The Breast 51 (2020) 94–101

Contents lists available at ScienceDirect

The Breast

journal homepage: www.elsevier.com/brst

Original article

# What are the appropriate thresholds for High Quality Performance Indicators for breast surgery in Australia and New Zealand?

Shehnarz Salindera [a, *], Michelle Ogilvy [b], Andrew Spillane [c, d]

[a] Royal North Shore Hospital Sydney, Australia
[b] Mortality & Morbidity Audits, Royal Australasian College of Surgeons, Australia
[c] University of Sydney, Royal North Shore Hospital Sydney, Australia
[d] Surgical Oncology at the Poche Centre, Suite 2, 40 Rocklands Rd, North Sydney, NSW, 2060, Australia

ARTICLE INFO

*Article history:*
Received 9 September 2019
Received in revised form
3 January 2020
Accepted 12 January 2020
Available online 30 January 2020

*Keywords:*
Breast cancer outcomes
Quality
Standards of care

ABSTRACT

*Aim:* To evaluate BreastSurgANZ members' compliance at various threshold rates for 4 evaluable High-Quality Performance Indicators (HQPIs) introduced to improve patient care. To benchmark global best practice to assist in determining the eventual threshold standards.
*Method:* BreastSurgANZ Quality Audit data 2012–2016 & 2018 was used to determine rates of attainment through a range of thresholds for 4 HQPI's. Rates were assessed for different volume surgeons and comparison made to international standards.
*Results:* 1.3761 patients needing mastectomy for in situ disease, if the threshold rate for immediate breast reconstruction (IBR) was $\geq$ 40% then 30% of all members and 78% of very high-volume surgeons achieved that rate, which is comparable to international recommendations.
2.26,007 patients requiring mastectomy, if the threshold rate for IBR was $\geq$ 20% then 28% of all surgeons and 78% very high-volume surgeons met the standard. This is below most international recommendations.
3. For 31,698 invasive tumours $\leq$ 2 cm, if the threshold rate for breast conservation was $\geq$ 70% then 64% of all surgeons met the standard; 70% is comparable internationally.
4.1382 women =<50 years if the threshold rate for neoadjuvant chemotherapy was set at $\geq$ 15% then 36% of surgeons complied; 15% is below most international recommendations.
*Conclusions:* Even at these modest thresholds there are low levels of achievement by BreastSurgANZ members with high volume surgeons more likely to comply. These thresholds are either comparable or lower than globally accepted standards. Members should strive to meet, even exceed these important goals as they are a metric of improved patient care.


## 1. Introduction

Breast cancer surgical management and multidisciplinary care has evolved rapidly over the past 5–10yrs and there are numerous local and international guidelines which recommend best practice and some that indicate standards for care [1]. The Breast Surgeons of Australian & New Zealand Inc. (BreastSurgANZ) Quality Audit (BQA) was originally established in 1999 and is a bi-national surgical audit documenting the care breast cancer patients receive. The BQA has been mandatory for all full members of BreastSurgANZ since 2010. Since 2004 the BQA has included key performance indicators (KPIs) (see Table 1), which reflect factors important for the best survival outcomes. The KPIs are automatically generated from data entered and give real time feedback to the individual surgeon. If rates of KPIs are below the recommended standards, then the surgeon needs to review his/her practice and explain the discrepancy. In 2017 6 new High-Quality Performance Indicators (HQPIs) were introduced (see Table 2). These HQPIs were developed to indicate important aspects of contemporary management that have a major impact on quality of life outcomes. They are evaluating areas that are often highlighted as essential parts of best practice and recommendations by expert groups [2,8].

A process of BreastSurgANZ oversighting the memberships' compliance with KPIs, termed the "Outliers Process", has been

* Corresponding author.
*E-mail addresses:* shehnarz@hotmail.com (S. Salindera), Andrew.Spillane@melanoma.org.au (A. Spillane).

https://doi.org/10.1016/j.breast.2020.01.007

**Table 1**
Key performance indicators.

| No. | KPI | Quality threshold |
|---|---|---|
| 1. | Percentage of invasive cases undergoing breast conserving surgery referred for radiotherapy | 85% or more |
| 2. | Percentage of oestrogen positive invasive cases referred for hormonal therapy | 85% or more |
| 3. | Percentage of invasive cases undergoing axillary surgery | 90% or more |
| 4. | Percentage of in situ cases undergoing breast surgery without axillary clearance | 90% or more |
| 5. | Percentage of high-risk invasive cases undergoing mastectomy referred for radiotherapy | 85% or more |
| 6. | Percentage of high-risk cases referred for chemotherapy | 90% or more |

**Table 2**
High quality performance indicators.

| | | Suggested Quality threshold |
|---|---|---|
| 1 | Rate of immediate breast reconstruction for in situ breast cancer patients requiring mastectomy | 40% or more |
| 2 | Rate of immediate breast reconstruction for invasive breast cancer patients requiring mastectomy | 20% or more |
| 3 | Rate of breast conservation for tumour =< 2 cm | 70% or more |
| 4 | Rate of involvement of a breast case nurse in management of the patient | 90% or more |
| 5 | Rate of discussion of patients at a multidisciplinary meeting | 90% or more |
| 6 | Rate of use of neo-adjuvant chemotherapy in women =< 50yo | 15% or more |

difficult to implement but remains a goal of the society. HQPIs are new, and, in the process of introducing them BreastSurgANZ is currently piloting the software used for their assessment as new data points had to be introduced for HQPIs 4 and 5.

The aim of this study was to interrogate the BQA to evaluate the memberships' compliance at various suggested thresholds for the 4 evaluable HQPIs being implemented. In addition, comparison to global standards has been included to inform the thresholds that will eventually be set for the HQPI. It is important that these thresholds reflect international best practice and not just meet a standard that is arbitrarily set. Whilst achieving adequate performance at high levels for KPIs is mandatory for breast surgeons because they reflect improved survival, achieving high rates with HQPIs may be considered aspirational for many. However, in wealthy countries like Australia and New Zealand patients have the right to expect consistent and contemporary care in a range of locations despite geographic and resource issues. It is expected that with time higher rates of compliance with HQPI will occur and with time and improvements in training the recommended thresholds should rise as standards of care improve [9].

## 2. Methods

Data was retrieved from the BQA database on 16/4/19 for cases reported between 2012 and 2016 for HQPI 1,2 & 3 and 2018 for HQPI 6 using search algorithms listed in Appendix A. Data is not yet available for HQPI 4 & 5 (see Table 2) thus will not be included. For the purposes of this study, surgeons who performed less than 50 cases annually were deemed low volume; between 51 and 100 medium volume; 101–150 breast procedures annually, were considered high volume; and 18 members performed >151 cases annually and were considered very high volume. Surgeon compliance with a range of threshold standards was evaluated. Expected standards were based on METeOR-the Australian repository for metadata standards [2]. To date no formal threshold standards have been adopted by BreastSurgANZ. This research will inform final decisions.

## 3. Results

The BQA detailed data from 361 members who had entered 31, 698 cases of invasive breast cancer and 3761 cases of in situ cancer. This included 240 low volume; 89 medium volume; 23 high volume; and 9 very high-volume members.

## 4. Discussion

### 4.1. Why do we need quality indicators?

Performance indicators have become an international tool to measure the quality of healthcare delivery and its improvement [3]. An effective performance indicator should be a standardized, evidence-based measure of health care quality, agreed upon by an expert panel, that can be used with hospital data to track clinical performance and outcomes [4,5]. In breast cancer management not only has there been reported significant variation in care between hospitals for patients with similar pathology [6], but there has also been reported significant variance between actual practice and optimal recommended care [7]. Breast cancer performance indicators have been introduced internationally to record the level of adherence to recommended practice and to detect and reduce these variances [7,8].

### 4.2. HQPI 1: rate of immediate breast reconstruction post mastectomy for DCIS

Ductal carcinoma in situ (DCIS) is a precursor lesion of invasive disease [10] and when it is so extensive as to require mastectomy there are no "disease related" reasons why IBR cannot be offered. Various levels of compliance at a range of thresholds can be seen in Fig. 1 but at our proposed threshold of 40% only 30% of members achieved that rate and disturbingly 38% of members had $\leq$ 5% rate. The higher the caseload the greater the percentage of surgeons achieving the threshold, with up to 78% for very high-volume surgeons compared to only 19% of low volume surgeons. The

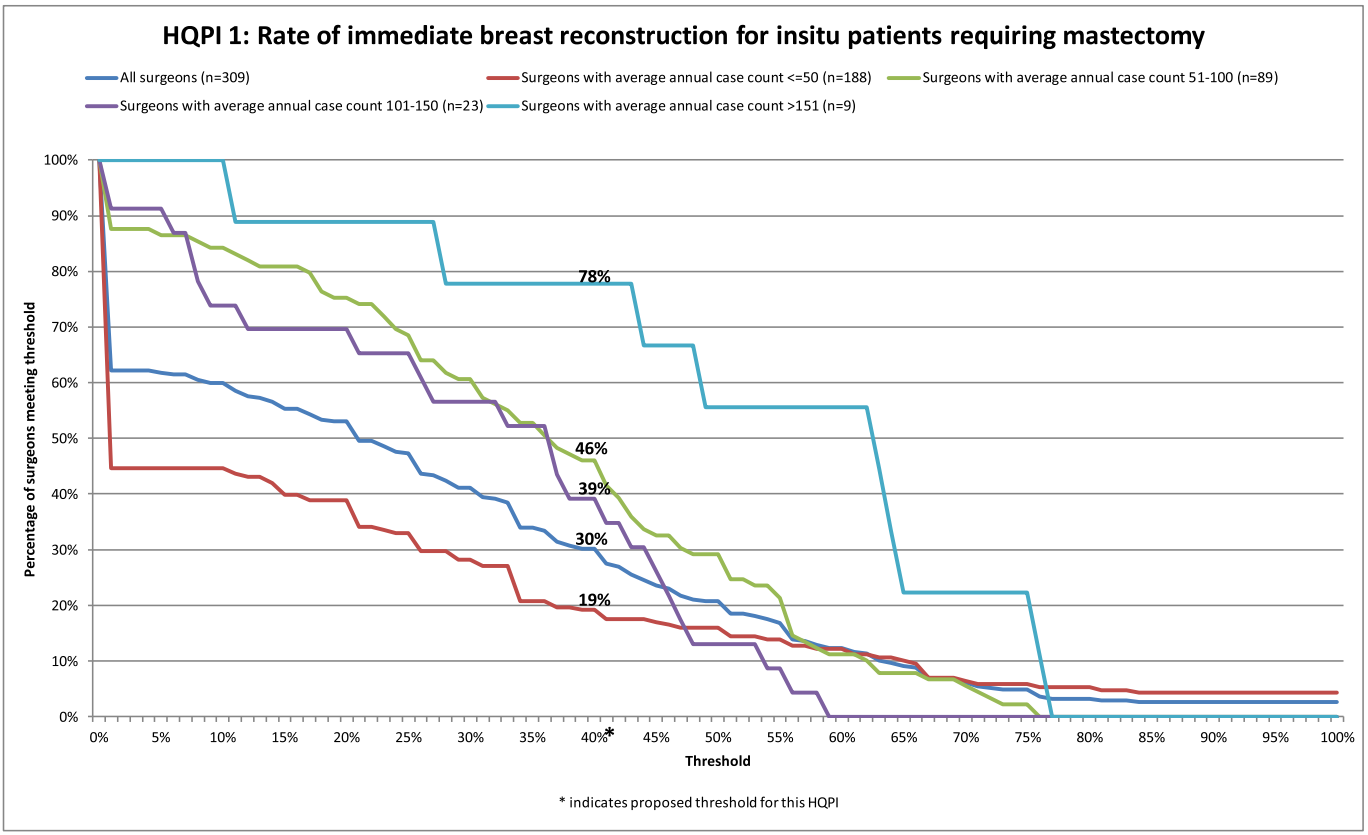


**Fig. 1. HQPI 1: rates of immediate breast reconstruction (IBR) for in situ breast cancer (DCIS) requiring mastectomy:** A total of 3761 cases found and if the threshold rate was set at ≥ 40% of a surgeon's cases having IBR then 30% of all BreastSurgANZ contributing surgeons were compliant (Fig. 1). There were 19% low volume surgeons (only 188 of 240 contributed), 46% of medium volume surgeons, 39% of high-volume surgeons and 78% of very high-volume surgeons compliant at that level. Only 62% of surgeons were compliant at an IBR threshold of 5%.

European EUSOMA guidelines recommend a similar rate of 40% [11] and some member nations have published their audit results. For example, data analysis from the Dutch NABON (National Breast Cancer Organisation) Breast cancer audit [12] demonstrated that IBR was performed in 41% of patients with DCIS. They found that IBR rates were increased due to hospital organisational factors (hospital type/volume, number of weekly MDTs, attendance of plastic surgeon at weekly MDT meetings). They also noted that there was a significant rate difference for IBR if at a cancer specific hospital compared to a district hospital (Odds Ratio (OR) 6.1) and those with a plastic surgeon (2.5 plastic surgeons per 100 diagnoses) compared to those hospitals with no or limited access to plastic surgeons (OR 3.26) [12]. Therefore, our target threshold of 40% is globally comparable. More needs to be done by BreastSurgANZ and individual members to improve our IBR rate for DCIS such as improving access to oncoplastic trained breast surgeons and/or plastic surgeons and resources, facilitating patients who live in remote areas without resources to be able to travel to receive reconstruction if that is their preference.

4.3HQPI 2: rate of immediate breast reconstruction for invasive breast cancer patients requiring mastectomy (Fig. 2)

The safety and efficacy of IBR (implant or autologous) has been well established and incorporated into Australian [8] and international best practice guidelines [11–13]. Cancer Australia and the Australian Cancer Council recommends all women undertaking a mastectomy should have reconstruction discussed with them [8] and the ESO-ESMO 3rd international consensus guidelines for breast cancer in young women (<40 years) affirms that IBR offers the same survival rates as mastectomy without reconstruction and should be offered to all patients [13]. Concerns around delay to adjuvant chemotherapy or impact of radiotherapy on reconstruction outcomes have steadily become irrelevant with increasing outcomes data, more frequent use of neoadjuvant chemotherapy and improved technical advances in reconstruction options such as acellular dermal matrix, mesh, and fat grafting [14–17].

The EUSOMA guidelines recommend IBR with a threshold level of 40% [11], double that being proposed as an initial target in Australia. Only 28% of the BQA members are achieving that low IBR rate, 24% of low volume surgeons and 36%–78% for higher caseload volume surgeons (see Fig. 2). Disturbingly nearly half the members have an IBR rate of 5% or less. This variation could be accounted for by the large number of low-volume surgeons in the data base or that there are barriers to offering IBR even for some high-volume surgeons. The Scottish guidelines suggest a target of 10% [18] and Singapore 20% [19] despite the well documented safety and psychological and emotional well-being related benefits [14,15]. A Dutch retrospective analysis found key factors inhibiting the decision making of IBR post mastectomy [22] included higher age (62.2 vs 51.9) and BMI (27 vs 24.3) and failure of surgeon to offer IBR due to predicted need for post mastectomy radiation (29.3%) or just failure of informing the patient (10%). In Australia reports of around 40% IBR rate have been achieved by some groups [20] with the main reasons not to have reconstruction being patient choice (45%) and surgeon's perception of high-risk tumours (32%) [20]. Other published Australian experiences such as retrospective study by Chang et al. of patients who underwent mastectomy and received adjuvant chemotherapy, with or without IBR demonstrate similar findings [21]. Surgeon related factors seem to be the main determinate of offering IBR in wealthy, well-resourced countries like Australia [23].

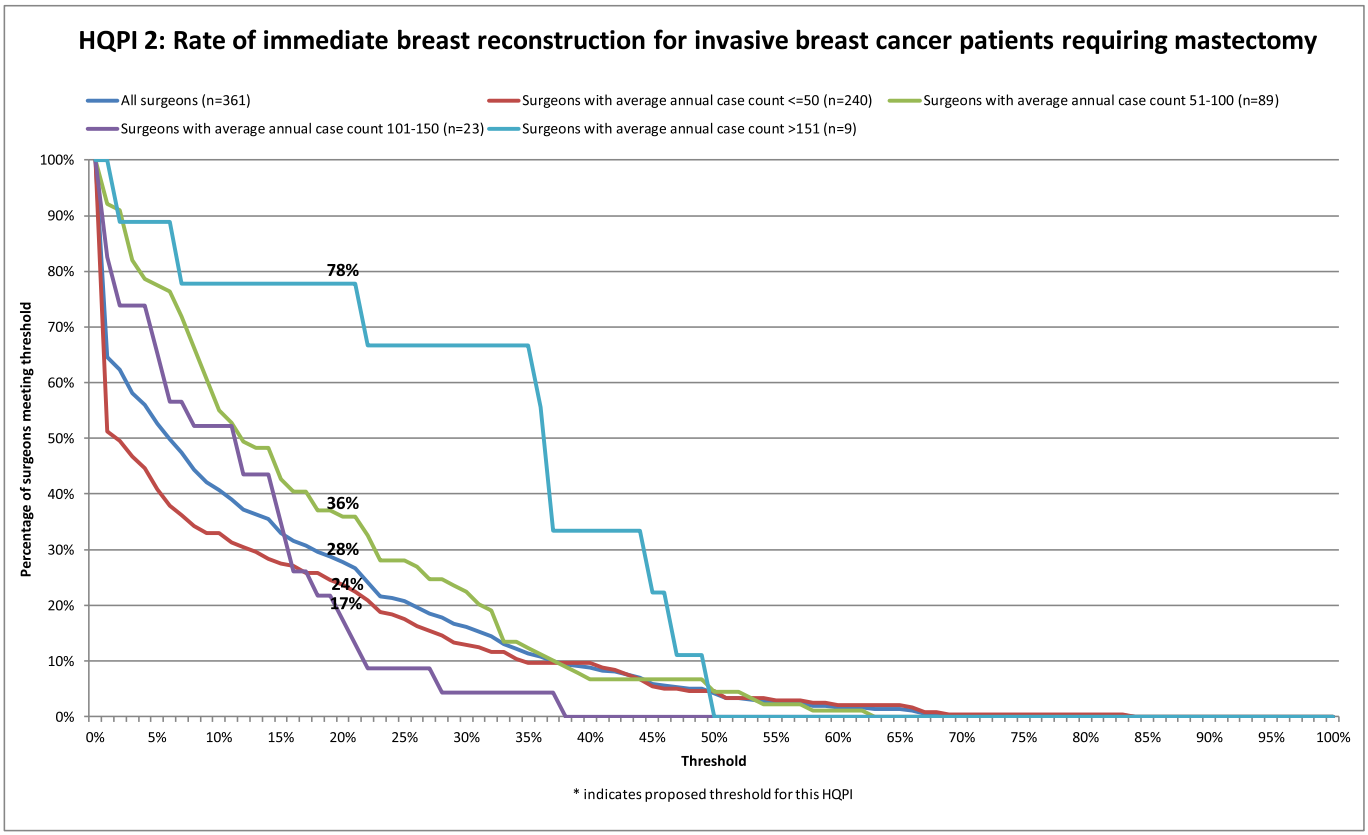


**Fig. 2. HQPI 2: Rate of immediate breast reconstruction for invasive breast cancer patients requiring mastectomy:** If the threshold was set at ≥ 20% IBR for invasive breast cancer requiring mastectomy, of the 22,007 cases evaluated 28% of all surgeons met the standard. For low volume surgeons the rate of compliance was 24%, medium volume 36%, high volume 17% and 78% of very high-volume caseload surgeons. Only 52% of surgeons were compliant at an IBR threshold of 5%.

### *4.4. HQPI 3: rate of breast conservation surgery for tumours =<2 cm in size*

Multiple prospective randomised trials over the past decades have demonstrated that patient survival after undergoing breast conserving surgery (BCS) is equivalent to mastectomy in the treatment of invasive breast cancer [23–25]. Internationally the breast conservation rate has been used to compare cancer care among various geographical areas and centres, race or socioeconomic status, fellowship-trained versus general surgeons etc [26,27]. Tan et al. concur that a threshold of 70% best represents the evidence [25] and this corresponds with ESMO guidelines [28]. Our finding of an overall 64% of the membership achieves that BCS rate (see Fig. 3), low volume surgeons are below this at a rate of 58% but with higher volume surgeons achieving better rates up to 89% for very high-volume surgeons. Reasons for this could include surgeon factors, patient factors or tumour factors. For example, US reviews have found that selection bias by surgeons preferring mastectomy, with 71% of patients reporting they weren't offered a clear choice [29] and 56% of surgeons believing the treatments were not equal [30]. Other concerns reported in the literature include cosmetic outcomes and patient insurance status for limiting BCS rates [31,32]. Analysis of the SEER database also suggests that tumour biology influences surgical decision making with grade I hormone receptor positive/HER2-tumours having a BCS rate of 72.2% vs triple negative cancers 34.6% and HER2+ cancers [33–35]. Our data was not reviewed for the molecular biology and in the Australia and New Zealand setting of universal healthcare, insurance status is thought to less likely influence decision making. There are issues with access to radiotherapy facilities for rural and remote patients in a vast, sparsely populated country. Therefore, it is likely that surgical selection bias and cosmetic outcomes are more likely to be contributing to under-performing of BCS overall and in lower volume surgeons. These issues are likely encountered less often in higher volume centres with oncoplastic skills, hence the higher rates with higher case load members.

### *4.5. **HQPI 4.** rate of involvement of a breast care nurse in management of the patient*

With the improvement in detection and management of breast cancer, there has been a significant survival increase. In Australia the 5 year survival rate was 72% between 1984 and 1988, compared to 90% in 2009–2013 [36]. With the increasing number of survivors, there is a higher need for accessible and quality post-treatment medical and psychosocial care [37,38]. It is well documented that many patients lack information regarding their pathology and management; and feel they do not receive sufficient practical or emotional support from their health professionals [39–41]. The specialist breast care nurse (BCN) was introduced in Australia in the 1990s to assist in co-ordinating services, provide information and psycho-social support [42]. BCNs usually have oncology nursing experience, as well as a post graduate Diploma of Breast Care Nursing. The BCN can reduce medical staff workloads; with patients sometimes preferring to consult with a BCN over the general practitioner [43]. Current reviews have shown that patients highly value the BCN [43–46]. High levels of involvement of a BCN in care should be achieved in Australia and New Zealand. The current recommendation is >90% of cases but to date no data is available to monitor this.

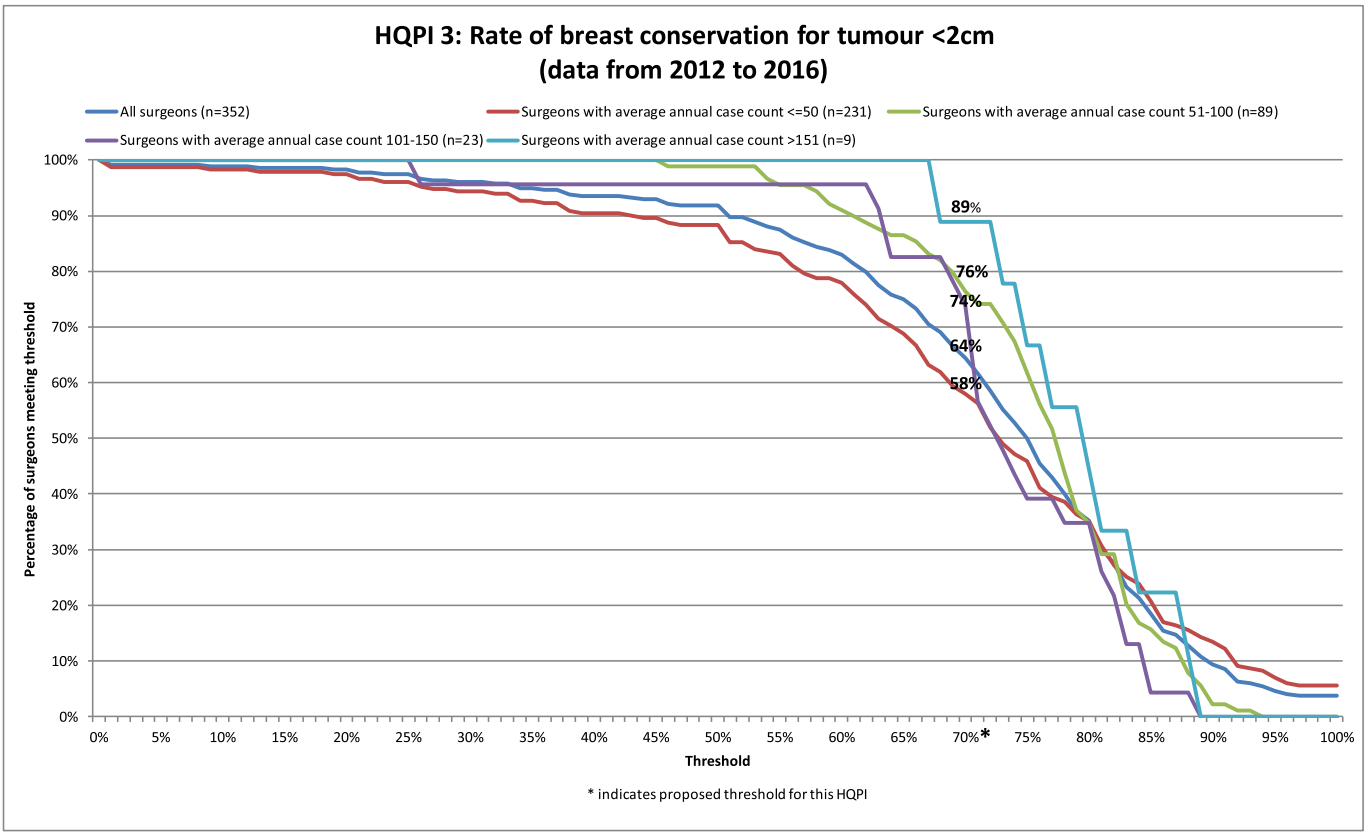


**Fig. 3. HQPI 3: rate of breast conservation for tumours <2 cm in size:** if the threshold rate for breast conservation for the 31,698 eligible cases was set at ≥ 70% of all member cases then 64% were compliant. There were 58% low volume surgeons and 76% of medium volume compliant at that level. For higher volume caseload members 74% of high-volume surgeons and 89% of very high-volume caseload surgeons met the standard.

### *4.6. HQPI 5: rate of discussion of cases at MDT*

In Australia, multi-disciplinary team (MDT) meeting has been considered best practice to facilitate coordinated cancer care [47]. The MDT should include at least a surgeon, medical oncologist, radiation oncologist, pathologist, radiologist and breast care nurse [48]. The development of the MDT meetings has strong evidence indicating the improved outcomes to patient care and greater cooperation and communication between the involved medical departments [49,50]. The largest comparative cohort study performed in Scotland [50] indicated an 11% reduction in breast cancer mortality upon the introduction of MDT care. Further studies in Europe have shown higher cancer survival rates in areas with MDTs compared to those without [51,52]. The discussion of breast cancer patients at a multidisciplinary meeting is a common key performance indicator internationally [11,18,53–55] with European standards setting a target of 90% of cases. Although the BQA had insufficient data to confirm Australasian rates of MDT discussion other Australian reports suggest that most patients are discussed [47,48] and that those decisions are implemented in over 90% of cases [56]. High levels of MDT review should be achieved in Australia and New Zealand. The current recommendation is >90% of cases.

### *4.7. HQPI 6: rate of use of neo-adjuvant chemotherapy (NACT) in women < 50 years*

Clinical trials have demonstrated that there is no difference between overall survival or recurrence rates between neoadjuvant and adjuvant chemotherapy [57]. Furthermore, with the advent of molecular subtyping of breast cancers and HER2 directed therapy there is a preference to give chemotherapy in the neoadjuvant setting now for those relevant subtypes and tumour characteristics where chemotherapy is clearly indicated [57]. Known benefits range from downstaging large tumours and improving operability to facilitating BCS and better management of the axilla [57–59] evaluating response rate and demonstrating resistance in some patients for further adjuvant treatment [60][61. The NSABP B-18 study & early breast cancer trialists collaborative group also suggested that NACT has improved overall survival in women aged <50 years [57,62,63] which is again likely related to triple negative molecular subtypes which have a greater preponderance in younger women [61,64]. Threshold standards for use of NACT have thus been set to 85% in the Scottish guidelines [18] and ESMO guidelines recommend it as the standard of care for all appropriate patients [28]. Dutch reports suggest rates of 84.5% of stage III patients receiving neoadjuvant systemic therapy [65]. However, the BQA threshold of 15% seems significantly lower than international recommendations (see Fig. 4) and even at that level only 36% of members are achieving this goal. This is not explained by unit specialisation as very high-volume surgeons are only achieving a rate of 29%. Possible reasons for this could include high volume surgeons are more likely to utilise complex oncoplastic techniques to facilitate breast conservation in large tumours. Also, that NACT would not alter patient choice for mastectomy and reconstruction [30]. The American National Cancer Database (NCDB) reviewed 354, 204 patients of which 16.7% underwent neoadjuvant chemotherapy [66]. This demonstrated that receipt of neoadjuvant chemotherapy was associated with larger tumour size (cT1 7%, cT2 25% and cT3 58%), more advanced nodal disease (cN0 11%, cN1-3

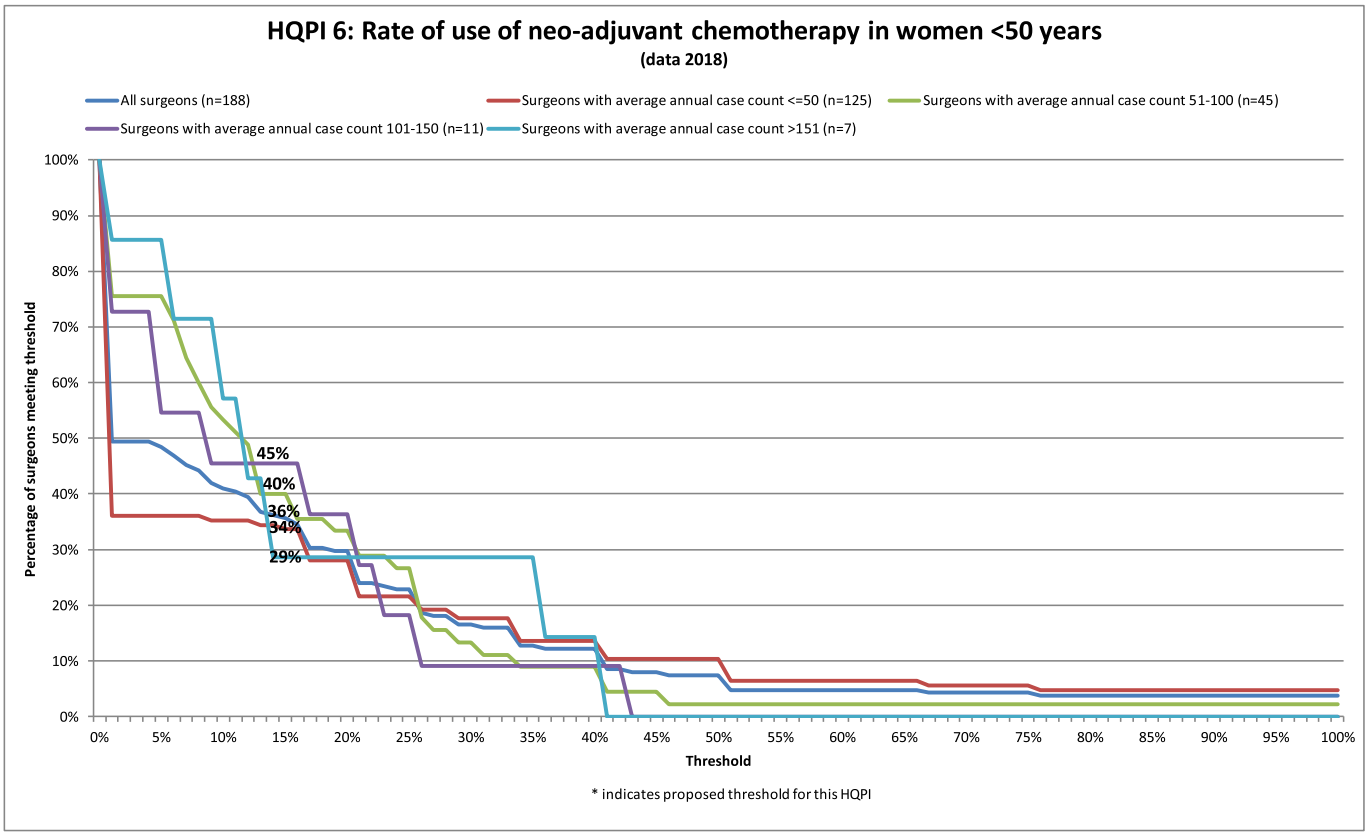


**Fig. 4. HPQI 6: Rate of use of neo-adjuvant chemotherapy (NACT) in women ≤ 50yrs of age:** if the threshold rate for use of NACT for 1382 eligible patients in 2018 was set at ≥ 15% then 36% of all BreastSurgANZ members met this standard. For low volume surgeons 34% were compliant, 40% medium volume surgeons, 45% of high caseload surgeons and 29% of very high-volume surgeons would have complied with this standard. Only 49% of surgeons were compliant at a NACT threshold of 5%.

39%) and appropriately with a younger patient, age < 50 years 21% vs > 50 years 14% [66]. Therefore, the proposed threshold of 15% seems too low and BreastSurgANZ should set a higher threshold and strongly encourage members to increase their use of NACT.

## 5. Limitations

The BQA database is the only such audit of breast cancer data in Australasia however not all surgeons performing breast surgery are members and despite the membership requirement it is likely that not all members enter all their cases. It is possible that with 66% of surgeons included having a case volume of ≤ 50 cases per year diluting achievement rates. Thus, threshold rates per surgeon volume are more accurate reflection of clinical practice. The data fields on NACT were only more recently added to the BQA so there was only a limited amount of data for HQPI 6, hence this data set is smaller than the others.

## 6. Conclusion

Performance indicators are used globally in breast cancer management to measure the quality of care delivered and to encourage higher standards and better outcomes. The six HPQI's set by the BreastSurgANZ are the same or similar to factors evaluated in other countries and specialist consensus groups in the UK and Europe and reviews from the USA. Member surgeons are overall achieving lower rates of IBR, particularly for invasive cancer and very low rates for use of NACT in women ≤ 50yrs of age, with higher volume surgeons performing better. However, both thresholds should be set to a higher standard to meet international levels. Even with these proposed threshold standards too many member surgeons are underperforming, particularly when compared to international standards in rates of IBR for DCIS, rates of NACT in young women and BCS for tumours ≤ 2 cm in size. Improvements need to be made and factors such as providing broad education on the patient benefits of achieving or exceeding the HQPIs to BreastSurgANZ members, training more oncoplastic breast surgeons and/or breast specialised plastic surgeons and lobbying health services to provide resources are all clearly important. Repeating this audit a few years after commencing formal HQPI reporting and including all 6 HQPIs is mandatory to track and further promote improvements in care.

## Disclosures

The Authors acknowledge the data reported here has been supplied by Breast Surgeons of Australia and New Zealand from the BreastSurgANZ Quality Audit. The interpretation and reporting of these data are the responsibility of the authors and should not be seen as an official interpretation by the BreastSurgANZ Quality Audit, or Breast Surgeons of Australia and New Zealand.

## Funding

There were no sources of funding.

## Ethic approval

Ethics was not required by the Royal Australasian College of Surgeons.

**Appendix A**
Algorithm for BQA data base search:

| HQPi | Inclusions | | Exclusions |
|---|---|---|---|
| | Numerator | Denominator | |
| 1 | In situ eases with both a mastectomy and a reconstruction, and where the dales of these two procedures are the same.InvasiveInsitu = *"In Situ"* AND ([bsurgSurgeryDate] where bsurgSurgeryType] = Mastectomy)=((bsurgSurgeryDate]where [bsurgSurgeryType] = Reconstruction) | In situ cases treated with mastectomy where patient has not refused reconstruction.InvasiveInsitu- *"In Situ"* AND bsurgSurgeryType] = Mastectomy AND bstInterventionChangedBypatient ≠ reconstruction [note. Sec appendix for changes to this field] | 1. InvasiveInsitu = null or *"Unknown"*<br>2. InvasiveInsitu *"Insitu"* = *'In Situ"* AND NoBreastSurgery = null |
| 2 | Invasive cases with both a mastectomy and a reconstruction, and where the dates of these two procedures are the same. InvasiveInsitu = *"Invasive"* AND [bsurgSurgeryDate] Where [bsurgSurgeryType]Matectomy)= ([bsurgSurgeryDate] where [bsurgSurgeryType] = Reconstruction) | Invasive cases treated with mastectomy where patient has not refused reconstruction InvasiveInsitu = *"Invasive"* AND [bsurgSurgeryType] = Matectomy AND bstnterventionChangedByPatient ≠ Reconstruction [note. See appendix for changes to this field] | 1. InvasiveInsitu = null or *"Unknown"*<br>2. InvasiveInsitu = *"Invasive"* AND NoBreastSurgery = null |
| 3 | Cases with a total extent of lesion less than 20 mm or, if total extent of lesion is blank, tumour size less than 20 mm Treated with breast conserving surgery only (i.e. Complete local Excision, Open Biopsy. Re-excision or ABBI. but not mastectomy or "Other" surgery).1. InvasiveInsitu = *"invasive"* AND TotalLesionExtent <20 OR Total lesion Extent = Null AND InvasiveTumourSize <20 AND BreastSurgery.bsurgSurgeryType = *"CLE"* Or *"Open Biopsy"* Or *"Re-excision'* Or *"ABBI"* AND BreastSurgery.bsurgSurgcryType ≠ Wastectomy AND ≠ Other<br>2. InvasiveInsitu = *"Insitu"* AND InsituTumourSize <20 AND BreastSurgery.bsurgSurgeryType = *"CLE"* Or *"Open Biopsy"* Or *"Re-excision'* Or *"ABBI"* AND BreastSurgery.bsurgSurgcryType ≠ Wastectomy AND ≠ Other | Cases with a total extent of lesion less than 20 mm or. If total extent of lesion is blank, tumour size less than 20 mm and have been treated with any surgery (i.e. excluding 'no surgery" cases).<br>1. InvasiveInsitu = *"invasive"* AND TotalLesionExtent <20 OR Total lesion Extent = Null AND InvasiveTumourSize <20 AND NoBreastSurgery = *"No"*<br>2. InvasiveInsitu = *"Insitu"* AND InsituTumourSize <20 AND NoBreastSurgery *"No"* | 1. InvasiveInsitu = null or *"Unknown"*<br>2. InvasiveInsitu = *"Insitu"* AND lnsituTumourSize = null<br>3. InvasiveInsitu = *"Invasive"*AND Invasive TumourSize = null<br>4. InvasiveInsitu = *"Insitu"* AND InsituTumoursize<20 AND NoBreastSurgery = null<br>5. InvasiveInsitu = *"Invasive"* AND Invasive TumourSize AND NoBreastSurger = null |
| 4 | (BrCareNurse) = *"Yes"* | [BrCareNurse] = *"Yes"* or *'No"* | [BrCareNurse] = null or "unknown* |
| 5 | [MOTrev] = *"Yes'* | [MOTrev] = *"Yes"* or *'No'* | [MOTrev] = null or "unknown" |
| 6 | Female patients under 50 treated with neoadjuvant chemotherapy<br>Age at diagnosis ([DiagnosisDate] −[patDOB]) <50 AND patGenderlD = "female" AND ChemotherapyNeoAdj = "Yes" | Female patients under 50, where we know whether they were treated with neoadjuvant chemotherapy<br>Age at diagnosis ([DiagnosisDate] −[patDOB]) <50 AND patGenderlD = "female" AND ChemotherapyNeoAdj = "Yes" or "No" | 1. [DiagnosisDate] = null<br>2. partDOB = null<br>3. ChemotherpyNeoAdj = null<br>4. patGenderID = null |

## Declaration of competing interest

All contributors agree with the contents of the manuscript. There are no conflicts of interest. This manuscript has not been published previously and is not under consideration elsewhere.

## Acknowledgements

BreastSurgANZ members for their contributions to the BreastSurgANZ Quality Audit.

Prof Andrew Spillane's academic position is supported by the Friends of the Mater Foundation.

## References

[1] Marshall MN, et al. Can health care quality indicators be transferred between countries? Qual Saf Health Care 2003;12(1):8–12.
[2] ( METeOR) MOR. Cancer treatment—multidisciplinary team review indicator. 2018 8/5/2014.
[3] Braithwaite J, et al. Health system frameworks and performance indicators in eight countries: a comparative international analysis5. SAGE Open Med; 2017. 2050312116686516.
[4] Hassett MJ, et al. Selecting high priority quality measures for breast cancer quality improvement. Med Care 2008;46(8):762–70.
[5] Hogeveen SE, et al. Comparison of international breast cancer guidelines: are we globally consistent? cancer guideline AGREEment. Curr Oncol 2012;19(3):e184–90.
[6] Gray JE, et al. Degree of variability in performance on breast cancer quality indicators: findings from the Florida initiative for quality cancer care. J Oncol Pract 2011;7(4):247–51.
[7] Bryant J, et al. Examining and addressing evidence-practice gaps in cancer care: a systematic review. Implement Sci 2014;9(1):37.
[8] Cancer Australia Statement. Influencing best practice in breast cancer. https://thestatement.canceraustralia.gov.au/. accessed 9/9/2019.
[9] Spillane AJ, Flitcroft K, Warrier S, Katelaris A. Evaluation of a structured clinical program and formal coursework in breast surgeon training in Australia and New Zealand. EJSO May 2019.
[10] Collins LC, et al. Outcome of patients with ductal carcinoma in situ untreated after diagnostic biopsy: results from the Nurses' Health Study. Cancer 2005;103(9):1778–84.
[11] Biganzoli L, et al. Quality indicators in breast cancer care: an update from the EUSOMA working group. Eur J Canc 2017;86:59–81.
[12] Schreuder K, et al. Hospital organizational factors affect the use of immediate breast reconstruction after mastectomy for breast cancer in The Netherlands. Breast 2017;34:96–102.
[13] Paluch-Shimon S, et al. ESO-ESMO 3rd international consensus guidelines for breast cancer in young women (BCY3). Breast 2017;35:203–17.
[14] Nedumpara T, Jonker L, Williams MR. Impact of immediate breast reconstruction on breast cancer recurrence and survival. Breast 2011;20(5):437–43.
[15] Murphy Jr RX, et al. Impact of immediate reconstruction on the local recurrence of breast cancer after mastectomy. Ann Plast Surg 2003;50(4):333–8.
[16] Pomahac B, et al. New trends in breast cancer management: is the era of immediate breast reconstruction changing? Ann Surg 2006;244(2):282–8.
[17] Nahabedian MY, Momen B. The impact of breast reconstruction on the oncologic efficacy of radiation therapy: a retrospective analysis. Ann Plast Surg 2008;60(3):244–50.
[18] Scotland NQI. Clinical Standards; Management of breast cancer services. 2008.
[19] Sim N, et al. Breast reconstruction rate and profile in a Singapore patient population: a National University Hospital experience. Singap Med J 2018;59(6):300–4.
[20] Wong A, et al. Increasing breast reconstruction rates by offering more women a choice. ANZ J Surg 2014;84(1–2):31–6.
[21] Chang RJ, et al. Does immediate breast reconstruction compromise the delivery of adjuvant chemotherapy? Breast 2013;22(1):64–9.
[22] Weenk M, et al. Factors influencing the decision to pursue immediate breast reconstruction after mastectomy for breast cancer. Gland Surg 2017;6(1):43–8.
[23] Flitcroft KL, Brennan ME, Costa Dsj Spillane AJ. Regional variation in immediate breast reconstruction in Australia: equity implications of a 'postcode lottery'. BJS Open Accept August 2017. https://doi.org/10.1002/bjs5.19.
[24] Agarwal S, et al. Effect of breast conservation therapy vs mastectomy on disease-specific survival for early-stage breast cancer. JAMA Surg 2014;149(3):267–74.
[25] Tan MP. Is there an ideal breast conservation rate for the treatment of breast cancer? Ann Surg Oncol 2016;23(9):2825–31.
[26] NIH Consensus Development Conference statement on the treatment of early-stage breast cancer. Oncology 1991;5(2):120–4.

[27] Lee MC, et al. Determinants of breast conservation rates: reasons for mastectomy at a comprehensive cancer center. Breast J 2009;15(1):34–40.
[28] Senkus E, et al. Primary breast cancer: ESMO Clinical Practice Guidelines for diagnosis, treatment and follow-up. Ann Oncol 2015;26(Suppl 5). v8–30.
[29] Keating NL, et al. Treatment decision making in early-stage breast cancer: should surgeons match patients' desired level of involvement? J Clin Oncol 2002;20(6):1473–9.
[30] Morrow M, et al. Factors predicting the use of breast-conserving therapy in stage I and II breast carcinoma. J Clin Oncol 2001;19(8):2254–62.
[31] Wang HT, et al. Aesthetic outcomes in breast conservation therapy. Aesthetic Surg J 2008;28(2):165–70.
[32] Lautner M, et al. Disparities in the use of breast-conserving therapy among patients with early-stage breast cancer. JAMA Surg 2015;150(8):778–86.
[33] Chen K, et al. Breast-conserving surgery rates in breast cancer patients with different molecular subtypes: an observational study based on surveillance, epidemiology, and end results (SEER) database. Medicine (Baltim) 2016;95(8):e2593.
[34] Wiechmann L, et al. Presenting features of breast cancer differ by molecular subtype. Ann Surg Oncol 2009;16(10):2705–10.
[35] Jia H, et al. HER-2 positive breast cancer is associated with an increased risk of positive cavity margins after initial lumpectomy. World J Surg Oncol 2014;12:289.
[36] Australia C. Breast cancer statistics. Available from: https://breast-cancer.canceraustralia.gov.au/statistics; 2018.
[37] Ahern T, Gardner A. Literature review: an exploration of the role of the Australian breast care nurse in the provision of information and supportive care. Collegian 2015;22(1):99–108.
[38] Lawler S, et al. Follow-up care after breast cancer treatment: experiences and perceptions of service provision and provider interactions in rural Australian women. Support Care Canc 2011;19(12):1975–82.
[39] Aranda S, et al. Meeting the support and information needs of women with advanced breast cancer: a randomised controlled trial. Br J Canc 2006;95(6):667–73.
[40] Girgis A, et al. Perceived needs of women diagnosed with breast cancer: rural versus urban location. Aust N Z J Publ Health 2000;24(2):166–73.
[41] Davis C, et al. Assessing the support needs of women with early breast cancer in Australia. Canc Nurs 2004;27(2):169–74.
[42] Jones L, et al. Scope of practice of the breast care nurse: a comparison of health professional perspectives. Eur J Oncol Nurs 2010;14(4):322–7.
[43] Jiwa M, et al. Women with breast cancers' preferences for surveillance follow-up. Collegian 2011;18(2):81–6.
[44] Eley R, Rogers C. Consumer perceptions of the effectiveness of a breast care nurse in providing coordinated care to women with breast cancer in Queensland, Australia 2012;29:56–61.
[45] Brennan M, et al. Survivorship care after breast cancer. Aust Fam Physician 2008;37(10):826–30.
[46] Paytner Hea. Evaluation of the McGrath foundation's breast cancer nurses initiative. Austr. J. Canc. Nurs. 2013;14(2):4–9.
[47] Australia C. All about multidisciplinary care. Available from: https://canceraustralia.gov.au/clinical-best-practice/multidisciplinary-care/all-about-multidisciplinary-care. [Accessed 2 July 2018].
[48] Australia BCN. Multidisciplinary care. Available from: https://www.bcna.org.au/about-us/advocacy/position-statements/multidisciplinary-care/. [Accessed 17 July 2018].
[49] Rankin NM, et al. Cancer multidisciplinary team meetings in practice: results from a multi-institutional quantitative survey and implications for policy change. Asia Pac J Clin Oncol 2018;14(1):74–83.
[50] Kesson EM, et al. Effects of multidisciplinary team working on breast cancer survival: retrospective, comparative, interventional cohort study of 13 722 women. BMJ 2012;344:e2718.
[51] Eaker S, et al. Regional differences in breast cancer survival despite common guidelines. Cancer Epidemiol Biomark Prev 2005;14(12):2914–8.
[52] Kersten C, et al. Does in-house availability of multidisciplinary teams increase survival in upper gastrointestinal-cancer? World J Gastrointest Oncol 2013;5(3):60–7.
[53] Del Turco MR, et al. Quality indicators in breast cancer care. Eur J Canc 2010;46(13):2344–56.
[54] Bao H, et al. Developing a set of quality indicators for breast cancer care in China. Int J Qual Health Care 2015;27(4):291–6.
[55] Key performance indicators report for symptomatic breast disease services. Ireland: National Cancer Control Programme; 2010.
[56] Rajan S, et al. Multidisciplinary decisions in breast cancer: does the patient receive what the team has recommended? Br J Canc 2013;108(12):2442–7.
[57] Rastogi P, et al. Preoperative chemotherapy: updates of national surgical adjuvant breast and bowel project protocols B-18 and B-27. J Clin Oncol 2008;26(5):778–85.
[58] van der Hage JA, et al. Efficacy of adjuvant chemotherapy according to hormone receptor status in young patients with breast cancer: a pooled analysis. Breast Cancer Res 2007;9(5):R70.
[59] King TA, Morrow M. Surgical issues in patients with breast cancer receiving neoadjuvant chemotherapy. Nat Rev Clin Oncol 2015;12(6):335–43.
[60] Minckwitz GV, et al. For the KATHERINE investigators, *trastuzumab Emtansine for residual invasive HER2-positive breast cancer*. N Engl J Med 2019;380:617–28.
[61] Colleoni M, et al. Response to primary chemotherapy in breast cancer patients with tumors not expressing estrogen and progesterone receptors. Ann Oncol 2000;11(8):1057–9.
[62] Bear HD, et al. The effect on tumor response of adding sequential preoperative docetaxel to preoperative doxorubicin and cyclophosphamide: preliminary results from National Surgical Adjuvant Breast and Bowel Project Protocol B-27. J Clin Oncol 2003;21(22):4165–74.
[63] Early Breast Cancer Trialists' Collaborative G. Effects of chemotherapy and hormonal therapy for early breast cancer on recurrence and 15-year survival: an overview of the randomised trials. Lancet 2005;365(9472):1687–717.
[64] Ashba J, Traish AM. Estrogen and progesterone receptor concentrations and prevalence of tumor hormonal phenotypes in older breast cancer patients. Canc Detect Prev 1999;23(3):238–44.
[65] Spronk PER, et al. Variation in use of neoadjuvant chemotherapy in patients with stage III breast cancer: results of the Dutch national breast cancer audit. Breast 2017;36:34–8.
[66] Killelea BK, et al. Neoadjuvant chemotherapy for breast cancer increases the rate of breast conservation: results from the National Cancer Database. J Am Coll Surg 2015;220(6):1063–9.