Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.
Impact of the COVID-19 pandemic on surgical breast cancer care in the Netherlands: a multicentre retrospective cohort study.

Authors
M.D. Filipe¹ MD m.d.filipe-2@umcutrecht.nl
D. van Deukeren² BSc
M. Kip³ BSc
A. Doeksen² MD PhD
A. Pronk³ MD PhD
P.M. Verheijen⁴ MD PhD
J.T. Heikens²,⁵ MD PhD
A.J. Witkamp¹ MD PhD m.c.richir@umcutrecht.nl
M.C. Richir¹ MD PhD

¹ Department of Surgery, Cancer Centre, University Medical Centre Utrecht, The Netherlands
² Department of Surgery, St. Antonius Hospital, Nieuwegein, The Netherlands.
³ Department of Surgery, Diakonessenhuis, Utrecht, The Netherlands.
⁴ Department of Surgery, Meander Medical Centre, Amersfoort, The Netherlands.
⁵ Department of Surgery, Rivierenland Hospital, Tiel, The Netherlands.

Corresponding author
M.D. Filipe
Address: PO Box 85500, 3508 GA, Utrecht, The Netherlands
E-mail: m.d.filipe-2@umcutrecht.nl
Phone: +31 887556968
Keywords: COVID-19; surgery; pandemic; complications; breast cancer;
Micro abstract
Coronavirus disease 2019 (COVID-19) has an enormous impact on healthcare systems worldwide. This multicenter observational study of 217 consecutive breast cancer patients showed that there was a decrease of the number of breast cancer patients undergoing a surgical procedure. Additionally, multivariate analysis showed that there was no change in the number of postoperative complications during the 10 week study period.
Title:
Impact of the COVID-19 pandemic on surgical breast cancer care in the Netherlands: a multicenter retrospective cohort study.

Authors
M.D. Filipe MD m.d.filipe-2@umcutrecht.nl
D. van Deukeren BSc
M. Kip BSc
A. Doeksen MD PhD
A. Pronk MD PhD
P.M. Verheijen MD PhD
J.T. Heikens MD PhD
A.J. Witkamp MD PhD
M.C. Richir MD PhD m.c.richir@umcutrecht.nl

1 Department of Surgery, Cancer Centre, University Medical Centre Utrecht, The Netherlands
2 Department of Surgery, St. Antonius Hospital, Nieuwegein, The Netherlands.
3 Department of Surgery, Diakonessenhuis, Utrecht, The Netherlands.
4 Department of Surgery, Meander Medical Centre, Amersfoort, The Netherlands.
5 Department of Surgery, Rivierenland Hospital, Tiel, The Netherlands.

Corresponding author
M.D. Filipe
Address: PO Box 85500, 3508 GA, Utrecht, The Netherlands
E-mail: m.d.filipe-2@umcutrecht.nl
Phone: +31 887556968
Keywords: COVID-19; surgery; pandemic; complications; breast cancer;
Abstract

Abstract

Background
Coronavirus disease 2019 (COVID-19) has put a strain on regular healthcare worldwide. In the Netherlands, the national screening programs, including breast cancer, were halted temporarily. This poses a challenge to breast cancer care, since approximately 40% of cases is detected through national screening. Therefore, the aim of this study is to evaluate the impact of the COVID-19 pandemic on surgical care of breast cancer patients in the Netherlands.

Methods
This multicenter retrospective cohort study investigated the impact of COVID-19 on breast cancer patients undergoing surgery from March 9th to May 17th 2020. Primary endpoints were the number of surgical procedures performed over time, tumor characteristics, type of surgery and route of referral. The secondary endpoint was the number postoperative complications over time.

Results
In total, 217 consecutive breast cancer patients requiring surgery were included. There was an overall decrease in the number of breast cancer patients undergoing surgical procedures. The most significant decline was seen in surgical procedures for T1-2 and N0 tumors. A decline in the number of referrals from both the national screening program and the general practitioners was observed. The number of postoperative complications remained stable over the study period.

Conclusion
The temporary halt of the national screening program for breast cancer has resulted in fewer surgical procedures over time and a pronounced decrease in the lower tumor stages that were operated on.
Introduction
Coronavirus disease 2019 (COVID-19) is a highly infectious disease caused by acute respiratory syndrome coronavirus 2 (SARS-CoV-2) which is responsible for the ongoing pandemic (1). SARS-CoV-2 is mostly detected with polymerize chain reaction (PCR) from oropharyngeal swabs (2). To date, over 11,000,000 cases and over 530,000 deaths have been confirmed worldwide (3).

COVID-19 pandemic has posed a challenge to regular healthcare (4). Worldwide, measures to alleviate healthcare systems, such as suspension of elective surgeries, were taken (5). In the Netherlands, similar policies were implemented regarding oncological care. If possible, elective surgeries were postponed and the national screening programs for breast and colorectal cancer were temporarily halted as from March 16th 2020 (4,6). This has led to a concerning decline in breast cancer diagnoses (4,7). Breast cancer is the most common cancer and leading cause of cancer death in women worldwide (8). In the Netherlands, the incidence of breast cancer is roughly 17,000 cases per year, of which approximately 40% is detected through the national screening program (9,10). Surgical resection with or without radiotherapy and/or systemic treatment of the primary tumor is the treatment of choice in patients with new onset breast cancer (11–13). The measures taken to alleviate health care systems due to COVID-19 strongly affect breast cancer patients, especially due to postponed surgeries and halted national screening (4,6).

Recently, the number of breast cancer diagnoses have been reduced up to 50%, which can be attributed to the temporary halt of the national screening program and/or to fewer referrals from general practitioners (GP) (4). However, the consequences for surgical care for breast cancer are unknown. Therefore, the aim of this study is to determine the impact of the COVID-19 pandemic on the surgical demand for breast cancer.
Materials and methods

Patient Selection

This retrospective multicenter cohort study included all consecutive surgical patients operated between March 9th and May 17th 2020 in five hospitals in the Netherlands: University Medical Centre Utrecht, Ziekenhuis Rivierenland, St. Antonius Ziekenhuis, Diakonessenhuis and Meander Medical Centre. Consecutive patients were included if they were older than 18 years and underwent breast cancer surgery. The ethics committee of all participating centres approved this study and decided that informed consent was not required. The study is part of the trial registered in the research registry (www.researchregistry.com, unique identifying number: researchregistry5720).

Diagnosis of COVID-19

Included patients could be tested for COVID-19 prior to or during admission to the hospital. In addition, COVID-19 related symptoms could be registered. Reverse transcriptase PCR for SARS-CoV-2 was used in all centers, according to European guidelines for analysis (2). The genes used for analysis were the RdRP gene, E gene, and the N gene. The E gene assay was used first, followed by a confirmatory testing with the RdRp gene assay.

In this study, COVID-19 related symptoms were defined as cough, fever, fatigue, chest pain, dyspnoea and/or other flu-like symptoms.

Endpoints and definitions

The primary endpoints were the number of surgical procedures for breast cancer, TNM classification prior to operation, type of surgical procedure and initial referral (i.e. due to the national screening program or by the GP). The secondary endpoint was the number of postoperative complications. Additionally, we aimed to determine which factors influence the risk of postoperative complications.

Surgical procedures were defined as breast conserving therapy (BCT), mastectomy (with and without immediate reconstruction) and other types of procedure (i.e. lymph node dissection, lymph node biopsy, re-excision, scar-excision).

The general condition of patients prior to surgery was assessed with the American Society of Anesthesiologists (ASA) classification (14). The severity of the complications were classified according to the Clavien-Dindo classification (15). Major complications were defined as Clavien-Dindo class III or higher.

Tumors were categorized according to the tumor, node and metastasis (TNM) classification system (16). Phyllodes tumors were not graded according to the TNM classification (17).
Furthermore, radiotherapy, anti-hormonal therapy, immune therapy and chemotherapy were classified as adjuvant or neo-adjuvant therapy.

The number of comorbidities was based on the history of cardiovascular disease, pulmonary disease, renal disease and/or diabetes.

Statistical analysis

Descriptive statistics were used to describe patient and treatment characteristics. Continuous data were reported as means plus standard deviation (SD), or as medians and interquartile range (IQR), depending on the distribution. Student’s t test or Mann–Whitney U test was used to determine difference between groups, depending on the distribution. Differences between categorical data were assessed with the Chi-Square test.

Multiple imputation by chained equations (MICE) using the MICE package in R was performed for imputing missing data. Missing data were compared to non-missing data to determine whether data were missing at random. The imputation was repeated ten times, followed by application of Rubin’s rule to combine parameter estimates and standard errors (18,19). Imputed data were compared later to the complete cases to determine the validity of the imputation model. Imputed data were used in the analyses. Two-sided P-values below 0.05 were considered statistically significant.

Multivariate logistic regression analyses was performed to study the risk of the development of complications in patients who had undergone surgery. Odds ratio (OR) and 95% confidence intervals (CI) were used to quantify the risk. Possible confounding factors and effect modifiers were age, body mass index (BMI), ASA classification, type of breast surgery, number of comorbidities, TNM classification, week in which surgery was performed, symptoms associated with COVID-19 and testing for COVID-19.

All calculations were performed using RStudio 1.2.5001 (with R version: x64 3.6.3). Visualization of plots was performed using the ggplot2 package.
Results

Patient characteristics

In total, 217 consecutive breast cancer patients with a mean age of 62 years were included in this study. The majority of patients was diagnosed with T1-2 breast cancer (81.7%) without lymph node involvement (N0) (71%). Furthermore, ten patients were diagnosed with a phyllodes tumor. None of the included patients was diagnosed with metastatic disease. Neoadjuvant and adjuvant treatment was involved in 61 (28.1%) and 170 (78.3%) patients, respectively. One-hundred-thirty-nine (64.1%) patients underwent BCT. Twenty-one patients were tested for COVID-19 (9.7%) and none of them were tested positive. Complications occurred in 18 patients, of which eight (3.7%) patients suffered from major complications (Table 1).

Types of breast surgery over time

The number of different types of breast surgery performed from March 9th to May 17th are presented Figure 1. There was an overall decline in the total number of surgical procedures performed which was most pronounced after week six of the study. However, in the last two weeks (week 9 and 10) there appeared to be a slight increase in the total number of breast cancer surgeries performed. BCT procedures declined steady over time, except for the slight rise in the last two weeks of the study. At the same time, mastectomy and other types of breast surgery remained stable over time. There were no significant differences in the proportion of surgical procedures performed between the weeks (p=0.173).

Initial referral and T and N stage

The route of referral for the included breast cancer patients is presented in Figure 2. This includes the number of patients referred by the GP or due to national screening. In the study period, there was an overall decrease in the number of breast cancer patients requiring surgery who were originally diagnosed due to the national screening program. At the same time, the number of patients who were referred by the GP declined sharply after the week 6th week of the study. However, this number increased again after the 8th week.

The number of breast cancer patients with T1 and N1 tumors gradually declined over the weeks, while the decrease of patients with N0 tumors started after the 6th week of the study. Other T stages and N stages remained stable over time (Figure 3).
Complications

There was no increase in the number or severity of postoperative complications during the study period.

Multivariate analysis demonstrates that solely the number of comorbidities and surgery type contributed to the risk of developing postoperative complications in patients requiring breast cancer surgery (Table 2). Patients undergoing mastectomy had a significant higher risk of developing postoperative complications (OR 3.73, 95% CI: 1.14-12.23; p = 0.030) compared to patients undergoing BCT. Likewise, the number of comorbidities increased the risk of postoperative complications (OR 1.95, 95% CI 1.05-3.45; p = 0.035). COVID-19 related symptoms and neo-adjuvant therapy did not increase the risk of postoperative complications.
Discussion
This multicenter retrospective cohort study shows that there has been an overall decrease in the number of breast cancer surgeries performed during the COVID-19 pandemic in the Netherlands. Furthermore, a decline in the number of referrals from the national screening and from the GP was observed. Finally, no increase in the number of postoperative complications was seen over the included study period. COVID-19 related symptoms did not increase the risk of postoperative complications.

COVID-19 has put an enormous strain on the healthcare systems worldwide. Many measures taken by hospitals in less affected areas, such as the reallocation of hospital resources and prioritizing care, are based on the experiences of these high endemic countries (20–22). For surgical procedures, it was advised to only provide the most essential (oncological) care in order to accommodate the increased demand of COVID-19 care in hospitals. In addition, these advices were given to reduce the risk of postoperative complications in COVID-19 patients and to reduce the risk of spreading (23,24). As in other countries, in the Netherlands it was recommended only to perform essential surgery (6). Furthermore, the Dutch national screening program for breast cancer was temporarily from 16th of March 2020 until half June 2020 halted to alleviate health care workers (4). Normally, around 40% of new onset breast cancer cases is detected through the national screening program (9,10). The combination of the temporary halt of national screening and the recently reported decline in new breast cancer diagnoses is worrisome (9,10).

The halt of the national screening programs has an impact on the number of surgical procedures for breast cancer. The current study demonstrated a sharp decrease in the number of breast cancer surgeries. This decrease can be explained by the fact that surgical resection with or without radiotherapy and/or systemic treatment is the treatment of choice in patients with new onset breast cancer (11–13). This confirms previous findings that show that there are nationwide fewer breast cancer diagnosis during the COVID-19 epidemic (4). Furthermore, this decrease was especially prominent six weeks after the temporary stop of the national screening program, which equals week seven in our study period. In the Netherlands, treatment (neo-adjuvant, radiotherapy and/or surgery) is normally required within six weeks after initial cancer diagnosis (25). Therefore, a decline in the number of surgical procedures can be expected six weeks after halting national screening. Moreover, the current study showed that there was not only a decrease of breast cancer patients who were referred through national screening program but also in patients referred by the GP. This was because in the beginning of the pandemic the Dutch government discouraged patients to visit the GP unless absolutely necessary. While the patients referred by the GP increased steadily in the last weeks of the study, the number of patients referred due to...
national screening decreased further. The increase of GP referrals might be attributed to the awareness campaigns by the Dutch government later on, encouraging patients with symptoms to visit their GP (26).

The current study demonstrated a decline in T1-2 and N0 tumors, which can be attributed to the temporary halt of the Dutch national screening program. This is not surprising since the majority of screening detected breast cancers is diagnosed at an early stage (27). However, we do not suspect that the temporary halt of the breast cancer screening program has a significant impact on long-term outcomes since most breast cancers that are discovered by the screening program are early staged breast cancers that will develop slowly. Consequently, we do not suspect that there will be an increase in the number of higher staged breast cancers since the breast cancer screening program stopped for only 4 months. This confirms previous findings from the Netherlands Comprehensive Cancer Organisation, IKNL that show that there are nationwide fewer breast cancer diagnosis during the COVID-19 pandemic (4). The higher T and N stages appear to have remained relatively stable over time. The decrease in T1-2 and N0 tumors also explains the decrease in BCT performed, since BCT is the preferred treatment over mastectomy in these tumor stages (11–13). Despite the relatively small risk of postoperative complications in breast cancer surgery, many studies recommend not to perform or to postpone these procedures (23,24,28,29). However, no rise in postoperative complications in patients undergoing breast cancer surgery during the COVID-19 pandemic has been observed in this study. Multivariate analysis showed that patients undergoing mastectomy and patients with multiple comorbidities were at increased risk of developing postoperative complications. This is in line with previous studies reporting that a significantly higher complication rate is seen in patients undergoing mastectomies and in patients with comorbidities (28,29).

This study has some limitations. Firstly, the number of included patients was relatively small. Therefore, the number T3-4 tumors was low, which makes the recognition of patterns for this patient group more difficult. The relative low number of N2-3 tumors posed similar challenges in pattern recognition over time. However, this study did show a clear decreasing pattern in the lower staged tumors over time. Secondly, only 21 patients were tested for COVID-19 and all of them were tested negative. There was no change in the number of postoperative complications. However, more research is necessary to determine the direct risk of COVID-19 positive patients on the development of postoperative complications in patients undergoing breast cancer surgery and compared this to COVID-19 negative patients. Therefore, it is not possible to determine the direct risk of COVID-19 on postoperative complications in patients with breast cancer. Thirdly, there are significant fluctuations in the weekly number of patients undergoing surgical procedures, which is most likely due to the
relatively small number of patients. Finally, the current study focuses on surgical care while non-surgical care (radiotherapy, chemotherapy and anti-hormonal therapy) is also likely to have been affected by the COVID-19 pandemic (30,31). Since non-surgical care was not addressed in this study, it is not possible to present the impact of the COVID-19 pandemic on breast cancer treatment in all its facets.

Considering these limitations, this study has shown that the impact of the COVID-19 pandemic has dramatically decreased the number of breast cancer surgeries performed. This decrease was not only attributed to the temporary stop of the national screening program but was also due to fewer referrals from the GP. There was no change in the number of postoperative complications. However, more research is necessary to determine the direct risk of COVID-19 positive patients on the development of postoperative complications in patients undergoing breast cancer surgery and compare this to COVID-19 negative patients. Furthermore, provided that the necessary precautions to avoid the spread of COVID-19 are taken, patients should be encouraged to visit their GP and one should strive to restart national screening programs. However, in the event of a second wave, we recommend briefly temporarily stopping the national screening program again and at the same time continuing to perform surgical procedures on patients referred by the GP.
Figure 1. Number of breast cancer surgeries presented per type of surgical procedure. BCT = breast conserving therapy.
Figure 2. Number and percentage of breast cancer patients who underwent a surgical procedure between March 9\textsuperscript{th} and May 17\textsuperscript{th} 2020 who were referred by the national screening program or by the general practitioner.
Figure 3. Number of surgical procedures per T and N stage. T = tumor, N = node.
# Tables

Table 1. Baseline characteristics breast cancer patients undergoing surgery.

| Parameter                              | $N = 217$ |
|----------------------------------------|-----------|
| Age in years, mean (SD)                | 62.2 (13.1)|
| BMI in kg/m², median (IQR)             | 23.3 [23.0–30.4] |
| ASA classification                      |           |
| ASA I, N (%)                           | 47 (21.7%)|
| ASA II, N (%)                          | 130 (59.9%)|
| ASA III, N (%)                         | 40 (18.4%)|
| Diagnosis during national screening program, N (%) | 55 (25.7%) |
| T stage                                |           |
| T0, N (%)                              | 28 (13.5%)|
| T1, N (%)                              | 119 (57.5%)|
| T2, N (%)                              | 50 (24.2%)|
| T3, N (%)                              | 6 (2.9%)|
| T4, N (%)                              | 4 (1.9%)|
| T missing, N                           | 10        |
| N stage                                |           |
| N0, N (%)                              | 147 (71.0%)|
| N1, N (%)                              | 49 (23.7%)|
| N2, N (%)                              | 7 (3.4%)|
| N3, N (%)                              | 4 (1.9%)|
| N missing, N                           | 10        |
| M stage                                |           |
| 0 (0.0%)                               |           |
| Neo-adjuvant therapy                   | 61 (28.1%)|
| Adjuvant therapy                       | 170 (78.3%)|
| Type of surgery                        |           |
| BCT, N (%)                             | 139 (64.1%)|
| Mastectomy, N (%)                      | 63 (29.3%)|
| Other, N (%)                           | 15 (6.9%)|
| Patients tested for COVID-19, N (%)    | 21 (9.7%)|
| Complications                          |           |
| No complications, N (%)                | 199 (91.7%)|
| Minor complications, N (%)             | 10 (4.6%)|
| Major complications, N (%)             | 8 (3.7%)|

$N =$ number, $SD =$ standard deviation, $BMI =$ body mass index, $IQR =$ interquartile range, $ASA =$ American Society of Anesthesiologist, $T =$ tumor, $N =$ node, $M =$ metastasis, $BCT =$ breast conserving therapy, $COVID-19 =$ Coronavirus disease 2019
Table 2. Multivariate analysis determining the risk of postoperative complications in patients undergoing breast surgery.

| Parameter                          | Estimate | OR (95% CI)      | Standard error | Z value | P value |
|-----------------------------------|----------|------------------|----------------|---------|---------|
| Week number                       | -0.143   | 0.87 (0.70 - 1.08) | 0.11           | -1.301  | 0.193   |
| Patient age                       | 0.038    | 1.04 (0.99 - 1.09) | 0.026          | 1.478   | 0.140   |
| BMI                               | -0.033   | 0.97 (0.89 - 1.05) | 0.042          | -0.801  | 0.423   |
| Number comorbidities              | 0.670    | 1.95 (1.05 - 3.65) | 0.318          | 2.104   | 0.035   |
| ASA classification                | 0.405    | 1.50 (0.53 - 4.26) | 0.533          | 0.760   | 0.448   |
| T stage                           | -0.190   | 0.83 (0.40 - 1.70) | 0.369          | -0.516  | 0.606   |
| N stage                           | -0.310   | 0.73 (0.26 - 2.07) | 0.529          | -0.586  | 0.558   |
| Type of surgery                   |          |                  |                |         |         |
| BCT                               | NA       | 1.00 (reference) | NA             | NA      | NA      |
| Mastectomy                        | 1.318    | 3.73 (1.14 - 12.23) | 0.605         | 2.177   | 0.030   |
| Other                             | 0.583    | 1.79 (0.15 - 21.74) | 1.273         | 0.458   | 0.647   |
| Neo-adjuvant therapy              | 0.625    | 1.87 (0.50 - 7.02) | 0.675          | 0.926   | 0.355   |
| COVID-19 symptoms                 | 0.070    | 1.07 (0.29 - 3.90) | 0.659          | 0.106   | 0.916   |

OR = odds ratio, CI = confidence interval, T = tumor, N = node, COVID-19 = Coronavirus disease 2019, BMI = body mass index, ASA= American Society of Anesthesiologists classification, BCT = breast conserving therapy, NA = not applicable
References

1. Li H, Liu S-M, Yu X-H, Tang S-L, Tang C-K. Coronavirus disease 2019 (COVID-19): current status and future perspectives. Int J Antimicrob Agents. 2020/03/29. 2020 May;55(5):105951.

2. Corman VM, Landt O, Kaiser M, Molenkamp R, Meijer A, Chu DK, et al. Detection of 2019 novel coronavirus (2019-nCoV) by real-time RT-PCR. Eurosurveillance. 2020 Jan 23;25(3).

3. Johns Hopkins CSSE. Coronavirus COVID-19 Global Cases by the Center for Systems Science and Engineering (CSSE) at Johns Hopkins University (JHU). Available from: https://gisanddata.maps.arcgis.com/apps/opsdashboard/index.html#/bda7594740fd40299423467b48e9ecf6

4. Dinmohamed AG, Visser O, Verhoeven RHA, Louwman MWJ, van Nedeveen FH, Willems SM, et al. Fewer cancer diagnoses during the COVID-19 epidemic in the Netherlands. Lancet Oncol. 2020 Apr;

5. Burki TK. Cancer guidelines during the COVID-19 pandemic. Lancet Oncol. 2020 May;21(5):629–30.

6. NVVH. Handvat voor chirurgische ingrepen tijdens Corona-crisis. 2020.

7. Nederland I kankercentrum. COVID 19 en borstkanker.

8. Bray F, Ferlay J, Soerjomataram I, Siegel RL, Torre LA, Jemal A. Global cancer statistics 2018: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA Cancer J Clin. 2018 Nov;68(6):394–424.

9. Vondeling GT, Menezes GL, Dvortsin EP, Jansman FGA, Konings IR, Postma MJ, et al. Burden of early, advanced and metastatic breast cancer in The Netherlands. BMC Cancer. 2018 Mar 7;18(1):262–3.

10. Koleva-Kolarova RG, Daszczuk AM, de Jonge C, Abu Hantash MK, Zhan ZZ, Postema EJ, et al. A modelling study to evaluate the costs and effects of lowering the starting age of population breast cancer screening. Maturitas. 2018 Mar;109:81–8.

11. Agarwal S, Pappas L, Neumayer L, Kokeny K, Agarwal J. Effect of breast conservation therapy vs mastectomy on disease-specific survival for early-stage breast cancer. JAMA Surg. 2014 Mar;149(3):267–74.

12. Hartmann-Johnsen OJ, Karesen R, Schlichting E, Nygard JF. Survival is Better After Breast Conserving Therapy than Mastectomy for Early Stage Breast Cancer: A Registry-Based Follow-up Study of Norwegian Women Primary Operated Between 1998 and 2008. Ann Surg Oncol. 2015 Nov;22(12):3836–45.

13. van Maaren MC, de Munck L, de Bock GH, Jobsen JJ, van Dalen T, Linn SC, et al. 10 year survival after breast-conserving surgery plus radiotherapy compared with mastectomy in early breast cancer in the Netherlands: a population-based study. The Lancet Oncology. 2016 Aug;17(8):1158–70.

14. Owens WD. American Society of Anesthesiologists Physical Status Classification System in not a risk classification system. Anesthesiology. 2001 Feb;94(2):378.

15. Dindo D, Demartines N, Clavien PA. Classification of surgical complications: a new proposal with evaluation in a cohort of 6336 patients and results of a survey. Ann Surg. 2004 Aug;240(2):205–13.

16. Rao AA, Feneis J, Lalonde C, Ojeda-Fournier H. A Pictorial Review of Changes in the BI-RADS
17. Tan BY, Acs G, Apple SK, Badve S, Bleiweiss IJ, Brogi E, et al. Phyllodes tumours of the breast: a consensus review. Histopathology. 2016 Jan;68(1):5–21.

18. Beaulieu-Jones BK, Lavage DR, Snyder JW, Moore JH, Pendergrass SA, Bauer CR. Characterizing and Managing Missing Structured Data in Electronic Health Records: Data Analysis. JMIR Med informatics. 2018 Feb;6(1):e11.

19. Zhang Z. Multiple imputation with multivariate imputation by chained equation (MICE) package. Ann Transl Med. 2016 Jan;4(2):30-5839.2015.12.63.

20. Ravikumar N, Nallasamy K, Bansal A, Angurana SK, Basavaraja G V, Sundaram M, et al. Novel Coronavirus 2019 (2019-nCoV) Infection: Part I - Preparedness and Management in the Pediatric Intensive Care Unit in Resource-limited Settings. Indian Pediatr. 2020 Mar 29;

21. Guest JL, Del Rio C, Sanchez T. The 3 Steps Needed to End the COVID-19 Pandemic: Bold Public Health Leadership, Rapid Innovations, and Courageous Political Will. JMIR public Heal Surveill. 2020 Apr 2;

22. Zangrillo A, Beretta L, Silvani P, Colombo S, Scandroglio AM, Dell’Acqua A, et al. Fast reshaping of intensive care unit facilities in a large metropolitan hospital in Milan, Italy: facing the COVID-19 pandemic emergency. Crit Care Resusc. 2020 Apr 1;

23. Al-Jabir A, Kerwan A, Nicola M, Alsafi Z, Khan M, Sohrabi C, et al. Impact of the Coronavirus (COVID-19) pandemic on surgical practice - Part 1. Int J Surg. 2020 Jul;79:168–79.

24. Al-Jabir A, Kerwan A, Nicola M, Alsafi Z, Khan M, Sohrabi C, et al. Impact of the Coronavirus (COVID-19) pandemic on surgical practice - Part 2 (surgical prioritisation). Int J Surg. 2020 Jul;79:233–48.

25. SONCOS. Dutch guidelines stating that all patients must have had the first treatment within 6 weeks after cancer diagnosis. Available from: https://www.nvog.nl/wp-content/uploads/2018/02/SONCOS-normeringsrapport-versie-5-2017.pdf

26. Dutch Ministry. Campaign to encourage patients to visit the general practitioner during COVID-19 in order to keep up with cancer diagnoses [reference in Dutch]. Available from: https://www.rijksoverheid.nl/documenten/mediatexten/2020/04/17/letterlijke-tekst-persconferentie-na-ministerraad-17-april-2020

27. Elferink MAG, Toes-Zoutendijk E, Vink GR, Lansdorp-Vogelaar I, Meijer GA, Dekker E, et al. [National population screening for colorectal carcinoma in the Netherlands: results of the first years since the implementation in 2014]. Ned Tijdschr Geneeskd. 162:D2283.

28. El-Tamer MB, Ward BM, Schifftner T, Neumayer L, Khuri S, Henderson W. Morbidity and Mortality Following Breast Cancer Surgery in Women. Ann Surg. 2007 May;245(5):665–71.

29. ten Wolde B, Kuiper M, de Wilt JHW, Strobbe LJA. Postoperative Complications After Breast Cancer Surgery are Not Related to Age. Ann Surg Oncol. 2017 Jul 6;24(7):1861–7.

30. van Maaren MC, Strobbe LJA, Koppert LB, Poortmans PMP, Siesling S. Nationwide population-based study of trends and regional variation in breast-conserving treatment for breast cancer. Br J Surg. 2018 Dec;105(13):1768–77.

31. Kilsdonk MJ, van Dijk BA, Otter R, van Harten WH, Siesling S. Regional variation in breast cancer treatment in the Netherlands and the role of external peer review: a cohort study comprising 63,516 women. BMC Cancer. 2014 Dec 16;14(1):596.
Highlights

- The COVID-19 pandemic has caused a significant reduction of breast cancer patients undergoing surgery.
- Reduction of the number of breast cancer surgical procedures performed were due to the temporary suspension of the national screening program and the fewer referrals from the general practitioner.
- The number of breast cancer patients with higher staged tumors that underwent a surgical procedure remained stable while the number of patients undergoing surgical procedures with lower staged tumors dropped significantly.
Clinical practice points

Coronavirus disease 2019 (COVID-19) has an enormous impact on regular healthcare worldwide. Measures taken to reduce the spreading of COVID-19 include social distancing but also a temporary stop of the national screening programs. Measures taken to reallocate hospital resources in favor of COVID-19 care include postponing (oncological) surgical procedures. Another reason for postponing (oncological) surgical procedures was out of the fear of increased risk of postoperative complications. Since surgery one of the most important factor for the treatment of breast cancer, the aim of this study was to determine the impact of the COVID-19 pandemic on surgical care for breast cancer.

The current multicenter observational study showed that there was a decrease in the number of surgical procedures performed due to breast cancer. This reduction was not only due to the suspension of the national screening program but also due to fewer referrals from the general practitioner. The decrease in the weekly number of surgical procedures performed was most pronounced in the lower staged breast cancer tumors. Additionally, none of the breast cancer patients undergoing surgery tested positive for COVID-19. However, only patients with COVID-19 like symptoms (such as fever cough and dyspnea) were tested for COVID-19. Yet, multivariate analysis showed that there was no increase in postoperative complications over time. This means that even if some of the untested breast cancer patients were actually positive for COVID-19, they were not at an increased risk of developing postoperative complications since the number of postoperative remained stable over the study period.