999	Verkooijen et al. 1999	Alberta 2000-2001
Mastectomy	52%	28%	23%	57%
Radiation post BCS	N/A	54%	75%	56%
AND	25%	15%	16%	20%

A surprising finding in our study was that treatment with mastectomy was significantly higher in the CCI catchment only in tumours less than 2 cm after adjustment for other factors. The greater likelihood of having a mastectomy may reflect a personal preference of the women in the CCI catchment or may be influenced by other factors such as long distances to a radiation facility and being away from home for the 5 week radiation treatment period. No other demographic information such as socioeconomic status, level of education, rural or urban residence or marital status was available for analysis, which may have provided some clues to the differences in the personal characteristics between the catchments that might explain the high rates of mastectomy.

The higher rates of axillary node dissection in the community hospitals was significant on adjusted analysis. Review of the OR notes found that surgeons had performed purposeful AND in most cases. Justification for AND was found in 6 cases, 3 in the community and 3 at academic sites. In each case invasive disease was reported or suspicious on biopsy leading the surgeon to perform AND which is considered acceptable judgment. On final pathology however diagnosis ended up as pure DCIS.

It is unclear whether or not use of axillary node dissection is due to a genuine concern for occult invasion, a motivation outside of medicine such as financial remuneration or, lack of understanding of the pathology of this disease. A better understanding of the factors influencing this treatment choice will facilitate interventions to decrease overly aggressive therapy in the future.

C. Quality indicators

The quality indicators developed in the first part of this study were ranked in order of priority by the expert panel. Categorizing the indicators by importance would place final clear margin, complete pathology report and radiation oncology referral in the high or top priority group. This category was a natural division as these three indicators were consistently rate 1, 2 or 3 by the majority of panelists. The next three "intermediate" variables lumpectomy, specimen x-ray for mammographically detected lesions and axillary node dissection were also very close in ranking, within less than 0.5 of an average score between them. Finally, bilateral preoperative mammogram and pre operative core biopsy rate would be considered low priority.

The number one quality indicator was final clear margin rate. Both catchments areas had very high ratios of >95% which was set as the target goal for good quality. No significant difference was found between the TBCC and CCI catchments (96% vs. 99%, p =0.14) Because this generally falls under the auspices of the surgeon, we looked to see how many of the patients who had a documented positive margin had been referred to either cancer centre and were recommended to have further surgery for positive margins. A total of 21 patients in the TBCC catchments had positive margins documented after a surgical procedure, 14 of which had re-excision by the surgeon. Seven patients were sent to the TBCC DCIS clinic where all of them were recommended to have further surgery to obtain clear margins. One patient was lost to follow up, and the other 6 proceeded with a re-excision or mastectomy. Similarly, 24 patients at the CCI had positive margins documented after a surgical procedure, 19 of which had re-excision to negative margins

by their surgeon. Five were sent to the CCI and recommended to have further surgery, all of whom did. The course of these 12 patients suggests that referral to the cancer centre resulted in obtainment of clear margins and that some were left with positive margins after their initial surgeries. What is unclear is whether or not the surgeon had advised the patient that clear margins are the standard and if the patient declined further surgery, or wished a second opinion regarding other modalities to treat it.

Also considered a top priority was the complete pathology rate. Neither catchments area achieved the target goal of >90%, however the rates were not significantly different from each other (TBCC 73% vs CCI 80%, p =0.12). Interestingly, there did not seem to be a consistent element of the report missing causing the report to be incomplete. As noted in the assessment of patient characteristics, the reported rates for each individual component of the complete pathology report was high. The more likely explanation is that the majority of the incomplete pathology reports are a result of only one missing component. To assess for likelihood of an incomplete pathology report, descriptive analysis was performed to examine for patterns that may explain why these were missing such as advanced age, treatment with mastectomy or type of treatment facility (academic or community). Chi square methods were used to determine if having incomplete pathology reporting was predicted by age, surgery site, type of surgery or method of diagnosis. No significant difference between groups was found on any of the listed variables.

The only high priority quality indicator that was significantly different between groups was referral to radiation oncology after BCS (TBCC 91% vs CCI 67%, p <

0.0037). The presence of the clinic was likely to have played a significant role as there was facilitated referral through an invitation to attend sent out at the time of treatment. Over time, the surgeons also may have developed a culture of sending all of their DCIS patients for assessment as a matter of routine simply because they knew the clinic existed. By this measure, the TBCC catchments area appears to provide significantly better quality care to their patients who have had lumpectomy.

Even though radiotherapy rates were excluded in the final list of indicators, a comparison was made to determine if the actual proportion of radiotherapy treatment was different among between groups. There was no significant difference in the proportion of patients ended up with radiotherapy treatments (62.5% vs 72% $p = 0.21$) suggesting that in spite of the greater proportion of referrals, this has not been reflected in the actual number of patients who ultimately end up being treated with radiotherapy.

There was no difference in the proportions of patients treated with lumpectomy, having a specimen x-ray if mammographically detected or a complete axillary node dissection. All of these elements of treatment occur during the time of surgical intervention, which generally occurs prior to referral to the cancer centre. The rates of lumpectomy were similar to those found in other population based studies in North America [8, 43] and less than those in Europe [41]. A prospective study to determine patient preference for mastectomy would be clarifying, in addition to providing standardized and complete pathologic reporting.

Like Baxter et al., our study found a surprisingly high rate of axillary node dissection in both catchments, far above the recommended level of < 10% that was the set

target rate. That the value is not set at 0% is to provide for some judgment in cases where the suspicion for invasive cancer is high, based on the pathologic report or clinical findings. A large study at Memorial Sloan Kettering Cancer Centre evaluating so called "high risk" DCIS – those that are palpable, are so large they require a mastectomy or have microinvasion (<1mm of invasive tumour) have shown these to comprise only 10% of all DCIS cases in a large series [41]. All of the cases in Alberta were dictated as purposeful AND's, with only a few providing justification in their operative note. A study evaluating AND in patients treated in Ontario with DCIS found strikingly similar rates with no clear influencing factors aside of treatment with mastectomy (Rakovitch, personal communication; 2005).

Falling short of the target > 90% rate of specimen x-ray was the identical rates of 63% in both catchments. Difficulties with locating documentation of the x-ray from the patient record or registry chart may contribute to the problem. Misclassification bias may occur as lack of documentation in the chart would cause the case to be coded as not having had a specimen x ray, when in fact one was performed and not documented. Improved standardized reporting of operative notes to include this element would be required to ensure its accuracy. In addition, poor ability to abstract the information from the medical chart may make it a difficult indicator to interpret and draws into question its feasibility as a good quality indicator.

The lowest priority indicators that both occur during the diagnosis phase of the treatment process are unlikely to be affected directly as a result of the presence of the multidisciplinary clinic. Use of these two variables to assess the quality provided could

only reflect an educational or an institutional treatment effect that developed over time *indirectly* as a result of the clinic. Although active continuing medical education (CME) initiatives were not a part of the DCIS clinic, such activity to inform surgeons and family physicians of the need for preoperative bilateral mammograms or the availability of core biopsy facilities may occur and impact the community in the presence of such a clinic. In addition, dictated consultation letters can be a passive form of informing referral physicians of preferred or best practice.

The improved core biopsy rate of at the CCI may be related to the greater number of teaching facilities in the area or, a greater number of facilities providing biopsy services. The increase in surgical biopsy rate in the TBCC catchments may be influenced by greater ease on the part of physicians to obtain tissue with an open biopsy due to difficulties with access to biopsy machines. Further information regarding the availability and access to biopsy facilities is required to properly assess the reason for the significant difference in this indicator.

Both of the lowest ranked quality indicators measure processes that occur before potential contact with the TBCC DCIS clinic or the CCI cancer centre. Use of core biopsy and preoperative bilateral mammograms are not under the direct influence of the clinics as they occur during the diagnostic phase of the treatment of DCIS. It could therefore, be argued that they should not be used in the evaluation of the effect of the DCIS clinic on treatment. The panelists ranked both of these indicators as least important, which may reflect an acknowledgement of the limited influence organized clinics may have on the diagnostic period. While these indicators do not measure

processes during the actual treatment phase, they can provide some insight into any overt differences between the populations serviced between each catchment area.

This study found a statistically significant difference between quality indicators in the two catchments areas, one of which was considered high priority by the expert panel. Assessing the quality of treatment using these objective measures suggests that improved care is present using these performance measures as a benchmark. Importantly, the lack of attainment of the target levels in a number of quality indicators provides some insight into areas requiring improvement across Alberta that are not being addressed. In addition, baseline values are now available for benchmarks that can be re-evaluated after strategies are implemented to address these needs. Prior to the use of these indicators clinically, their validation is required.

D. Adherence to CPGs

By breaking the adherence to CPGs into separate functional components allows discrete segments of the treatment process to be evaluated together, which may provide more relevant information about the process of care.

a. CPGs in diagnosis

The diagnosis portion of the treatment process is largely determined by family physicians and surgeons, prior to any consultation with an oncologist. While some care models have evaluated pre operative assessment of patients to assist in decisions surrounding treatment [90], the diagnostic work up is done without consultation with an

oncologist. Not surprisingly, the adherence to CPGs in diagnosis was not significantly different between the CCI and TBCC DCIS catchments.

b. CPGs in treatment

The odds of adherence to treatment CPGs in the CCI catchments was almost half that of adherence in the TBCC DCIS catchments area after adjusting for tumour and surgery site characteristics, suggesting an association with the presence of the DCIS clinic. That the trend is in favour of the TBCC DCIS catchments suggests that there is an association with improved compliance to guidelines that is smaller than the power available to detect a smaller difference given the sample size. The analysis in this outcome was calculated on only 264 patients due to the exclusion of all of those cases that did not have a complete pathology report. The reduced sample has 80% power to detect a 17 percent difference. To detect a difference of 10% would require a sample size of approximately 400 patients. Given the DCIS clinic format no longer existed after 2001, no opportunity existed to increase the sample size in order to detect a smaller difference.

c. CPGs in adjuvant counseling

The adherence to adjuvant CPGs was similarly less than half as likely to occur in the CCI catchments than in the TBCC catchments.

The possibility that there truly is no difference between treatments provided between catchments may be due to the presence of an established referral pattern and

network of physicians that exists in the CCI catchments area in spite of the lack of formal organization. Informal networks among health care providers, especially those that have been established for some time have been shown to have an effect on physician practices [91]. In addition, the "culture" of a group of individuals, may be difficult to break and effect change in practice behaviour, due to ingrained beliefs that may persist in spite of logical arguments to the contrary [92]. For example treatment of DCIS with mastectomy in every case may be due to a surgeons belief that it is a better treatment, in spite of evidence demonstrating the benefits of BCS with radiotherapy.

The initial impetus for the development of the TBCC DCIS clinic was the recognition of wide variations seen in the treatment patterns of patients in southern Alberta. A time series comparison within the TBCC catchments area may have been better able to determine if the presence of the clinic improved care after its implementation. Confounding by the introduction of the national CPGs and general acceptance of BCS for treatment of invasive breast cancer need to be taken into consideration. The use of the CCI catchments area allowed control for similar influences on each group during the study period, including exposure to the widely published CPGs.

Although potential confounding factors such as patient age, tumour characteristics and surgery site characteristics were controlled on multivariate analysis, there remain other potentially influential factors that were not measured. Inclusion of other patient characteristics such as socioeconomic status, education level, actual location of patient residence (urban vs rural) as well as treatment level factors such as local practices and surgeon/oncologist characteristics (gender, advanced training, year of graduation etc)

may have provided more insight into treatment patterns. In addition, system level factors such as access to technology (ie image guided core biopsy), access to operating room time and location of radiation facilities may play a role.

Overall this study found a trend towards improved adherence to guidelines in the portions of treatment most likely to be influence by the presence of the DCIS clinic. No difference was found in the diagnosis phase as expected given the lack of direct influence of the clinic during that portion of the treatment.

4. Study strengths & weaknesses

The main strength of this study was the use of population-based data capturing incident cases of DCIS in the province and its relatively high reporting of pathology variables. In addition, it is the only study to have utilized defined quality indicators in DCIS developed using accepted consensus methods with an expert panel. The use of adherence to CPGs also provided insight into the effect of integration of the number of steps involved during each of the diagnostic, treatment and adjuvant phases of the management of DCIS and was used as measure of advanced process and intermediate outcomes.

Limitations of this study include its lower power to detect smaller differences that may have been present. This is in part exacerbated by the missing values in pathology reporting that tended to occur randomly as opposed to in certain individuals. For example instead of having a number of cases with poor pathology reporting across the board, most cases had only one of the necessary elements missing, precluding it from

being included in the CPGs treatment calculations. While possible that the characteristics of those with missing data is different than those who were reported, examination of the characteristics of those with missing pathology reports did not reveal any influencing factors such as patient age, treatment type or site of surgery.

Treatment variations were similar to those reported by others and no new information on the predictive factors for specific treatments were revealed in this study. More information on specific demographic variables of the patients in each catchment such as socioeconomic status, education level etc. may provide greater insight into the factors that influence treatment choices.

Lack of detailed information on the culture of practice in the CCI catchments area may have been significant. If a culture of excellent referral and assessment of DCIS patients through an informal network existed, then the formality and organization provided in the TBCC DCIS may be negated.

5. Conclusions

This study used a structure, process and outcome framework to evaluate the effect of organizational change in the treatment of patients with DCIS in Alberta. Eight quality indicators in the treatment of DCIS were developed using a three round Delphi process on a multidisciplinary expert panel from across Canada. The quality indicators were used successfully as measures of process in the evaluation of the introduction of a formal, organized multidisciplinary DCIS clinic in Alberta. Adherence to CPGs as a measure of advanced process measures of appropriateness and as an intermediate outcome was

assessed for the diagnosis, treatment and adjuvant phases of care for women with DCIS.

This study found that treatment of DCIS in a catchments area with a formal multidisciplinary DCIS clinic was improved over treatment of DCIS in a catchment area with no formal multidisciplinary clinic as measured using one high priority quality indicator. Although not attaining statistical significance, a trend towards improved adherence to CPGs in treatment and adjuvant therapy was found in the TBCC DCIS suggesting some improvements in quality over the CCI catchments with no DCIS clinic.

6. Implications and future directions

The presence of a formal, organized DCIS multidisciplinary clinic in the TBCC catchments area was found to provide at a minimum equivalent and improved care in one high priority quality indicator over care in the CCI catchments. A trend towards improvement in adherence to CPGs that address the component of care involving oncologists was identified. Factors influencing treatment choices are not entirely clear after controlling for common predictors such as demographics and tumour characteristics.

This study explored the influence of a formal organizational and structural change on the treatment choices. However, the study failed to identify which processes within that change impacts change the most. Further research into the formal and informal networks that health care professionals work and interact in to provide care to patients in a multidisciplinary setting are needed.

In addition improvements from the patient perspective were not addressed in this study. What remains unknown is the experience of the women treated in the clinic with

respect to the potential psychological and emotional benefits, or the reassurance provided through the knowledge that their case was reviewed in by a team of multidisciplinary specialists with expertise and special interest in DCIS. Evaluation of perceived benefits of the women who attend the DCIS clinic would address the non tangible benefits provided in this type of setting, as there is evidence that patient's psychological needs are better met in organized multidisciplinary clinics [47, 93].

The establishment of a method with which to measure quality of care used in this study is a first in the treatment of DCIS. While not without limitations, a group of 4 prioritized indicators was developed using the Delphi process and experts from across Canada. It was demonstrated that development of quality indicators is feasible in a disease that is not straightforward, particularly with respect to its treatment options provided by multiple clinical specialists. Research into the validation and implementation of such quality indicators as a measure of care is required both in breast cancer and other health realms.

This study has examined the challenges involved with measuring quality of care using the example of the treatment of DCIS in Alberta. The application of the structure, process and outcome model of measuring quality was used to provide a framework within which the evaluation of quality could be addressed. Examination of the effect of interventions like the formal multidisciplinary DCIS clinic on quality of care require defining what elements of the care pathway are being evaluated as well as discrete and defined measures of that pathway.

The lack of an obvious and clear benefit from the formal multidisciplinary DCIS

clinic suggests that perhaps the formalization of care pathways is not necessary if established networks and practice patterns already exist. Future directions should include improving the networks that may or may not require a physical connectivity to be successful in providing the desired level of care.

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