New European quality indicators on breast cancer calculated for the Dutch setting

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Abstract

Objectives: On behalf of the Quality Assurance Scheme Development Group (QASDG) quality indicators have been developed to determine the quality of care for breast cancer patients in Europe. The aim of this study was to calculate the quality indicators for patients with primary invasive and/or in situ breast cancer diagnosed in the Netherlands over the period 2012 to 2018 in order to determine the deviation from the norm, variation between Dutch hospitals, trends over time and to identify the usability and feasibility of the indicators.
Materials and methods: Data from the Netherlands Cancer Registry (NCR) was used to calculate the process and outcome indicators. Each indicator included female patients with invasive and/or in situ breast cancer who were aged over 18 years. All patients with prior ipsilateral breast cancer (invasive and/or in situ) were excluded. Quality indicators were calculated by constructing algorithms in STATA. Results on the indicators were presented in a summary table including the mean score and standard deviation over the years for each indicator. In addition, results were illustrated by funnel plots including a 95% confidence interval to represent the trend over time.
Results: During the study period, 133.527 patients were diagnosed with primary invasive (n = 109.623) or in situ (n = 23.904) breast cancer in one of the 75 hospitals. On average, Dutch hospitals scored above the norm for twelve indicators and scored below the norm for nine indicators. Three remaining indicators are monitoring indicators without a norm. In general, four indicators showed low variation (average st.dev. ≤5%), thirteen indicators showed middle variation (average st.dev. 5%-15%) and seven indicators showed large variation (average st.dev ≥15%). In total, three indicators showed a decreasing mean score over the years and four indicators showed an increasing mean score over the years.
Conclusion: Calculating the indicators provided insights on the quality of breast cancer care in the Netherlands. There are indicators who showed mean scores above the norm and low variation which reflects good quality of care. Other indicators with mean scores below the norm and/or large variation showed that Dutch hospitals should improve on the quality of breast cancer care. Overall, the indicators used are well constructed in order to determine the quality of breast cancer care for the Dutch setting which makes them usable and feasible.

Key words: breast cancer care, quality indicators

1. Introduction

Recent studies showed that treatment of breast cancer within an interdisciplinary breast unit was associated with improving quality of life and raises chances of survival for patients [1]. In 2016, the European Parliament Resolution on Breast Cancer called member states to deliver a report on progress in treatment within these breast units. To determine the quality of the breast units, it was necessary to define a set of quality indicators that should be routinely measured and evaluated in order to confirm that clinical outcomes meet the requested standards.

Quality indicators are standardized measures to determine health care outcomes and can be subdivided by the Donabedian framework [2]. In this framework, Donabedian distinguishes three types of indicators which are structure, process and outcome. Donabedian defined structure as the environment of health care, so the indicators provide information about the organizational aspects of the health system. The component process is defined as the procedure by which healthcare is being provided and guidelines are followed. The element outcome focuses on consequences of the provided healthcare. Quality indicators are important in breast cancer care because of the complexity of care and differences in treatment offered [1]. The quality indicators can be used for monitoring, making comparison to norms to support certfication and to benchmark between breastunits.

An European initiative to assess the quality of the delivered breast cancer care is the European Society of Mastology (EUSOMA). EUSOMA is a non-profit society founded by a group of specialists in breast cancer, who started a voluntary certification to assess the clinical performance in breast cancer units [1][3]. To confirm clinical outcomes were met, the EUSOMA developed quality indicators for breast cancer to create an agreed minimum standard of care and also to establish a benchmark [2]. 17 quality indicators have been identified, respectively, seven on diagnosis, four on surgery and loco-regional treatment, two on systemic treatment and four on staging, counselling, followup and rehabilitation. The quality indicators have been identified by taking into account the usability and feasibility, without increasing the registration burden [3].

To further improve the quality of breast cancer care, the European Commission initiated the European Commission Initiative on Breast Cancer (ECIBC) to develop evidence- and consensusbased recommendations and a quality assurance (QA) scheme for the entire pathway of breast cancer care [4]. The Joint Research Centre (JRC) provides the European Commission with independent scientifically substantiated information and has been mandated with developing the QA scheme [5]. This QA scheme, constructed within Quality Assurance Scheme Development Group (QASDG), aims to assesses whether requirements are being met by using qualitative and quantitative indicators and site visits. The QASDG consits of medical doctors, researchers and patients representatives and creates consensus on recommendations and reports using the Delphi method [4]. The QASDG is building on EUSOMA initiatives and it aims to set out accreditation for certification to assess the whole care pathway for breast units [6]. The QASDG constructed 55 indicators for international use to measure the quality of care for patients with invasive and/or in situ breast cancer in hospitals across Europe.

For this study, the quality indicators are calculated for the Dutch setting to gain insights in the quality of breast cancer care in the Netherlands. Quality of breast cancer care can be determined by comparing the scores on the indicators with the norm (established by the QASDG), analyse the differences in scores between hospitals and compare the scores over the years.

The aim of this study is to calculate the quality indicators, constructed by the QASDG and coordinated by the JRC, for patients with primary invasive and/or in situ breast cancer diagnosed in the Netherlands over the period 2012 to 2018, in order to determine the mean scores and deviation from the norm, variation between Dutch hospitals, trends over time and to identify the usability and feasibility of the indicators.

2. Methods

2.1 Design

This research is a retrospective observational descriptive cohort study. In general, the study includes female patients with invasive and in situ breast cancer diagnosed over the period 2012 to 2018 in the Netherlands and who were aged over 18 years. All patients with prior ipsilateral breast cancer (invasive and/or in situ) are excluded. For each indicator, different in- and exclusion criteria are defined and patients are selected accordingly. This way, each indicator will focus on variable subpopulations. In total, 77 Dutch hospitals are included, taking fusions into account. Hospitals fused during the study period (2012-2018) are considered as one over all years.

Quantitative data used in this study is derived from the Netherlands Cancer Registry (NCR) which is managed by the Netherlands Comprehenisive Cancer Organisation (IKNL). The NCR collects clinical data on diagnosis, treatment and survival of all cancer patients diagnosed in the Netherlands [7]. Diagnosis of new malignancies are electronically reported to the NCR by the pathology database (PALGA), medical registrations of hospitals and hematology laboratories. Additional information on diagnosis, treatment and follow up is derived from a patients electronic health record and is registred by trained datamangers [7].

2.2 Definition of the indicators

The QASDG constructed 55 quality indicators. This study includes 26 process and outcome indicators. Each indicator is divided by the Donabedian framework [3] (see table 1) and is assigned to a main subject, respectively, *general* (5, 6, 17), *diagnosis* (20), *surgery* (21, 22, 23, 24, 25, 26, 27, 28, 29, 30), *systemic treatment* (31, 32, 33, 35, 36, 37, 38, 39, 40) and *radiotherapy* (42, 43, 44). Each indicator is explained by a definition, rationale and norm.

2.2.1 General

Multidisciplinary team (indicator 5)

Proportion of women with breast cancer discussed by the multidisciplinary team prior to surgery (including patients with metastatic disease at diagnosis) or after surgery.

A MDT is a group of specialists from different healthcare disciplines who meet together to discuss a given patient and who are each able to contribute independently to the diagnostic and treatment decisions about the patient [8]. Multidisciplinary teams are assumed to optimize decision making in diagnosis, treatment and support of patients. All women with breast cancer visiting the breast centre should be discussed in a multidisciplinary team.

Norm: ≥90%

Lead time (diagnosis to treatment) (indicator 6)

Proportion of women with breast cancer who received treatment no longer than four weeks after the pathology report with diagnosis of cancer.

Limitation of the lead time between first consultation and primary treatment is considered important for high quality services. This is relevant from a medical perspective and from the patient's perspective in terms of patient-centeredness. Lead time between pathology report with diagnosis of cancer consultation and primary treatment should not be longer than four weeks.

Norm: ≥90%

Nurse referral (indicator 17)

Proportion of women with breast cancer who had a consultation with a breast care nurse at the time of diagnosis.

The breast care nurse is a case manager for the patient throughout the whole care pathway and can act as a patients advocate and offers an easily accessible way to come with problems. Breast care nurses give assessment and psychosocial support to women as soon as possible after or at the time of diagnosis and prior to treatment. Adequate information can help women in finding more balance, control, information and support in making their choices.

Norm: ≥95%

2.2.2 Diagnosis

Biomarkers (indicator 20)

Proportion of women with invasive breast cancer for whom the following biomarkers have been collected before starting treatment: Estrogen (ER) and Progesterone (PR) receptors, HER2 status.

Before the start of any treatment, including neoadjuvant or metastatic treatment, it is important ER and PR receptors, and HER2 status are collected to predict response rates to treatment. ER and PR receptors should be measured to select patients that are likely to respond to endocrine therapy [9]. HER2 expression should be measured to select patients for all forms of anti-HER2 therapy. Collecting biomarkers also supports decision making of the multidisciplinary team.

Norm: ≥95%

2.2.3 Surgery

Sentinel lymph node biopsy (indicator 21)

Proportion of surgically treated women with clinically node negative (cNO) invasive breast cancer that underwent sentinel lymph node biopsy (SLNB).

Sentinel lymph node biopsy is accepted as the standard of care for axillary staging in early clinically node-negative breast cancer, unless axillary node involvement is proven. The sentinel lymph node is the first lymph node that receives lymphatic fluid from a malignant tumour [10]. This way, the lymph node is functioning as a sentinel for further metastasis. Besides, it is useful for early tumour staging and determining individual surgical strategies. All eligible women should receive sentinel lymph node biopsy.

Norm: ≥90%

Axillary lymph node dissection (invasive) (indicator 22)

Proportion of surgically treated women with pathologically node negative (pN0) invasive breast cancer that did not undergo axillary lymph node dissection (ALND) (staged by SLNB only).

ALND is only indicated when axillary metastasis is evident. If axillary node disease is uncertain, other options are usually considered due to serious side effects of ALND such as reduced arm-/shoulder mobility, lymphedema, sensory disturbances and persistent pain [11]. Women with pathologically node negative (pN0) breast cancer - staged by SLNB - should not receive ALND.

Norm: ≥80%

Axillary lymph node dissection (DCIS) (indicator 23)

Proportion of surgically treated women with ductal carcinoma in situ (DCIS) that did not undergo axillary lymph node dissection (ALND).

ALND should be avoided in surgically treated women with DCIS. No women with DCIS should undergo ALND due to serious side effects such as reduced arm-/shoulder mobility, lymphedema, sensory disturbances and persistent pain [11].

Norm: ≥95%

Axillary lymph node dissection (10-nodes) (indicator 24)

Proportion of women treated with therapeutic axillary lymph node dissection (ALND) having 10 or more lymph nodes (including sentinel nodes) removed.

Therapeutic ALND should only be conducted if lymph node metastasis is identified histologically. ALND establishes nodal staging, predicting prognosis and optimizing regional control of the tumour. The National Comprehensive Cancer Network states removal of ≥10 lymph nodes as an appropriate ALND to stage the axilla [12]. This way, having 10 or more nodes removed is considered as the standard.

Norm: ≥90%

Breast-conserving surgery (DCIS) (indicator 25)

Proportion of surgically treated women with ductal carcinoma in situ (DCIS) with a radiological tumour extent ≤2 cm who did not undergo primary mastectomy.

Breast-conserving surgery is considered first choice of treatment in DCIS with small tumour size. However, the choice of surgery must be tailored to the individual patient. Most women with DCIS with a radiological tumour extent ≤2 cm should receive breast conserving surgery instead of primary mastectomy.

Norm: ≥80%

Breast-conserving surgery (invasive) (indicator 26)

Proportion of surgically treated women with invasive breast cancer with a pathological tumour size ≤2 cm (pT1) who underwent breast conserving surgery.

Breast-conserving surgery is considered first choice of treatment in invasive breast cancer with small tumour size. However, the choice of surgery must be tailored to the individual patient. Most women with invasive breast cancer with a pathological tumour size ≤2 cm should receive breast conserving surgery.

Norm: ≥70%

Single breast operation (DCIS) (indicator 27)

Proportion of surgically treated women with ductal carcinoma in situ (DCIS) who underwent a single breast operation for the primary tumour.

Achieving tumour free resection margins in a single operation - preventing re-operation – is an important goal in breast surgery. Most surgically treated women with ductal carcinoma in situ (DCIS) should undergo only one operation for the primary tumour.

Norm: ≥70%

Single breast operation (invasive) (indicator 28)

Proportion of surgically treated women with invasive breast cancer (T1, T2) that underwent a single breast operation for the primary tumour (only one operation)

Achieving tumour free resection margins in a single operation - preventing re-operation – is an important goal in breast surgery. Most surgically treated women with invasive breast cancer (T1, T2) should undergo only one operation for the primary tumour.

Norm: ≥80%

Breast reconstruction (immediate) (indicator 29)

Proportion of women who underwent immediate breast reconstruction after mastectomy.

Breast reconstruction should be available for women after mastectomy. Immediate reconstruction in most women can make the prospect of losing a breast easier to accept, but not all women will be suitable for immediate reconstruction. Some women may decline or defer reconstruction because of personal preference. Although no specific quality target is set for either immediate or delayed breast reconstruction, it is considered important to monitor the proportion of reconstruction. Women who underwent mastectomy should be offered immediate breast reconstruction.

Norm: This is a monitoring indicator without setting a norm

Breast reconstruction (delayed) (indicator 30)

Proportion of women who underwent delayed breast reconstruction within 12 months after mastectomy

Breast reconstruction should be available for women after mastectomy. Not all women will be suitable for immediate reconstruction. Some women may decline or defer reconstruction because of personal preference. It is important to monitor the proportion of women who underwent delayed breast reconstruction within 12 months after mastectomy.

Norm: This is a monitoring indicator without setting a norm

2.2.4 Systemic treatment

Lead time chemotherapy (indicator 31)

Proportion of women with invasive M0 breast cancer who received the first adjuvant chemotherapy cycle no longer than 8 weeks after the last surgery.

Delaying chemotherapy too long after surgery significantly increases the risk of local recurrence and might have an adverse impact on the survival. Patients should receive first adjuvant chemotherapy cycle as soon as possible.

Norm: ≥80%

Estrogen negative adjuvant chemotherapy (indicator 32)

The proportion of surgically treated women with ER– (T >1 cm or Node+) invasive M0 breast cancer who underwent adjuvant chemotherapy.

Chemotherapy reduces the risk of distant spread of breast cancer in the years after surgery increasing the survival rate. All surgically treated women with ER negative, node positive, invasive M0 breast cancer should undergo adjuvant chemotherapy.

Norm: ≥85%

Neoadjuvant anti- HER2 therapy (indicator 33)

The proportion of women with HER2+ invasive M0 breast cancer treated with neoadjuvant chemotherapy who underwent neoadjuvant anti-HER2 therapy.

In preoperative setting, combining HER2 therapy plus chemotherapy is recommended while this combination improves the response rate and reduces the risk of relapse [13]. All women with HER2+ invasive M0 breast cancer treated with neoadjuvant chemotherapy should undergo neoadjuvant anti-HER2 therapy.

Norm: ≥90%

Hormone sensitive endocrine therapy (indicator 35)

The proportion of surgically treated women with hormone sensitive (ER+ and/or PR+) invasive M0 breast cancer who were prescribed endocrine therapy.

Endocrine therapy (such as tamoxifen) is used after surgery to reduce the risk of recurrence in women with hormone sensitive breast cancer. All surgically treated women with hormone sensitive (ER+ and/or PR+) invasive M0 breast cancer should be prescribed endocrine therapy. Endocrine therapy should start as soon as possible but no later than one year after diagnosis.

Norm: ≥85%

Triple negative neoadjuvant chemotherapy (indicator 36)

The proportion of women with stage II and III triple negative breast cancer that received neoadjuvant chemotherapy.

Women with stage II and III triple negative breast cancer (TNBC) should be offered neoadjuvant chemotherapy. The use of neoadjuvant chemotherapy in patients with stage II and III triple negative breast cancer improved breast conservation and pathologic complete response, and is accepted as the current standard of care. The response to neoadjuvant chemotherapy provides physicians with important prognostic information which makes neoadjuvant therapy an attractive approach for all patients with TNBC [14]. It is important to monitor the use of neoadjuvant chemotherapy in this group of women.

Norm: This is a monitoring indicator without setting a norm

HER2+ neoadjuvant systemic therapy (indicator 37)

The proportion of women with stage II and III HER2+ breast cancer that received neoadjuvant systemic therapy.

Women with stage II and III HER2+ breast cancer should be offered neoadjuvant systemic therapy. The use of neoadjuvant systemic therapy in patients with stage II and III HER2+ breast cancer improved breast conservation and pathologic complete response, and is accepted as the current standard of care. It is important to monitor the use of neoadjuvant chemotherapy in this group of women.

Norm: This is a monitoring indicator without setting a norm

Locally advanced (indicator 38)

The proportion of women with locally advanced breast cancer (LABC) (tumour >3 cm or T4 or nodal status ≥N2) that underwent neoadjuvant systemic therapy.

The use of neoadjuvant systemic therapy in patients with locally advanced breast cancer reduces the risk of relapse. Primary chemotherapy is the main choice of treatment for patients with LABC [15]. All women with locally advanced breast cancer (tumour >3 cm or T4 or nodal status ≥N2) should undergo neoadjuvant systemic therapy.

Norm: ≥90%

ER+ HER2- metastatic breast cancer (indicator 39)

The proportion of women with ER+ and HER2- metastatic (at diagnosis) breast cancer receiving only endocrine-based (ET) therapy in the first line of treatment.

The preferred option for first line of treatment in women with ER+ and HER2- metastatic breast cancer is endocrine-based treatment. Endocrine therapy is the preferred option for hormone receptor positive disease even in the presence of visceral disease chemotherapy is reserved for life-threatening advanced disease, proof of endocrine resistance or visceral crisis [16].

Norm: ≥50%

HER2+ anti-HER2 therapy (indicator 40)

The proportion of women with HER2+ breast cancer treated with neoadjuvant systemic therapy who underwent neoadjuvant anti-HER2 therapy.

Neoadjuvant anti-HER2 therapy may lead to increased breast conservation in women with breast cancer and improves outcome. Currently, chemotherapy in combination with HER2-targeted therapy is the standard systemic treatment [17]. All women with HER2+ breast cancer treated with neoadjuvant systemic therapy should undergo neoadjuvant anti-HER2 therapy.

Norm: ≥90%

2.2.5 Radiotherapy

Lead time radiotherapy (indicator 42)

Proportion of women with primary invasive M0 breast cancer should start adjuvant radiotherapy no longer than 8 weeks after completion of last breast cancer surgery or last cycle of adjuvant chemotherapy.

Delaying radiotherapy too long after surgery might allow the proliferation of the remaining tumour cells and significantly increases the risk of local recurrence [18]. Lead time between completion of last breast cancer surgery or last cycle of adjuvant chemotherapy and start of adjuvant radiotherapy for women with primary invasive M0 breast cancer should be no longer than 8 weeks.

Norm: ≥80%

BCS adjuvant radiotherapy (indicator 43)

Proportion of women with M0 invasive breast cancer treated with breast conserving therapy who underwent whole breast adjuvant radiotherapy, or when indicated partial breast adjuvant radiotherapy.

After breast conserving surgery, radiotherapy substantially reduces the risk of cancer recurring in the breast and moderately reduces the risk of death. Radiation therapy may help prevent breast cancer from recurring or spreading to other parts of the body by eliminating microscopic disease that remains in the breast after surgery. All women with M0 invasive breast cancer treated with breast conserving therapy should undergo whole breast adjuvant radiotherapy, or when indicated partial breast radiotherapy.

Norm: ≥80%

Mastectomy adjuvant radiotherapy (indicator 44)

Proportion of women with invasive M0 breast cancer with ≥4 axillary lymph nodes involved who underwent local regional radiotherapy after mastectomy.

All women with invasive M0 breast cancer with ≥4 axillary lymph nodes involved must undergo local regional radiotherapy after mastectomy. Post-mastectomy radiotherapy significantly and substantially improved loco-regional control, reduces recurrence and breast cancer mortality in all women with node positive disease [19].

Norm: ≥90%

Table 1. Summary of the quality indicators constructed by the QASDG

Indicator	Donabedian	Norm %
General		
5. Proportion of women with breast cancer discussed by the multidisciplinary team prior to surgery or after surgery	Process	≥90
6. Proportion of women with breast cancer who received treatment no longer than 4 weeks after the pathology report with diagnosis of cancer	Process	≥90
17. Proportion of women with breast cancer who had a consultation with a breast care nurse at the time of diagnosis	Process	≥95
Diagnosis		
20. Proportion of women with invasive breast cancer for whom the following biomarkers have been collected before starting treatment: ER & PR receptors, HER2 status	Process	≥95
Surgery		
21. Proportion of surgically treated women with cN0 invasive breast cancer that underwent SLNB	Process	≥90
22. Proportion of surgically treated women with pN0 invasive breast cancer that did not undergo ALND (staged by SLNB only)	Process	≥80
23. Proportion of surgically treated women with DCIS that did not undergo ALND	Process	≥95
24. Proportion of women treated with therapeutic ALND having 10 or more lymph nodes (including sentinel nodes) removed	Outcome	≥90
25. Proportion of surgically treated women with DCIS with a radiological tumor extent ≤ 2cm who did not undergo primary mastectomy	Process	≥80
26. Proportion of surgically treated women with invasive breast cancer with a pathological tumor size ≤ 2cm pT1 who underwent breast conserving surgery	Process	≥70
27. Proportion of surgically treated women with DCIS who underwent a single breast operation for the primary tumor	Outcome	≥70
28. Proportion of surgically treated women with invasive breast cancer (T1, T2) that underwent a single breast operation for the primary tumor	Outcome	≥80
29. Proportion of women who underwent immediate breast reconstruction after mastectomy	Process	M *
30. Proportion of women who underwent delayed breast reconstruction within 12 months after mastectomy	Process	M *
Systemic treatment		
31. Proportion of women with invasive M0 breast cancer who received the first adjuvant chemotherapy cycle no longer than 8 weeks after the last surgery	Process	≥80
32. The proportion of surgically treated women with ER– (T > 1 cm or Node+) invasive M0 breast cancer who underwent adjuvant chemotherapy	Process	≥85
33. The proportion of women with HER2+ invasive M0 breast cancer treated with neoadjuvant chemotherapy who underwent neoadjuvant anti-HER2 therapy	Process	≥90
35. The proportion of surgically treated women with hormone sensitive (ER+ and/or PR+) invasive M0 breast cancer who were prescribed endocrine therapy	Process	≥85
36. The proportion of women with stage II and III triple negative breast cancer that received neoadjuvant chemotherapy	Process	M*
37. The proportion of women with stage II and III HER2+ breast cancer that received neoadjuvant systemic therapy	Process	M*
38. Proportion of women with locally advanced breast cancer (tumor >3 cm or T4 or nodal status ≥N2) that underwent neoadjuvant systemic therapy	Process	≥90
39. The proportion of women with ER+ and HER2- metastatic (at diagnosis) breast cancer receiving only endocrine-based therapy in the first line of treatment	Process	≥50
40. The proportion of women with HER2+ breast cancer treated with neoadjuvant systemic therapy who underwent neoadjuvant anti-HER2 therapy	Process	≥90
Radiotherapy		
42. Proportion of women with primary invasive M0 breast cancer should start adjuvant radiotherapy no longer than 8 weeks after completion of last breast cancer surgery or last cycle of adjuvant chemotherapy	Process	≥80
43. Proportion of women with M0 invasive breast cancer treated with breast conserving therapy who underwent whole breast adjuvant radiotherapy	Process	≥90
44. Proportion of women with invasive M0 breast cancer with ≥4 axillary lymph nodes involved who underwent local regional radiotherapy after mastectomy	Process	≥90

M = This is a monitoring indicator without setting a norm*

2.3 Statistical Analysis

The quality indicators constructed by the QASDG are based on specified datavariables. The datavariables are presented in a datadictonary, containing the name of the variable, the format of the variable, codes for the different categories of each variable, and a reference to the classification or standard that should be used (e.g. ICD-O-3, TNM8, etc.). Data of the NCR used in this study needs to be recoded to the standard components of the QASDG datavariables using the statistical software programm STATA. Quality indicators consist of a denominator and a numerator and are calculated in STATA with the use of the constructed algorithms. These algorithms are constructed according to the provided description of the numerator and denominator. Indicators are calculated by dividing the numerator by the denominator and are expressed as scores between 0 and 100 percent. Each score is a percentage of registered patients in year X at hospital A in the Netherlands who fullfill the description of the numerator and meet the eligible criteria of the specific indicator. Results are presented in a summary table, which includes the mean score and standard deviation per indicator for 2012, 2014, 2016 and 2018. In addition, results will be illustrated by funnel plots for 2012 and 2018 including a 95% confidence interval to represent the trend over time. Mean scores are compared to the norm which expresses the deviation from the norm. The variation between Dutch hospitals is represented by the standard deviation. In this study, low variation is defined as an average standard deviation ≤5% over the years, middle variation is defined as an average standard deviation between 5% and 15% over the years and large variation is defined as an average standard deviation ≥15% over the years. Lastly, scores are compared over the years to show trends over time.

3. Results

During the study period, 133.527 patients were diagnosed with primary invasive (n = 109.623) or in situ breast cancer (n = 23.904) in one of the 75 hospitals. Results of the indicators are presented in table 2, which includes the mean score and standard deviation per indicator for 2012, 2014, 2016 and 2018. In appendix A, indicators are illustrated by funnel plots for 2012 and 2018 including a 95% confidence interval. Some funnel plots are presented in this article to illustrate results on deviation from the norm, variation between hospitals and trends over time.

3.1 Deviation from the norm

3.1.1 Above the norm

Twelve out of the twenty-four indicators show mean scores above the norm for 2012, 2014, 2016 and 2018. From these indicators, one is an diagnosis indicator (20), seven are surgery indicators (21, 22, 23, 25, 26, 27 & 28), three are systemic treatment indicators (31, 33 & 40) and one is an radiotherapy indicator (42). For example, indicator 20 (biomarkers) scores respectively a mean of 97%, 96%, 96% and 97% with a norm of 95%.

3.1.1 Below the norm

Nine out of the twenty-four indicators show mean scores below the norm for 2012, 2014, 2016 and 2018. From these indicators, two are general indicators (5 & 6), one is an surgery indicator (24), four are systemic treatment indicators (32, 35, 38 & 39) and two are radiotherapy indicators (43 & 44). For example, indicator 5 (multidisciplinary team), scores respectively a mean of 85%, 86%, 87% and 86% with a norm of 90%. Indicator 39 (ER+ HER2- metastatic breast cancer) differs from the other indicators as it shows a mean score between 0% and 2% over the years with a norm of 50%.

3.1.1 Monitoring indicators

Three out of the twenty-four indicators are monitoring indicators without a norm. From these indicators, one is an surgery indicator (29) and two are systemic treatment indicators (36 & 37). The QASDG did not define a norm for these indicators so it is not possible to compare their mean scores with a norm.

3.2 Variation between hospitals

3.2.1 Low variation

Four out of the twenty-four indicators show low variation between hospitals (average standard deviation ≤5%). All these indicators (21, 22, 23 & 28) are surgical indicators. For example, indicator 21 (the use of a sentinel lymph node biopsy) is characterized by a standard deviation varying between 2% and 5% over all years. Even smaller variation was found for indicator 23 (the use of an axillary lymph node biopsy for DCIS) as the standard deviation does not exceed the 2% for all years.

3.2.2 Middle variation

Furthermore, thirteen out of the twenty-four indicators show middle variation between hospitals (average standard deviation between 5-15%). From these indicators, two are general indicators (5 & 6), one is an diagnosis indicator (20), four are surgical indicators (25, 26, 27 & 29), four are systemic treatment indicators (31, 33, 35 & 39) and two are radiotherapy indicators (42 & 43). For example, indicator 5 (the existence of a multidisciplinary team meeting) and indicator 33 (the use of neoadjuvant anti-HER2 therapy) are characterized with standard deviations varying between 8% and 10% and 7% and 15% for all years, respectively.

3.2.3 Large variation

Finally, seven out of the twenty-four indicators show large variation between hospitals (average standard deviation ≥15%). From these indicators, one is an surgery indicator (24), four are systemic treatment indicators (32, 36, 37 & 38) and two are radiotherapy indicators (40 & 44). For example, indicator 36 (the use of neoadjuvant chemotherapy for triple negative breast cancer) shows a standard deviation of 15%, 25%, 23% and 21% for 2012, 2014, 2016 and 2018, respectively. Indicators 24 (the removal of ≥10 nodes during axillary lymph node dissection) and 32 (the use of estrogen negative adjuvant chemotherapy), both differ from the other indicators with large variation while they show increasing values on standard deviation, respectively 8%, 8%, 20% and 24% for indicator 24 and 12%, 19%, 22% and 26% for indicator 32.

3.3 Trends over time

3.3.1 Increasing over time

Indicators for surgery (29) and systemic treatment (36, 37 & 38) show a mean score that is increasing over the years, respectively from 11% to 36%, 20% to 56%, 26% to 63% and 27% to 46%. See figure 1, indicator 29 (the use of breast reconstruction (immediate)), for illustration of the increasing mean scores over the years.

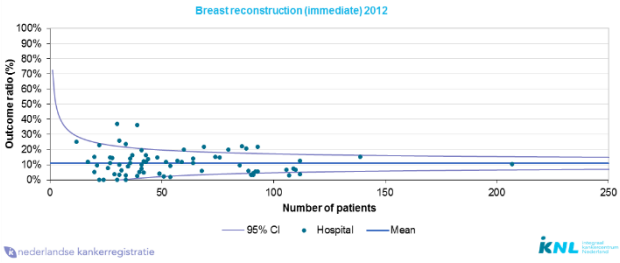

Figure 1a *– Breast reconstruction (immediate) 2012*

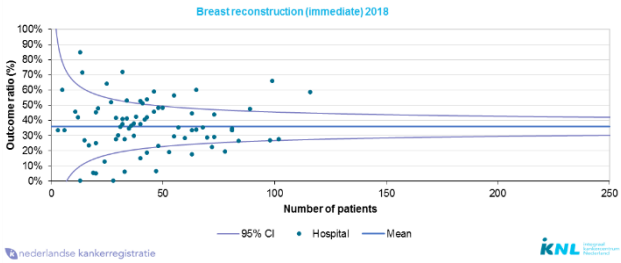

Figure 1b *– Breast reconstruction (immediate) 2018*

3.3.2 Decreasing over time

Indicator 6 (the lead time between diagnosis and start of treatment) shows a mean score that is decreasing over the years from 61% to 50%. This indicator is characterized by a lot of scores out of the confidence interval (see figure 2).

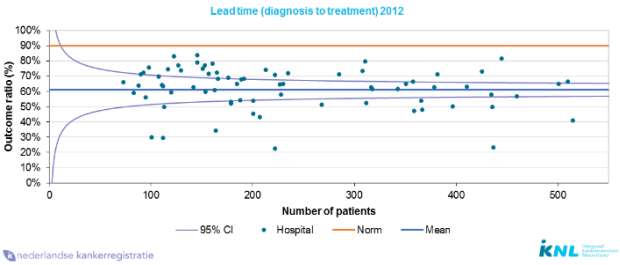

Figure 2a *– Lead time (diagnosis to treatment) 2012*

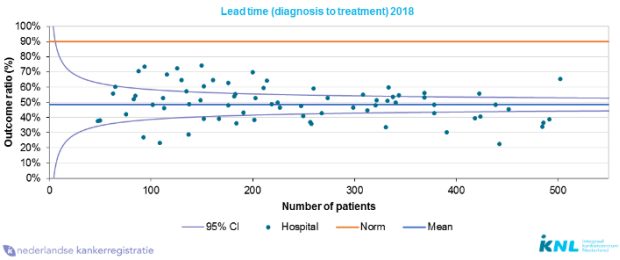

Figure 2b *– Lead time (diagnosis to treatment) 2018*

Indicator 24 (the removal of ≥10 nodes during axillary lymph node dissection) and 32 (the use of estrogen negative adjuvant chemotherapy) both show a decreasing mean score. Respectively, the mean scores decrease from 91% to 78% and 69% to 45% (see figure 3 & 4).

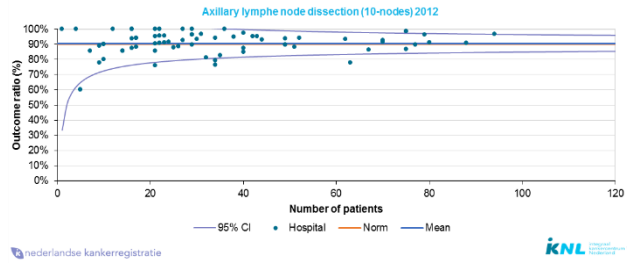

Figure 3a *– Axillary lymph node dissection (10-nodes) 2012*

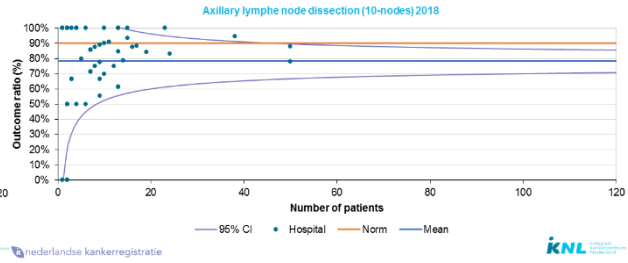

Figure 3b *– Axillary lymph node dissection (10-nodes) 2018*

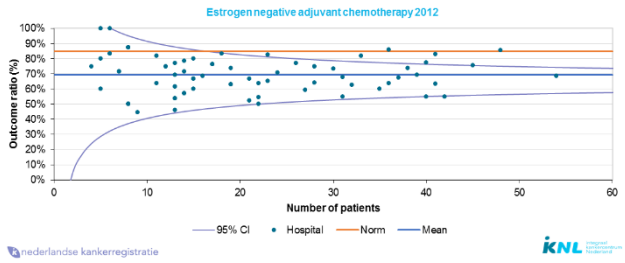

Figure 4a *– Estrogen negative adjuvant chemotherapy 2012*

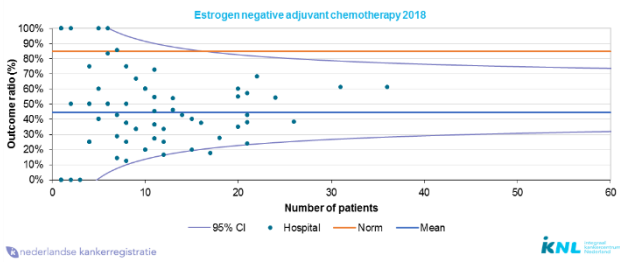

Figure 4b *– Estrogen negative adjuvant chemotherapy 2018*

Table 2. Summary table of the results on all calculated quality indicators, constructed by the QASDG, for patients with primary invasive and/or in situ breast cancer diagnosed in the Netherlands from 2012 to 2018.

				2012		2014		2016		2018	
Indicator	Name	Category	Norm%	Mean	St.dev.	Mean	St.dev.	Mean	St.dev.	Mean	St.dev.
5	Multidisciplinary team	General	≥90	85%	10%	86%	8%	87%	9%	86%	8%
6	Lead time (diagnosis to treatment)	General	≥90	61%	15%	60%	15%	58%	13%	50%	13%
17	Nurse referral	General	≥95	x	x	x	x	x	x	x	x
20	Biomarkers	Diagnosis	≥95	97%	4%	96%	5%	96%	7%	97%	5%
21	Sentinel lymph node biopsy	Surgery	≥90	97%	3%	97%	2%	97%	3%	96%	5%
22	Axillary lymph node dissection (invasive)	Surgery	≥80	98%	3%	99%	1%	99%	2%	99%	1%
23	Axillary lymph node dissection (DCIS)	Surgery	≥95	x	x	100%	2%	100%	0%	100%	1%
24	Axillary lymph node dissection (10-nodes)	Surgery	≥90	91%	8%	90%	8%	79%	20%	78%	24%
25	Breast-conserving surgery (DCIS)	Surgery	≥80	x	x	81%	15%	85%	12%	86%	12%
26	Breast-conserving surgery (invasive)	Surgery	≥70	71%	11%	72%	9%	75%	9%	78%	9%
27	Single breast operation (DCIS)	Surgery	≥70	85%	9%	90%	7%	89%	9%	91%	7%
28	Single breast operation (invasive)	Surgery	≥80	94%	3%	95%	3%	96%	2%	96%	2%
29	Breast reconstruction (immediate)	Surgery	M*	11%	8%	31%	17%	35%	17%	36%	17%
30	Breast reconstruction (delayed)	Surgery	M*	x	x	x	x	x	x	x	x
31	Lead time chemotherapy	Systemic	≥80	88%	10%	91%	10%	88%	17%	88%	15%
32	Estrogen negative adjuvant chemotherapy	Systemic	≥85	69%	12%	66%	19%	55%	22%	45%	26%
33	Neoadjuvant anti-HER2 therapy	Systemic	≥90	93%	15%	94%	14%	95%	15%	98%	7%
35	Hormone sensitive endocrine therapy	Systemic	≥85	68%	6%	67%	8%	65%	8%	62%	9%
36	Triple negative neoadjuvant chemotherapy	Systemic	M*	20%	15%	37%	25%	40%	23%	56%	21%
37	HER2+ neoadjuvant systemic therapy	Systemic	M*	26%	21%	34%	21%	46%	21%	63%	19%
38	Locally advanced	Systemic	≥90	27%	15%	39%	19%	42%	18%	46%	16%
39	ER+ HER2- metastatic breast cancer	Systemic	≥50	2%	7%	1%	4%	2%	7%	1%	4%
40	HER2+ anti-HER2 therapy	Systemic	≥90	90%	17%	90%	22%	93%	14%	96%	9%
42	Lead time radiotherapy	Radiotherapy	≥80	91%	7%	94%	4%	94%	4%	90%	9%
43	BCS adjuvant radiotherapy (whole or partial breast)	Radiotherapy	≥90	81%	9%	80%	8%	78%	9%	74%	8%
44	Mastectomy radiotherapy (local regional)	Radiotherapy	≥90	78%	20%	77%	21%	84%	20%	76%	24%

*M * = This is a monitoring indicator without setting a norm*
x = Data not registered in the NCR

4. Discussion

The QASDG developed quality indicators to measure the quality of breast cancer care in Europe. In this study, the quality indicators are calculated for patients with primary invasive and/or in situ breast cancer diagnosed in the Netherlands over the period 2012 to 2018, in order to determine the deviation from the norm, variation between Dutch hospitals, trends over time and to identify the usability and feasibility of the indicators. On average, Dutch hospitals score above the norm for twelve indicators and score below the norm for nine indicators (see table 2). The three remaining indicators are monitoring indicators without a norm. In general, four indicators for surgery show low variation, thirteen indicators for general, diagnosis, surgery, systemic treatment and radiotherapy show middle variation and seven indicators for surgery, systemic treatment and radiotherapy show large variation. Indicators for lead time between diagnosis and start of treatment, axillary lymph node dissection (10-nodes) and estrogen negative adjuvant chemotherapy show a mean score that is decreasing over the years, respectively from 61% to 50%, 91% to 78% and 69% to 45%. Indicators for breast reconstruction (immediate), triple negative neoadjuvant chemotherapy, HER2+ neoadjuvant systemic therapy and locally advanced show a mean score that is increasing over the years, respectively from 11% to 36%, 20% to 56%, 26% to 63% and 27% to 46%.

Results on mean scores show on which indicators Dutch hospitals score around or above the norm and also on which they should reflect and improve to assure patients get optimal breast cancer care. The indicators with mean scores above the norm show that hospitals in general live up to the agreed minimum standard of care established by the QASDG. For example, collecting biomarkers before treatment is an indicator with mean scores between 95% and 100% over the years with a norm of 95%. Scientific research shows that ER and PR receptors and HER2 status should be measured on all newly diagnosed breast cancer patients [20], which declares the high mean scores on the indicator. Indicators with mean scores below the norm, do not meet the standard quality of care. Some indicators score far below the norm, for instance hormone sensitive endocrine therapy, scores 62% to 68% while the norm is ≥85%. Other indicators score just below the norm, for instance multidisciplinary team, scores 85% to 87% while the norm is 90%. Further research should declare why hospitals score below the norm on these indicators and how they can meet the criteria of the specific indicator to achieve the norm and improve care for breast cancer patients.

Indicators with low variation show that, in general, all hospitals score close to the mean. The combination of low variation and mean scores above the norm for a specific indicator indicates good quality of care. Indicators with middle and large variation show differences in mean scores between hospitals. In this case, there is apparently no unambiguous approach in providing patients with the care needed. Hospitals should compare and reflect on their approaches to learn from each other.

Indicators with decreasing mean scores over the years show a decline which can possibly be caused by differences in the standard treatment of breast cancer. For example, the EUSOMA wields a maximum of six weeks from the first diagnostic examination to the date of primary treatment whereas the JRC states a maximum of four weeks [2]. Another example showing a decline in mean is the removal of lymph nodes. Nowadays, removal of 10 or more lymph nodes may no longer be the minimum yield to be considered a good surgery. Removing a lower number lymph nodes should result in fewer surgical side effects and ultimately improve the quality of life for the patient without compromising the oncological safety [21]. Indicators with increasing mean scores over the years are monitoring indicators and thus do not have a norm. Although no specific quality target is set for either of these indicators, it is considered important to monitor them. For instance, patients desire immediate restoration of their body shape after mastectomy more often and thus breast reconstruction after mastectomy has become part of treatment for breast cancer [22]. Also immediate breast reconstruction has been proven to be oncologically safe when compared to mastectomy alone. The use of neoadjuvant systemic therapy is increasing too. Research showed that disease-free and overall survival after neoadjuvant systemic therapy is equal to the use of adjuvant therapy. In addition, neoadjuvant systemic therapy increases the rate of breast conserving surgery, which minimises distress for breast cancer patients. Neoadjuvant systemic therapy is also a predictor of long-term outcomes and gives insight in prognostic information (for example response of a tumour to chemotherapy) in contrast to adjuvant trials, which do not show prognostic information until after 5 to 10 year follow up [23].

Besides constructing the quality indicators, the IT team of the JRC is currently constructing a Quality Indicator Calculator (QIC) to calculate the indicators with predefined algorithms. The QIC will be used by hospitals all over Europe to assess and monitor their delivered quality of care. This QIC can load the data variables from this study, calculate the 26 indicators using the predefined algorithms and export these indicators to an excel file. This way, in future research results of the QIC can be compared to the results of this study, to check the algorithms of the QIC and eliminate possible errors.

4.1 Limitations

This study includes process and some outcome indicators (see table 1). Structure indicators are excluded because the data needed for these indicators is not registered in the NCR. Two hospitals are excluded for the reason that their data is not being collected by data managers of the NCR. Indicators nurse referral and breast reconstruction (delayed) are not calculated (see table 2) for the reason that the variables used are not registered in the data of the NCR.

It has to be kept in mind the data used in this research is based on the Dutch healthcare system and results cannot be generalized to healthcare systems other than the Dutch healthcare system. Further research, using data on invasive and/or in situ breast cancer from other European countries, should make comparisons between European countries possible.

5. Conclusion

By calculating the indicators, it was possible to determine the deviation from the norm, the variation between Dutch hospitals and trends over time for all 24 indicators over the period 2012 to 2018 by which the aim of this study is achieved. The differences in quality of care are well represented by the differences in scores on the indicators. Indicators who showed mean scores above the norm and low variation reflect good quality of care. Other indicators with mean scores below the norm and/or large variation show that Dutch hospitals should improve on the quality of breast cancer care. The indicators used are well constructed in order to determine the quality of breast cancer care for the Dutch setting which makes them usable and feasible. Further research should identify possible reasons for large variation and discrepancies between the mean scores and norm on indicators to assure breast cancer patients get optimal care.

Acknowledgements

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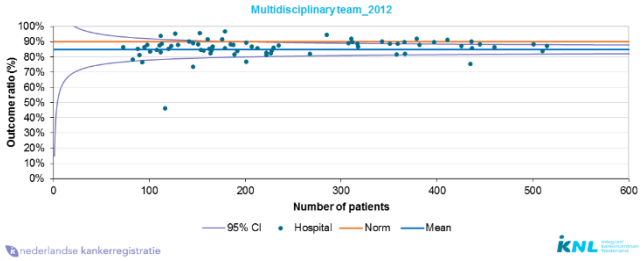
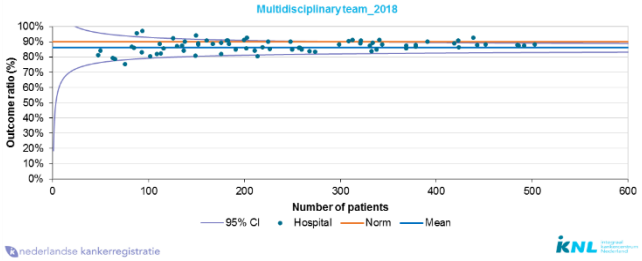
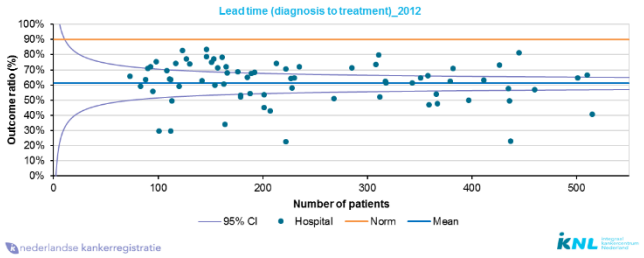
Appendix A

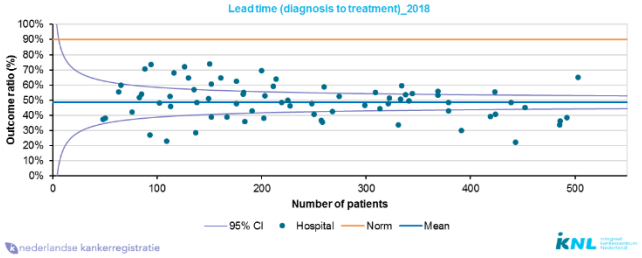
Indicator 5 – Multidisciplinary team



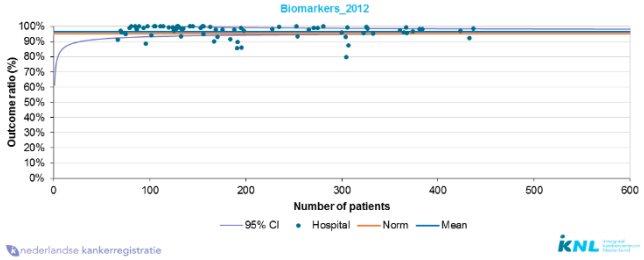


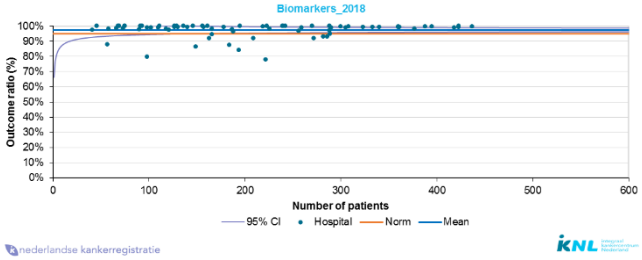
Indicator 6 – Lead time (diagnosis to treatment)



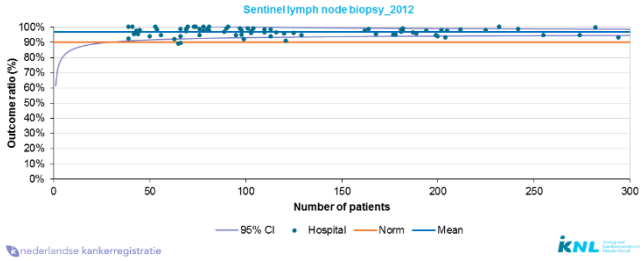


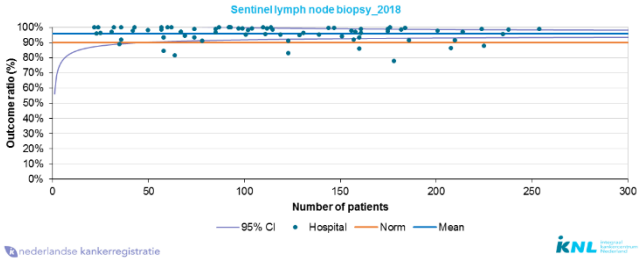
Indicator 20 – Biomarkers



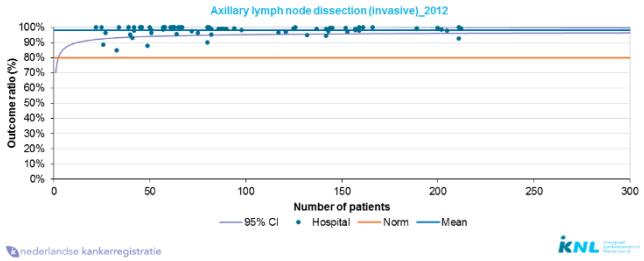


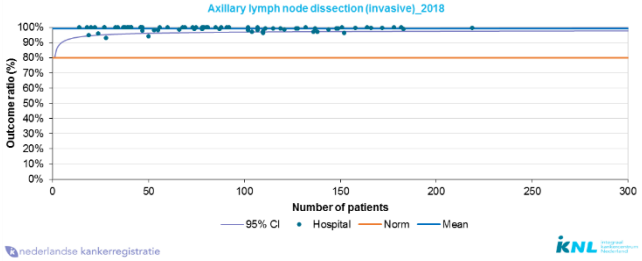
Indicator 21 – Sentinel lymph node biopsy



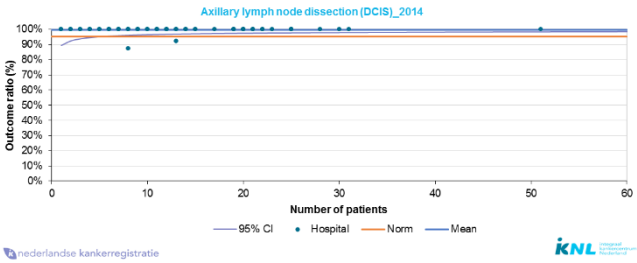


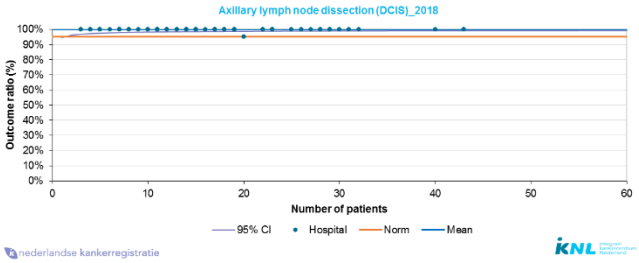
Indicator 22 – Axillary lymph node dissection (invasive)



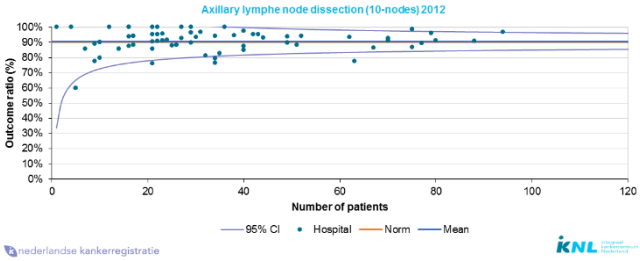


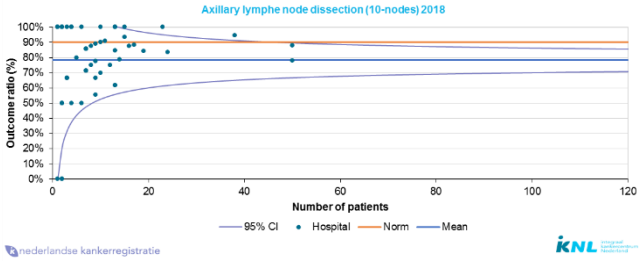
Indicator 23 - Axillary lymph node dissection (DCIS)*



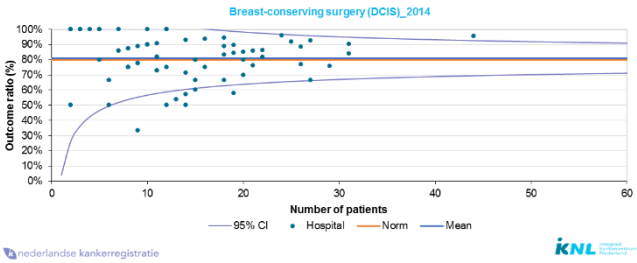


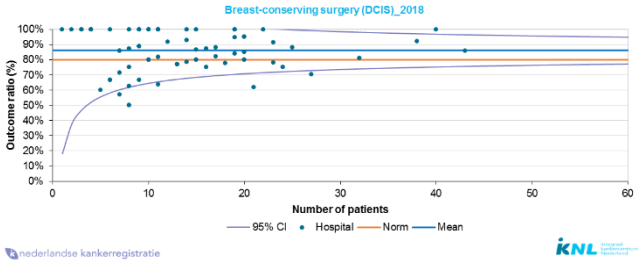
Indicator 24 - Axillary lymph node dissection (10-nodes)



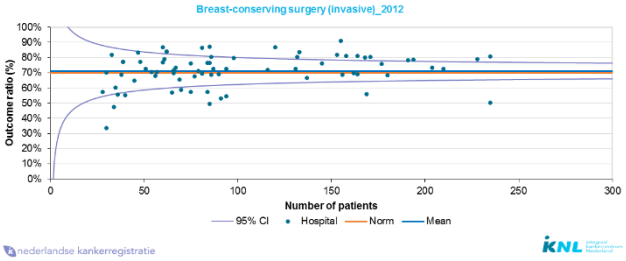


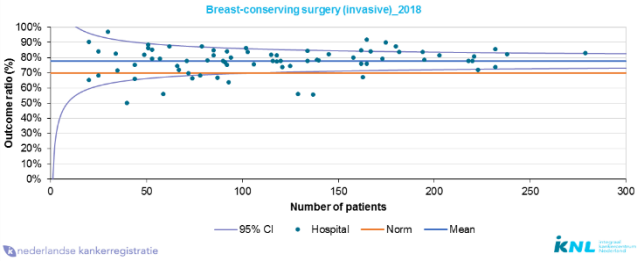
Indicator 25 - Breast-conserving surgery (DCIS)*



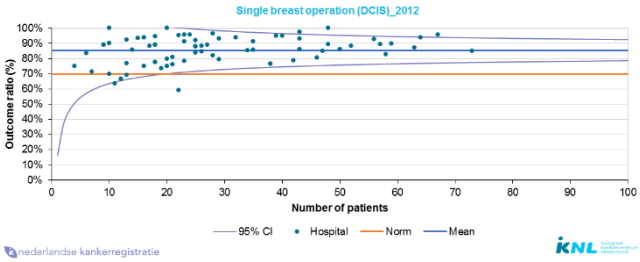


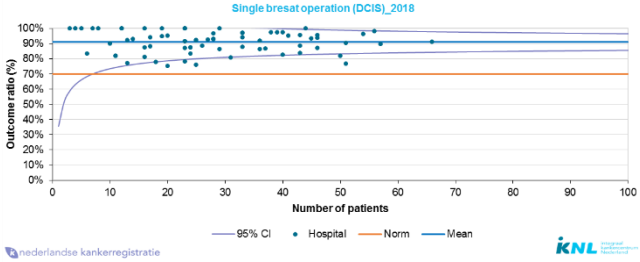
Indicator 26 – Breast-conserving surgery (invasive)





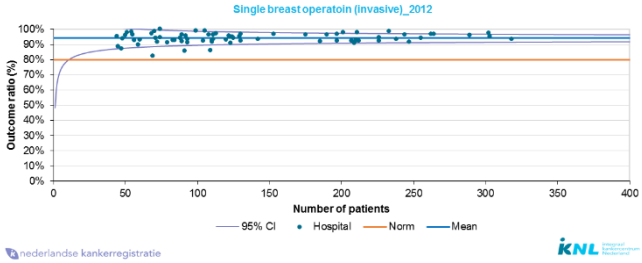
Indicator 27 – Single breast operation (DCIS)

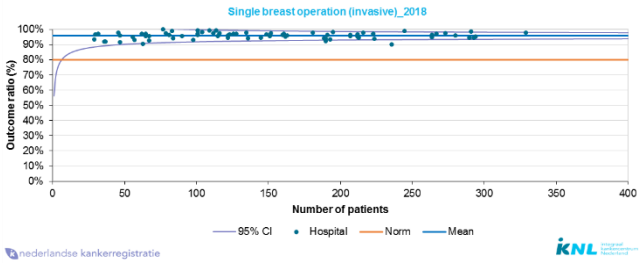




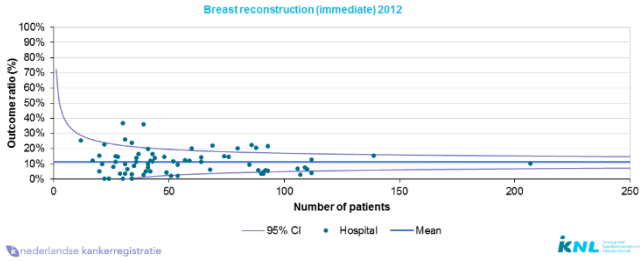
** Funnels for 2014 are illustrated because the data of 2012 is not registered in the NCR*

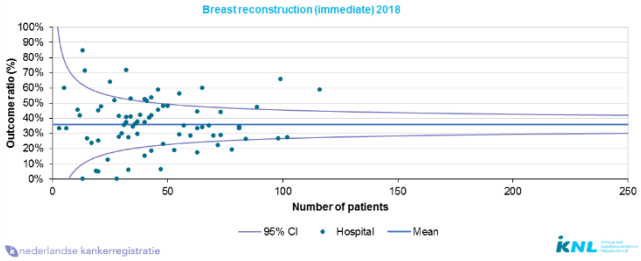
Indicator 28 – Single breast operation (invasive)



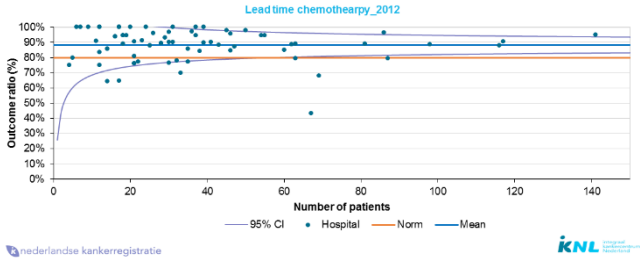


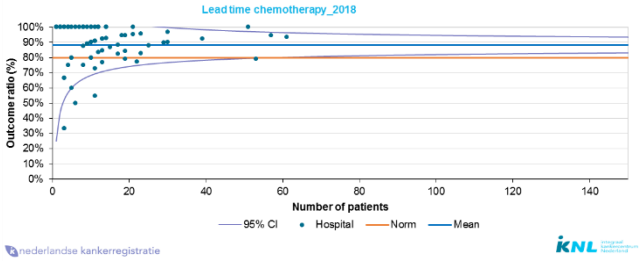
Indicator 29 – Breast reconstruction (immediate)



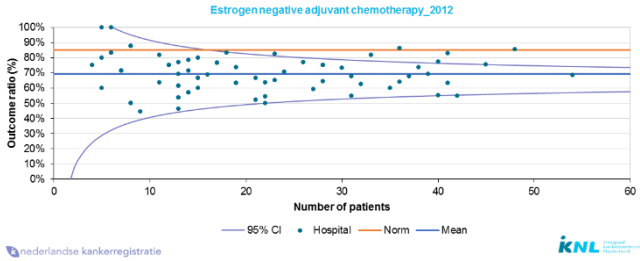


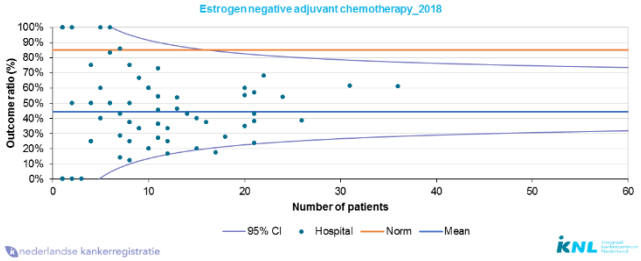
Indicator 31 – Lead time chemotherapy



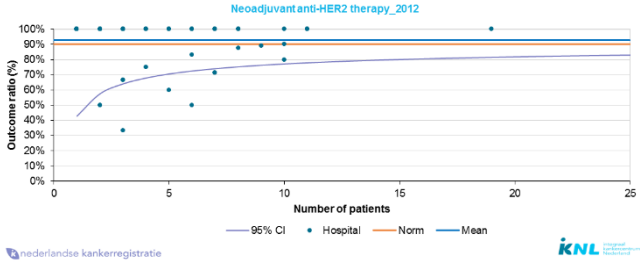


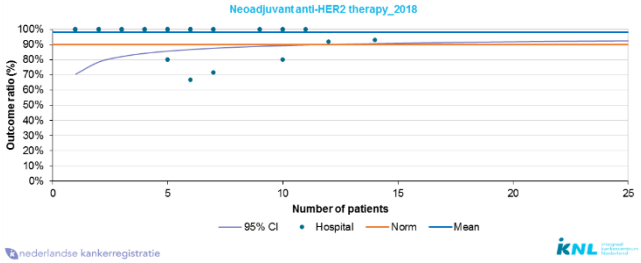
Indicator 32 – Estrogen negative adjuvant chemotherapy



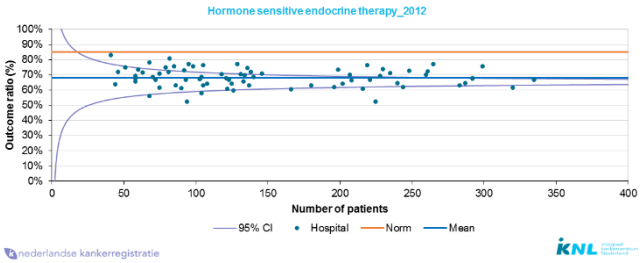


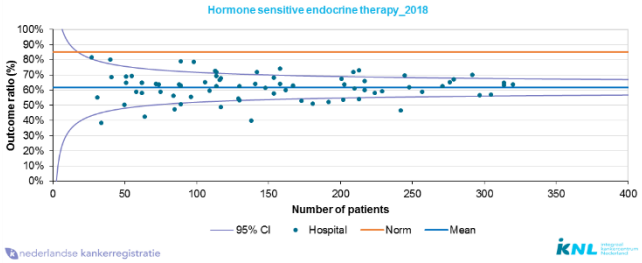
Indicator 33 – Neoadjuvant anti-HER2 therapy



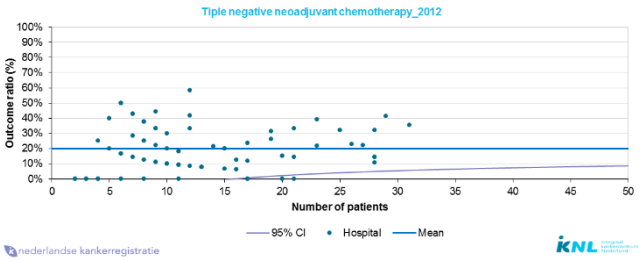


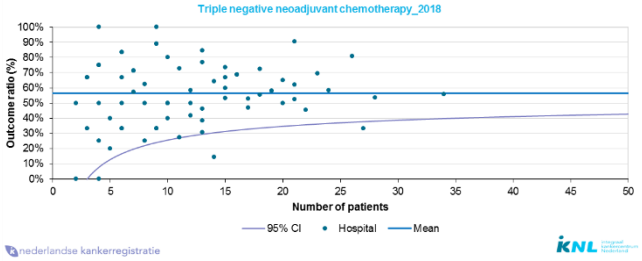
Indicator 35 – Hormone sensitive endocrine therapy



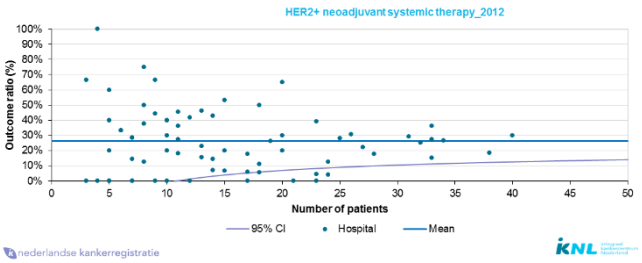


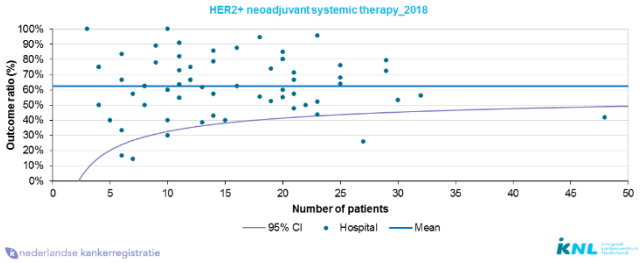
Indicator 36 – Triple negative neoadjuvant chemotherapy



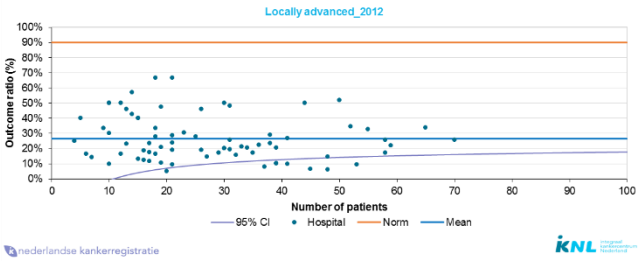


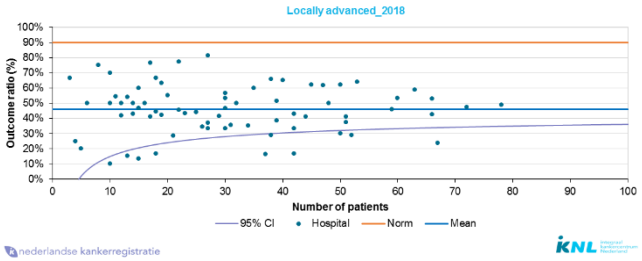
Indicator 37 – HER2+ neoadjuvant systemic therapy



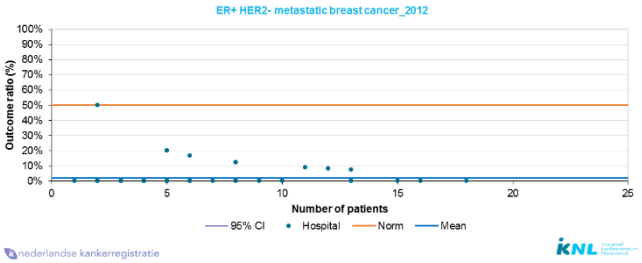


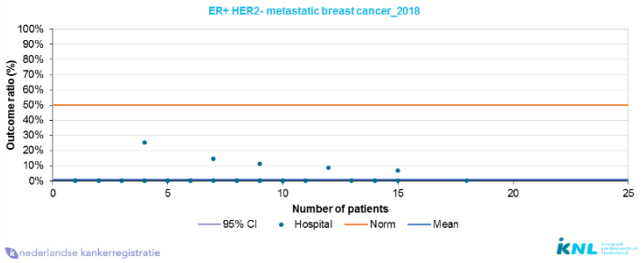
Indicator 38 – Locally advanced



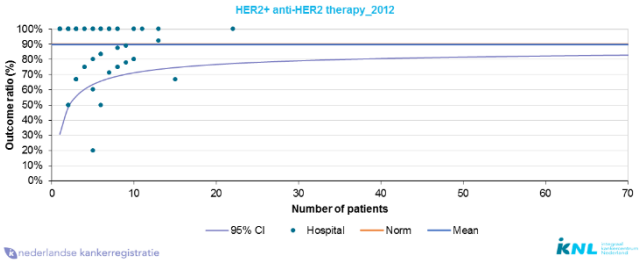


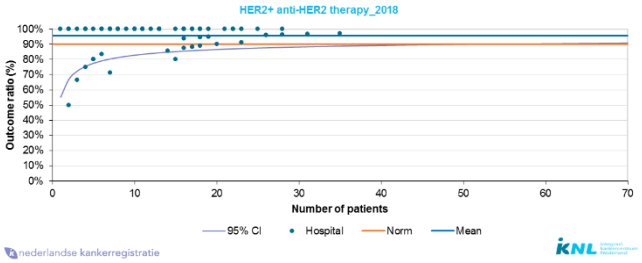
Indicator 39 – ER+ HER2- metastatic breast cancer



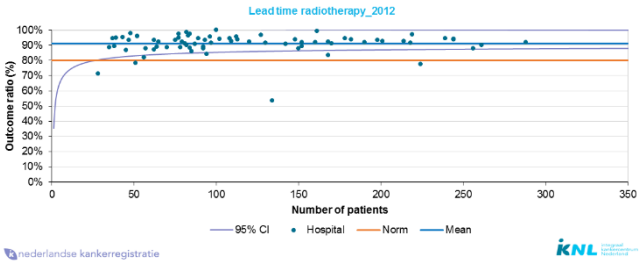


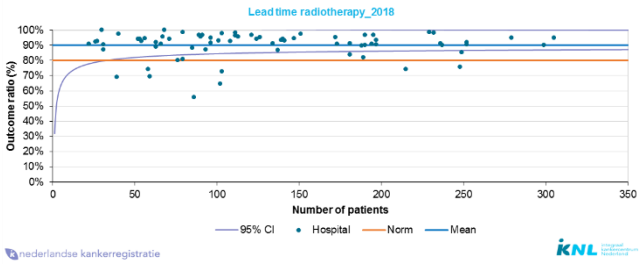
Indicator 40 - HER2+ anti-HER2 therapy



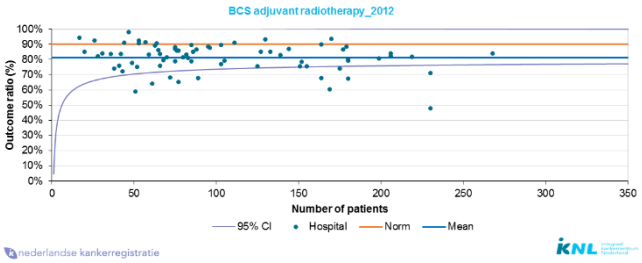


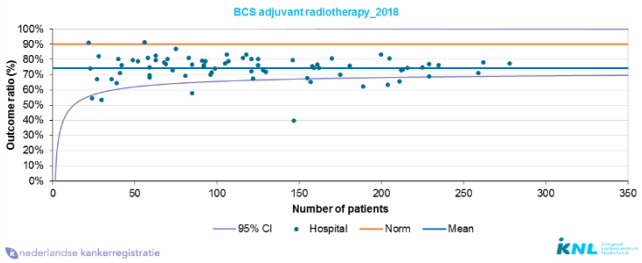
Indicator 42 - Lead time radiotherapy





Indicator 43 – BCS adjuvant radiotherapy





Indicator 44 – Mastectomy radiotherapy