TITLE: PATTERNS OF SURGICAL TREATMENT FOR WOMEN DIAGNOSED WITH EARLY
BREAST CANCER IN QUEENSLAND

SUBTITLE:

SHORTENED TITLE FOR RUNNING HEAD: TREATMENT PATTERNS OF EARLY BREAST
CANCER

AUTHORS:

Bridie Thompson¹, Peter Baade¹, Michael Coory², Philippe Carrière³, Lin Fritschi⁴

1 Viertel Centre for Research in Cancer Control, The Cancer Council Queensland,
Spring Hill

2 School of Population Health, The University of Queensland, Herston

3, School of Public Health, Queensland University of Technology, Kelvin Grove

4 Western Australian Institute for Medical Research, The University of Western
Australia, Nedlands

Corresponding author

Bridie Thompson, Epidemiology Unit, Viertel Centre for Research in Cancer Control,
The Cancer Council Queensland, P.O Box 201, Spring Hill, Qld 4004, Australia. Tel.:
+61 7 3258 2307; fax: +61 7 3258 2310

E-mail address: bridiethompson@cancerqld.org.au

Keywords:

breast cancer; mastectomy; treatment; patterns; age; geographical differences

ABSTRACT

Background: Australian women with early breast cancer should be given the choice between breast conserving surgery (BCS) or mastectomy. This is the first Australian study to report on patterns of surgical care specifically for early breast cancer at a population level.

Methods: Two population-based routine data collections were linked to obtain surgical treatment information for breast cancer cases diagnosed in 2004 in Queensland, from which we identified 1274 cases of early female breast cancer. Logistic regression was used to assess the likelihood of female breast cancer patients having mastectomy, BCS and axillary node dissection, after adjusting for patient and hospital demographics, tumour size and comorbidities.

Results: Three-quarters (77%) of women had BCS, 29% had a mastectomy and 86% had dissection of the axillary lymph nodes. The likelihood of women having mastectomy was higher among women living in rural areas, those treated in public hospitals, and women who had comorbidities of anaemia or heart failure. In contrast BCS was more likely for women treated in private hospitals or hospitals with high surgical caseload. Heart failure decreased the likelihood of BCS. Having an axillary node dissection was more likely among younger women and those treated in high caseload hospitals.

Conclusion: The observed differentials in surgical treatment for early breast cancer patients suggest that access issues may have contributed to the decision making process. Understanding the reasons why women with early breast cancer choose a certain treatment strategy should be a focus of future research.

SYNOPSIS

Patterns of care studies assist in evaluating compliance with clinical practice guidelines.

Variations in surgical management of early breast cancer exist according to geographical residence, age, comorbidities, tumour characteristics and hospital characteristics.

INTRODUCTION

Current recommendations for women diagnosed with early breast cancer are that they be offered the choice of either a mastectomy or breast conserving surgery (BCS) followed by radiotherapy.^{1, 2} These recommendations are based on a review of randomized trials that concluded there was no definitive difference in overall survival between patients treated with mastectomy and BCS.^{3, 4} ~~However, Adjuvant radiotherapy following BCS is a major factor in reducing the rate of local recurrence.²⁻⁴ However, radiotherapy is also associated with an increase in death from causes other than breast cancer, especially for women aged over 60.²⁻⁴ Although there is no evidence of improved overall or cancer specific survival differences,~~ randomized clinical trials have found slightly improved rates of disease free survival for women treated with BCS compared to those treated with mastectomy⁴⁻⁷, provided that radiotherapy is included in the treatment⁶. One clinical trial concluded that for early breast cancer, BCS was the best treatment option for patients of all ages⁷ which was also reflected in a survey of surgeons in the United Kingdom investigating preferred treatments⁸. Patients treated with BCS have reported a higher level of acceptance⁹ of the treated breast and that body image is better preserved than when treated with mastectomy¹⁰. Australian guidelines stipulate that when making the treatment choice, women should be informed that body image is better preserved with BCS.¹

Various factors influence whether women receive BCS and mastectomy, including geographical residence¹¹⁻¹⁴, age of the patient^{11, 12, 15}, access to healthcare facilities (including radiotherapy services) and costs^{16, 17}. A New South Wales study found that

53% of women living in urban areas had a mastectomy compared with 61% of their rural counterparts.¹³ This is consistent with the proportion of women who received BCS being 17% lower among women living in rural areas of Western Australia compared to women living in urban areas.¹⁴

One Australian study reported that younger women are more likely to have BCS.¹² Studies carried out in the United States suggest that older women are less likely to receive extensive surgery which means that they are more likely to have BCS than younger groups, but without adjuvant therapy.¹⁸⁻²¹ Lazovich et al found that in one region of the American population, there was decreasing likelihood of BCS and of radiotherapy following BCS with increasing age.²² Decreasing likelihood of axillary lymph node dissection with increasing age is a consistent trend in Australia^{13, 15} and internationally^{18, 20, 23-25}.

To date, Australian studies have included all stages of breast cancer.^{11-15, 26} Including more advanced cases of breast cancer, for which mastectomy is usually recommended²⁷, limits the ability to describe treatment patterns for women with early breast cancer.

This Queensland study is the first Australian study to report on patterns in surgical treatment specifically for women with early breast cancer. This study examines factors associated with the type of treatment utilised for women with early breast cancer in Queensland, including urban:rural differences, age, surgical caseload of the treating hospital, and presence of existing or resulting comorbidities. It also adjusts for known potential confounders including tumour size^{13, 28}, comorbidities¹² and surgical caseload volume²⁹.

METHODS

Approval to conduct the study

Ethical approval to conduct this study was obtained from The University of Queensland Medical Research Ethics Committee and Queensland Health Human Research Ethics Committee. Separate approval was obtained from Queensland Health to access the routinely collected population-based breast cancer incidence data diagnosed in Queensland in 2004, and to link this with the Queensland Hospital Admitted Patient Data Collection (QHAPDC).

All incident cases of invasive breast cancer (ICD_O C50) diagnosed between 1st January 2004 and 31st December 2004 were selected from the Queensland Cancer Registry (QCR). Cases of ductal carcinoma in situ were excluded. All public and private hospitals, pathology services and residential care facilities are required under the Public Health Act to notify of all confirmed cases of cancer to the QCR. The cohort of early stage breast cancer was based on the International Union Against Cancer classification of early breast cancer, as outlined in the Australian Clinical Practice Guidelines for early breast cancer¹. The study cohort was selected according to the specification of this classification of: T1-2, NO-1, M0.¹ The T classification was met by only including cases with tumours 5cm or smaller. Meeting the specification of N0 was achieved by excluding any cases with positive lymph nodes. None of the cases had known metastasis.

Hospital admissions

The QCR maintains a record of the most recent hospital-specific admission for each cancer patient, along with the unique identifiers on both the hospital admission record and the QCR database. Treatment in a hospital outpatients department is not recorded. The hospital information was used to select treatment and co-morbidity information from the Queensland Hospital Admitted Patient Data Collection (QHAPDC). Multiple hospital admissions could be extracted for the same patient.

Only hospital admissions between 1st January 2004 and 31st December 2005, and whose separation from hospital was after the date of breast cancer diagnosis were considered for this study. Each woman in the breast cancer cohort therefore had at least 12 months follow up time after diagnosis to assess treatment options.

Some breast cancer cases could not be linked to any hospital records, such as when the cancer notification was obtained solely from another source (e.g. from pathology records alone). Treatment in a hospital outpatients department did not result in a notification to the cancer registry. Since the specific reason why a case had no linked hospital records could be related to the notification process, the data linkage or the lack of surgery, we did not include any of these patients in the analysis.

Specific data items

Surgical procedures for the treatment of early breast cancer were categorised into three groups according to ICD-10-AM procedure block codes; mastectomy (1747 - 1749), breast conserving surgery (1744 and 1745) and dissection of axillary lymph node (808).

Although there are specific codes for combining mastectomy with axillary lymph node dissection (1750 - 1751), these codes were not used in the Queensland data. Women were categorised as having a specific treatment if they had at least one hospital record of having that procedure during the study period. Women could have more than one type of treatment.

Categories of remoteness were determined by the place of usual residence of the patient when diagnosed and defined by the Accessibility/Remoteness Index of Australia (ARIA+).³⁰ ARIA+ defines remoteness on the basis of five categories: Major City, Inner Regional, Outer Regional, Remote and Very Remote. For the purpose of this study, the categories of Outer Regional, Remote and Very Remote were combined to create the “Rural” category. Age was collapsed into 6 age groups (see Table 1). The treating hospitals were categorised into high volume and low volume based on the number of breast cancer-related surgical procedures carried out in each hospital during the study period. This method has previously been demonstrated by Bach et al.³¹ After considering the frequency distribution of surgical caseloads across the hospitals, we arbitrarily defined high volume hospitals as those conducting at least 101 breast cancer-related surgical procedures. We also categorised the hospitals into public or private hospitals.

A patient’s ability to tolerate treatments and their comorbidities are an important consideration in clinical decision making for breast cancer patients.³² Therefore for each patient episode, principal or other diagnosis codes were used to identify comorbidities (based on ICD-10-AM classification). These diagnosis codes were only listed on the hospital separation form if they affected the patient’s management in terms of treatment, diagnostic procedures or monitoring. A woman in the study cohort was

assumed to have a specific comorbidity if at least one hospital episode listed that comorbidity on the separation form. Only those co-morbidities which occurred in at least 50 patients were included in the analyses, and these were: anaemia (D50 – D64), diabetes (E10 – E14), hypertension (I10 - I15) and heart failure (I50 – I50).

Analyses

Chi-squared tests were used to assess the significance of bivariate associations. Separate logistic regression models were used to assess the association between each outcome (mastectomy, BCS, and axillary node dissection) and the following covariates: tumour size, age, ARIA+ category, public/private hospital, hospital breast surgery caseload, and comorbidities. Analyses were conducted using Stata (Statacorp LP, College Station, Texas).³³

RESULTS

Study cohort

A total of 2 279 female breast cancer cases were identified. Of these, 1 372 (60%) cases met the definition for early stage breast cancer. Among the early breast cancer cases, 91 (6.6%) were not able to be matched to hospital records and were excluded from further analysis. Patients without matching hospital records were older than those with matching hospital records ($p < 0.001$). A small number of the women ($N=7$) underwent surgical procedures at more than one hospital type and were excluded from the study. Of the 1 274 women in the final cohort, more than half of the women (54%) were aged between 50 and 69, and 56% resided in the south-east corner of Queensland ("Major city").

Therapeutic breast surgery

Of women with early breast cancer, 976 (77%) had BCS, 369 (29%) received mastectomy and 1 094 (86%) had dissection of the axillary lymph nodes (Table 1). A small proportion (9%) of the cohort were treated with both BCS and mastectomy during the study period. Most of the patients (87%) who underwent BCS ($N=976$) also had an axillary node dissection. Of the 342 patients who had a mastectomy, 93% also had an axillary node dissection during the study period.

No treatment

A total of 34 women (3%) did not have BCS, mastectomy or axillary node dissection. None of these women were younger than 40 years of age, but there was only a non-significant ($p=0.174$) suggestion that these women were generally older than women who had treatment. Most of these patients (85%) also suffered at least one of the comorbidities and 79% of them had a comorbidity of heart failure. There was no significant difference in the other covariates.

Mastectomy

The proportion of women having mastectomy was higher among older women, those living in rural areas, those with larger tumour size, those treated in public hospitals and in hospitals with low surgical volume, and women who had comorbidities of anaemia, diabetes or heart failure (Table 1).

Similar associations were seen in the multivariate model (Table 2). Exceptions included the weakening of the age effect (to statistical insignificance, but with similar direction), along with surgical volume and diabetes (Table 2).

~~Just over a quarter of the patients that had mastectomy were in the urban category (94%), of which a large proportion had previously had BCS (70%) during the study period.~~

Breast Conserving Surgery

Women who were young, living in urban areas, with smaller tumours, or who were treated in private hospitals or hospitals with high surgical volume were more often treated with BCS (Table 1). A smaller proportion of women with diabetes, hypertension and heart failure had BCS than those who did not have these co-morbidities.

In the multivariate model, the main impact of the adjustment for covariates was to reduce the effect of remoteness of residence, both in terms of effect size and statistical significance (Table 2). Adjusting for covariates reduced the association of diabetes and of hypertension with BCS to statistical insignificance (Table 2).

Axillary Node Dissection

Younger women and those treated in hospitals with high surgical volume had the highest percentages of axillary node dissection. The proportion of patients who received axillary node dissection was significantly affected by the tumour size, with axillary node dissection less likely for the smallest (<1 mm) tumours. Women with hypertension were also less likely to have axillary node dissection.

After adjustment for the other variables (Table 2), similar associations existed, with the exception of significant association with hypertension.

Discussion

This Queensland study shows that the proportion of women with early breast cancer treated with BCS is far greater than the proportion undergoing mastectomy (77% v's 29%). Most women (86%) underwent axillary node dissection which is recommended by the the Australian clinical practice guidelines, slightly higher than that reported in 1995 in NSW (82%).¹³

The use of axillary node dissection is closely associated with age and is more likely in the younger age groups. A similar trend exists for BCS. One Australian study also identified a decrease in axillary node dissection with increasing age.¹³ Hall et al found that, in Western Australia, BCS was significantly more likely in the younger age group.¹² Such trends have been examined more extensively in countries other than Australia, particularly the USA.^{22, 32} Holmes and Muss, when referring to the USA, confirm the findings that BCS and axillary node dissection are less frequent in older women.³² They suggest that women with oestrogen receptor positive tumours are likely to receive hormone therapy, such as tamoxifen, and therefore reduce the need for axillary node dissection.³²

The lower likelihood of elderly women having axillary node dissection has clinical support.^{11, 15, 18, 20, 23-25} Older women have lower breast density than younger women, making tumour detection easier, resulting in tumours being smaller at diagnosis and less likely to have nodal involvement.³⁴ Older patients and their clinicians may prefer to avoid the morbidity associated with axillary node dissection, especially when other prognostic factors may be more favourable. In addition, researchers who have studied differences in the biological and clinical characteristics of American women with breast

cancer, have identified favourable biological characteristics with increasing age.^{34, 35}

Whereas the proportion of hormone receptor positive tumours was greater in older women, hormone receptor negative tumours were more prevalent in younger women, regardless of tumour size or nodal status.^{34, 35} Hormone receptor status has been identified as an independent predictor of outcome in women with breast cancer.³⁵ The fact that older women have less aggressive disease, regardless of tumour size and axillary lymph node status, is potentially a reason for less aggressive surgical management.

The use of sentinel node biopsy has increased since 2000²⁶ and may partly explain why 14% of Queensland women did not undergo axillary node dissection. An Australia-wide study of invasive breast cancer patients treated in the 5 years up to 2005, found that 16% of invasive breast cancer cases did not have axillary node dissection, including 7% that underwent sentinel node biopsy alone.²⁶ This suggests that perhaps half of the 14% of Queensland women who did not have axillary node dissection, might have had sentinel node biopsy alone.²⁶ Given that the Queensland cohort is limited to known cases of early stage breast cancer, results of sentinel node biopsy are likely to have returned a negative result and less likely to have undergone further axillary node dissection.

The importance of quality of life and body image are usually given greater consideration by younger patients when choosing a treatment option than by older patients^{19, 36-38}. It follows, that given a choice, younger women are more likely to choose BCS over mastectomy. There is evidence from the USA suggesting that older patients are not offered BCS as frequently as younger patients.^{22, 32} If this practice is reflected within the Australian health system, the adherence to clinical practice

guidelines when it comes to offering treatment choice to elderly patients may need to be improved.

BCS was less common among older women. The opposite trend occurs with mastectomy with age, however this was not statistically significant. This has also been reported by another Australian study in women diagnosed during the mid 1990's.¹³

Heart failure increased the likelihood of mastectomy and decreased the likelihood of BCS. Hall et al found that patients were less likely to have BCS when they had more comorbidities (as measured by the Charlson weighted comorbidity index).¹² This suggests that women with heart failure are likely to be treated with mastectomy rather than BCS which is usually followed by radiotherapy. Non-breast cancer causes of death that can sometimes be attributed to radiotherapy, including vascular causes, increase with increasing age and are likely to influence a clinician to recommend mastectomy alone rather than BCS combined with radiotherapy.³²

Similarly, considering anaemia as a general indicator for poorer health, it was not surprising to find that women with anaemia were twice as likely to have mastectomy. Like women with heart failure, women who are in poor general health may be considered as less able to tolerate radiotherapy and more likely to be treated with mastectomy alone. Anaemia was potentially a result of the surgery rather than a pre-existing illness, and so this may also explain some of the increased risk.

Previous studies have demonstrated that women living in rural and remote areas are more likely to receive a mastectomy rather than breast conserving surgery.³⁹

Mastectomy has been shown to be a more common choice for women who have to

travel greater distances from home to radiotherapy services.^{40, 41} Possible explanations have included needing to spend the least time possible away from home due to work and family commitments.⁴² This study found similar rural differentials in treatment options. However the significance of this effect reduced greatly when we adjusted for the other covariates, indicating that geographical residence may be a confounder of other effect modifiers. For instance, women living in rural areas were significantly more likely to access treatment in low-caseload hospitals, which in turn were associated with lower likelihood of BCS. This is similar to that reported in WA by Mitchell et al¹⁴ and Furnival⁴² who reported that women in rural areas were more likely to be treated by surgeons with lower caseload. The higher likelihood of women receiving BCS when treated by a high caseload surgeon has also been reported.²⁹ Therefore the choice of treatment could be influenced by the services offered and doctors available at the closest hospital, rather than a personal preference for a particular treatment. However, the picture is not entirely clear as studies have shown that women living in rural areas more frequently prefer mastectomy over BCS⁴³ whilst urban women prefer BCS with radiotherapy⁴⁴. One study found that, despite the age of the woman, fear of radiotherapy and of associated side effects was a major concern for rural women.⁴³

There was no evidence that women living in rural areas were diagnosed with larger lesions and therefore tumour size cannot account for the decreased proportion of BCS in rural women.

The increased likelihood of BCS in higher volume hospitals may also be due to referral patterns. Women who choose BCS for treatment may be referred to hospitals with a higher surgical caseload, resulting in the observed pattern of BCS being more common in large volume hospitals.

Since there are relatively few private hospitals in rural areas of Queensland, the public/private differentials found in this study could be partly due to the previously mentioned treatment preferences of rural women, rather than a differential availability of treatment at public or private hospitals.

Although women in urban areas were less likely to have a mastectomy than women in rural areas, the proportion of urban women having a mastectomy after being diagnosed with early breast cancer was still substantial (26%). This is in spite of presumably having access to the full range of breast cancer treatment services, and suggests that choice of treatment may not be governed by distance alone, but also by other factors such as socio-economic status and access to suitable transport. Similarly, a substantial proportion of women with very small tumours (<1cm) chose mastectomy over BCS.

The decision-making process that women make about treatment after being diagnosed with early breast cancer needs to be explored further.

The main limitation of this study was that it was not possible to evaluate non-surgical therapies, such as radiation, endocrine therapy or chemotherapy. Patients are generally not admitted to hospitals for these procedures and thus information on these procedures were not included in our study data. This limited the number and type of clinical practice guidelines that could be evaluated using routine data collections to those involving invasive surgical procedures. Our definition of early breast cancer may not be completely comparable with other studies. Cases of early breast cancer were defined in our study according to a histological finding of no positive lymph nodes; slightly different to the guideline¹ of no fixed nodes. In addition, cases that were initially treated as early stage breast cancer and subsequently identified as advanced stage based on the

histological finding of positive lymph nodes, would have been excluded from the cohort.

Similarly while clinical practice guidelines recommend a level 1 or level 2 axillary node dissection, ICD-10-AM coding does not differentiate between level 2 and level 3 axillary lymph node dissection. Therefore we reported on all axillary node dissection, as has been done by other authors.¹³ Based on the results of a previous study²⁶, the compliance with this clinical practice guideline may be overestimated in our study by approximately 10%.

In conclusion, there was strong variation in the type of surgical treatment for early breast cancer in Queensland, reflecting differentials by age, type of treating hospital, and place of residence. Treatment differences exist for rural women diagnosed with early breast cancer compared to urban dwellers, perhaps related to the access to optimum cancer treatment services. This study also highlights the potential of linked routinely collected population-based data for monitoring surgery-related health services, and is the first Australian study to investigating patterns of care for early stage breast cancer specifically.

ACKNOWLEDGEMENTS

Funding for the study was granted to The Cancer Council Queensland by the Golden Casket Foundation. The Queensland Cancer Registry, which is managed under contract to Queensland Health, supplied the data on invasive breast cancer in 2004. Queensland Health made available a linked file of procedures recorded in the Queensland Hospital Admitted Patients Data Collection women with invasive breast cancer in 2004. The authors wish to thank Dr Euan Walpole and Associate Professor Joanne Aitken for their assistance with this project. Lin Fritschi was supported by an NHMRC Career Development Award.

References

1. Clinical Practice Guidelines: Management of early breast cancer. National Health and Medical Research Council 2001.
2. Wickerham DL, Costantino JP, Mamounas EP, Julian TB. The landmark surgical trials of the National Surgical Adjuvant Breast and Bowel Project. *World J Surg* 2006; 30(7):1138-46.
3. Effects of radiotherapy and surgery in early breast cancer. An overview of the randomized trials. Early Breast Cancer Trialists' Collaborative Group. *N Engl J Med* 1995; 333(22):1444-55.
4. Fisher B, Anderson S, Bryant J, et al. Twenty-year follow-up of a randomized trial comparing total mastectomy, lumpectomy, and lumpectomy plus irradiation for the treatment of invasive breast cancer. *N Engl J Med* 2002; 347(16):1233-41.
5. Blichert-Toft M, Rose C, Andersen JA, et al. Danish randomized trial comparing breast conservation therapy with mastectomy: six years of life-table analysis. Danish Breast Cancer Cooperative Group. *J Natl Cancer Inst Monogr* 1992(11):19-25.
6. Fisher B, Redmond C, Poisson R, et al. Eight-year results of a randomized clinical trial comparing total mastectomy and lumpectomy with or without irradiation in the treatment of breast cancer. *N Engl J Med* 1989; 320(13):822-8.
7. Veronesi U, Banfi A, Salvadori B, et al. Breast conservation is the treatment of choice in small breast cancer: long-term results of a randomized trial. *Eur J Cancer* 1990; 26(6):668-70.
8. Harries SA, Lawrence RN, Scrivener R, et al. A survey of the management of breast cancer in England and Wales. *Ann R Coll Surg Engl* 1996; 78(3 (Pt 1)):197-202.
9. McCormick B, Yahalom J, Cox L, et al. The patients perception of her breast following radiation and limited surgery. *Int J Radiat Oncol Biol Phys* 1989; 17(6):1299-302.
10. Moyer A. Psychosocial outcomes of breast-conserving surgery versus mastectomy: a meta-analytic review. *Health Psychol* 1997; 16(3):284-98.
11. Craft P, Primrose J, Lindner J, McManus P. Surgical management of breast cancer in Australian women in 1993: analysis of Medicare statistics. *Med J Aust* 1997; 166(12):626-9.
12. Hall SE, Holman CD, Hendrie DV, Spilsbury K. Unequal access to breast-conserving surgery in Western Australia 1982-2000. *ANZ J Surg* 2004; 74(6):413-9.
13. Kricker A, Haskill J, Armstrong BK. Breast conservation, mastectomy and axillary surgery in New South Wales women in 1992 and 1995. *Br J Cancer* 2001; 85(5):668-73.
14. Mitchell KJ, Fritschi L, Reid A, et al. Rural-urban differences in the presentation, management and survival of breast cancer in Western Australia. *Breast* 2006; 15(6):769-76.
15. Koshy A, Buckingham JM, Zhang Y, et al. Surgical management of invasive breast cancer: a 5-year prospective study of treatment in the Australian Capital Territory and South-Eastern New South Wales. *ANZ J Surg* 2005; 75(9):757-61.

16. Strong K, Australian Institute of Health and Welfare. Health in rural and remote Australia: the first report of the Australian Institute of Health and Welfare on rural health. Canberra: Australian Institute of Health and Welfare, 1998.
17. Furnival C. Access to breast-conserving treatment: are surgeons responsible? *ANZ J Surg* 2004; 74(6):402-3.
18. Enger SM, Thwin SS, Buist DS, et al. Breast cancer treatment of older women in integrated health care settings. *J Clin Oncol* 2006; 24(27):4377-83.
19. Mandelblatt JS, Hadley J, Kerner JF, et al. Patterns of breast carcinoma treatment in older women: patient preference and clinical and physical influences. *Cancer* 2000; 89(3):561-73.
20. Yancik R, Ries LG, Yates JW. Breast cancer in aging women. A population-based study of contrasts in stage, surgery, and survival. *Cancer* 1989; 63(5):976-81.
21. Wanebo HJ, Cole B, Chung M, et al. Is surgical management compromised in elderly patients with breast cancer? *Ann Surg* 1997; 225(5):579-86; discussion 586-9.
22. Lazovich DA, White E, Thomas DB, Moe RE. Underutilization of breast-conserving surgery and radiation therapy among women with stage I or II breast cancer. *Jama* 1991; 266(24):3433-8.
23. August D, Rea T, Sondak V. Age-related differences in breast cancer treatment. *Ann Surg Oncol* 1994; 1(1):45-52.
24. Guadagnoli E, Shapiro CL, Weeks JC, et al. The quality of care for treatment of early stage breast carcinoma: is it consistent with national guidelines? *Cancer* 1998; 83(2):302-9.
25. Hurria A, Leung D, Trainor K, et al. Factors influencing treatment patterns of breast cancer patients age 75 and older. *Crit Rev Oncol Hematol* 2003; 46(2):121-6.
26. Cuncins-Hearn AV, Boulton M, Babidge W, et al. National breast cancer audit: overview of invasive breast cancer management. *ANZ J Surg* 2006; 76(8):745-50.
27. Clinical Practice Guidelines Management of Advanced Breast Cancer. National Health and Medical Research Council 2001.
28. Martin MA, Meyricke R, O'Neill T, Roberts S. Breast-conserving surgery versus mastectomy for survival from breast cancer: the Western Australian experience. *Ann Surg Oncol* 2007; 14(1):157-64.
29. Ingram DM, McEvoy SP, Byrne MJ, et al. Surgical caseload and outcomes for women with invasive breast cancer treated in Western Australia. *Breast* 2005; 14(1):11-7.
30. Rural, Regional and Remote Health: A Guide to Remoteness Classifications. Australian Institute of Health and Welfare 2004.
31. Bach PB, Cramer LD, Schrag D, et al. The influence of hospital volume on survival after resection for lung cancer. *N Engl J Med* 2001; 345(3):181-8.
32. Holmes CE, Muss HB. Diagnosis and treatment of breast cancer in the elderly. *CA Cancer J Clin* 2003; 53(4):227-44.
33. Stata Corporation. Stata statistical software version 9.2. [College Station, TX]: Stata Corporation.
34. Diab SG, Elledge RM, Clark GM. Tumor characteristics and clinical outcome of elderly women with breast cancer. *J Natl Cancer Inst* 2000; 92(7):550-6.
35. Dunnwald LK, Rossing MA, Li CI. Hormone receptor status, tumor characteristics, and prognosis: a prospective cohort of breast cancer patients. *Breast Cancer Res* 2007; 9(1):R6.

36. Kenny P, King MT, Shiell A, et al. Early stage breast cancer: costs and quality of life one year after treatment by mastectomy or conservative surgery and radiation therapy. *Breast* 2000; 9(1):37-44.
37. Newcomb PA, Carbone PP. Cancer treatment and age: patient perspectives. *J Natl Cancer Inst* 1993; 85(19):1580-4.
38. Ohsumi S, Shimozuma K, Kuroi K, et al. Quality of life of breast cancer patients and types of surgery for breast cancer - current status and unresolved issues. *Breast Cancer* 2007; 14(1):66-73.
39. Mastaglia B, Kristjanson LJ. Factors influencing women's decisions for choice of surgery for Stage I and Stage II breast cancer in Western Australia. *J Adv Nurs* 2001; 35(6):836-47.
40. Nattinger AB, Kneusel RT, Hoffmann RG, Gilligan MA. Relationship of distance from a radiotherapy facility and initial breast cancer treatment. *J Natl Cancer Inst* 2001; 93(17):1344-6.
41. Schroen AT, Brenin DR, Kelly MD, et al. Impact of patient distance to radiation therapy on mastectomy use in early-stage breast cancer patients. *J Clin Oncol* 2005; 23(28):7074-80.
42. Furnival CM. Breast cancer in rural Australia. *Med J Aust* 1997; 166(1):25-6.
43. Wei JP, Sherry RM, Baisden BL, et al. Prospective hospital-based survey of attitudes of Southern women toward surgical treatment of breast cancer. *Ann Surg Oncol* 1995; 2(4):360-4.
44. Fontana V, Castro T, Polynice A. Preferences of healthy inner city women and the surgical treatment of early stage breast cancer. *Am Surg* 2007; 73(3):215-21.

Table 1: Proportions of women diagnosed with early breast cancer who received different treatment, stratified by with demographic factors, hospital characteristics, and comorbidities.

Category	n	Mastectomy (%)	Breast conserving surgery (%)	Axillary node dissection (%)
Total	1274	29.0	76.6	85.9
Age group		<i>p=0.049</i>	<i>p=0.001</i>	<i>p<0.001</i>
<40	64	28.1	84.4	95.3
40 – 49	238	24.0	82.8	91.6
50 – 59	359	27.3	78.0	89.4
60 – 69	327	28.1	76.8	89.9
70 – 79	200	36.5	67.5	78.5
80+	86	36.1	68.6	51.2
Remoteness		<i>p=0.002</i>	<i>p=0.003</i>	<i>p=0.276</i>
Major City	709	25.5	80.0	86.6
Inner Regional	380	30.8	74.0	83.7
Rural	163	38.4	69.2	87.6
Breast tumour size (cm)		<i>p<0.001</i>	<i>p<0.001</i>	<i>p<0.001</i>
<1	378	23.8	84.1	78.3
1.0 – 1.9	562	26.3	77.8	90.2
2.0 – 2.9	221	34.4	70.6	86.4
3.0+	113	48.7	57.5	89.4
Hospital type		<i>p<0.001</i>	<i>p=0.012</i>	<i>p=0.320</i>
Public	599	34.1	73.5	87.0
Private	675	24.4	79.4	85.0
Surgical volume		<i>p=0.001</i>	<i>p<0.001</i>	<i>p=0.001</i>
Low	561	34.0	71.7	82.9
High	706	25.4	81.3	89.2
Anaemia		<i>p<0.001</i>	<i>p=0.793</i>	<i>p=0.457</i>
No	1020	26.1	76.8	85.6
Yes	254	40.6	76.0	87.4
Diabetes		<i>p=0.026</i>	<i>p<0.001</i>	<i>p=0.151</i>
No	1173	28.1	77.8	86.4
Yes	101	38.6	62.4	81.2
Hypertension		<i>p=0.275</i>	<i>p=0.009</i>	<i>p=0.043</i>
No	1131	28.5	77.7	86.7
Yes	143	32.6	67.8	80.4
Heart Failure		<i>p<0.001</i>	<i>p<0.001</i>	<i>p=0.686</i>
No	701	24.0	81.5	86.3
Yes	573	35.1	70.7	85.5
BCS				<i>p=0.021</i>
No	298	*	*	81.9
Yes	976			87.2
Mastectomy				<i>p<0.001</i>
No	905	*	*	83.1
Yes	369			93.0

Note: Tests of significance based on the chi-squared statistic

* Association not tested

Table 2: Results of multivariate logistic regression analyses assessing the likelihood of women diagnosed with early breast cancer having specific treatment options. Each treatment variable adjusted for all covariates. Axilla node dissection also adjusted for the other treatment variables, BCS and mastectomy.

Category	Mastectomy	Breast conserving surgery	Axilla node dissection
Age group	$p=0.052$	$p=0.006$	$p<0.001$
<40	0.8 [0.4-1.5]	2.1 [1.0-4.4]	2.2 [0.6-7.7]
40 – 49	0.8 [0.6-1.2]	1.3 [0.8-2.0]	1.4 [0.8-2.6]
50 – 59	<u>1.00</u>	<u>1.00</u>	<u>1.00</u>
60 – 69	1.1 [0.8-1.5]	0.9 [0.6-1.3]	1.1 [0.6-1.9]
70 – 79	1.6 [1.1-2.4]	0.6 [0.4-0.9]	0.4 [0.2-0.7]
80+	1.4 [0.8-2.4]	0.7 [0.4-1.3]	0.1 [0.0-0.1]
Remoteness	$p=0.045$	$p=0.472$	$p=0.196$
Major City	<u>1.00</u>	<u>1.00</u>	<u>1.00</u>
Inner Regional	1.1 [0.8-1.6]	0.9 [0.7-1.3]	0.8 [0.5-1.3]
Rural	1.7 [1.1-2.5]	0.8 [0.5-1.2]	1.5 [0.8-2.8]
Breast tumour size (cm)	$p<0.001$	$p<0.001$	$p<0.001$
<1	<u>1.00</u>	<u>1.00</u>	<u>1.00</u>
1.0 – 1.9	1.2 [0.9-1.7]	0.6 [0.5-0.9]	3.2 [2.1-4.8]
2.0 – 2.9	1.7 [1.2-2.5]	0.5 [0.3-0.7]	2.7 [1.5-4.6]
3.0+	3.1 [2.0-5.0]	0.3 [0.2-0.4]	3.2 [1.4-7.0]
Hospital type	$p<0.001$	$p=0.014$	$p=0.983$
Public	<u>1.00</u>	<u>1.00</u>	<u>1.00</u>
Private	0.6 [0.5-0.8]	1.4 [1.1-1.9]	1.0 [0.7-1.4]
Surgical volume	$p=0.458$	$p=0.011$	$p=0.032$
Low	<u>1.00</u>	<u>1.00</u>	<u>1.00</u>
High	0.9 [0.7-1.2]	1.5 [1.1-2.1]	1.6 [1.0-2.4]
Anaemia	$p<0.001$	$p=0.474$	$p=0.843$
No	<u>1.00</u>	<u>1.00</u>	<u>1.00</u>
Yes	2.2 [1.6-3.0]	0.9 [0.6-1.2]	1.0 [0.7-1.7]
Diabetes	$p=0.472$	$p=0.250$	$p=0.918$
No	<u>1.00</u>	<u>1.00</u>	<u>1.00</u>
Yes	1.2 [0.7-1.9]	0.8 [0.5-1.2]	1.0 [0.5-1.9]
Hypertension	$p=0.659$	$p=0.561$	$p=0.766$
No	<u>1.00</u>	<u>1.00</u>	<u>1.00</u>
Yes	0.9 [0.6-1.4]	0.9 [0.6-1.4]	1.1 [0.6-2.0]
Heart Failure	$p<0.001$	$p<0.001$	$p=0.896$
No	<u>1.00</u>	<u>1.00</u>	<u>1.00</u>
Yes	1.6 [1.3-2.1]	0.6 [0.4-0.8]	1.0 [0.7-1.4]
BCS			$p<0.001$
No	*	*	<u>1.00</u>
Yes			12.0 [6.2-23.3]
Mastectomy			$p<0.001$
No	*	*	<u>1.00</u>
Yes			22.4 [10.5-47.6]

Note: results only for those with record of hospital admission (n = 1274)

Tests of significance based on Likelihood-ratio chi-squared tests from the multivariate models