Hospital transfer after a breast cancer diagnosis: a population-based study in the Netherlands of the extent, predictive characteristics and its impact on time to treatment

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Hospital transfer after a breast cancer diagnosis: A population-based study in the Netherlands of the extent, predictive characteristics and its impact on time to treatment

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A B S T R A C T

Purpose: Patients may transfer of hospital for clinical reasons but this may delay time to treatment. The purpose of this study is to provide insight in the extent of hospital transfer in breast cancer care; which type of patients transfer and what is the impact on time to treatment.
Methods: We included 41,413 breast cancer patients registered in the Netherlands Cancer Registry between 2014 and 2016. We investigated transfer of hospital between diagnosis and first treatment being surgery or neoadjuvant chemotherapy (NAC). Co-variate adjusted characteristics predictive for hospital transfer were determined. To adjust for possible treatment by indication bias we used propensity score matching (PSM). Time to treatment in patients with and without hospital transfer was compared.
Results: Among 41,413 patients, 8.5% of all patients transferred to another hospital between diagnosis and first treatment; 4.9% before primary surgery and 24.8% before NAC. Especially young (aged <40 years) patients and those who underwent a mastectomy with immediate breast reconstruction (IBR) were more likely to transfer. The association of mastectomy with IBR with hospital transfer remained when using PSM. Hospital transfer after diagnosis significantly prolonged time to treatment; breast-conserving surgery by 5 days, mastectomy by 7 days, mastectomy with IBR by 9 days and NAC by 1 day.
Conclusions: While almost 5% of Dutch patients treated with primary surgery transfer hospital after diagnosis and up to 25% for patients treated with NAC, our findings suggest that especially those treated with primary surgery are at risk for additional treatment delay by hospital transfer.

Introduction

Breast cancer is the most common neoplasm among women in the Netherlands with an incidence of more than 14,000 new patients [1]. Since 1989, the Netherlands Cancer Registry (NCR) registers data on patient-, tumor-, diagnostic- and treatment characteristics of all Dutch cancer patients. A high standard of care is provided in all breast cancer treating hospitals, offering both surgical and systemic treatment options in every hospital [2].

Hospital transfer can be clinically motivated e.g. because of the unavailability of certain treatment options, or patient's wish. However, hospital transfer can cause delay in treatment, extra costs and discontinuity of care as being demonstrated in different studies including patients diagnosed with ischemic stroke, diabetes and different types of cancer [3–9]. The first discussion about breast cancer patients changing hospital emerged after publication of studies focusing on predictors of delay of treatment [10,11]. A recent study by Bleicher et al. showed an association between hospital transfer and treatment delay. They also showed that more

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than one-third of breast cancer patients transfer hospital in the United States (US) [12]. Identifying predictive characteristics for hospital transfer based on previous studies is debatable as hospital transfer was not analyzed independently of other characteristics. The findings from the US cannot be generalized, as the healthcare systems differ between countries on care access by patients and hospital transfer depends of the organization of healthcare.

Because the existing research on hospital transfer by breast cancer patients is restricted to studies in non-population based settings in which not all breast cancer treating hospitals were participating, the relevance of a more detailed, population-based study is emphasized. Quantifying the extent of hospital transfer and assessing which patient characteristics are predictive of hospital transfer, could provide relevant information for physicians focusing on optimizing breast cancer care.

The primary aim of the present study is to analyze to what extent patients diagnosed with breast cancer transfer to another hospital between diagnosis and treatment in the Netherlands. Secondly, we sought to investigate predictive factors for hospital transfer and determine the impact of hospital transfer on time to treatment.

Methods

Patient population

The study was designed by the NABON Breast Cancer working group, an initiative that started in 2011 [2]. For this study data on patient, tumor and treatment characteristics as well as hospital characteristics were derived from the NCR database. All surgically treated female patients diagnosed in the Netherlands with invasive breast cancer between January 1th, 2014 and December 31th, 2016 were selected. Patients diagnosed with metachronous breast cancer in the same breast or contralateral, were included multiple times. Hospital transfers were recorded on patient level, so patients with bilateral tumor were counted as one. Patients with an unknown treatment status were excluded. The study was approved by the Privacy Review Board of the NCR.

Variables studied

Patient characteristics*:* Age at time of diagnosis was depicted in 10-year groups, as this provided more insight into differences between clinically relevant groups. Socio-economic status (SES) was determined using the postal code. The SES indicator uses fiscal data based on a combination of the mean value of the houses and mean household income and was provided at an aggregated level for each Dutch postal code [13]. SES was categorized in low (first - third decile), medium (fourth - seventh decile) and high (eight - tenth decile).

Tumor characteristics: Histologic finding, tumor differentiation grade according to Bloom–Richardson scoring system [14] and stage according to the 7th edition of the American Joint Committee on Cancer's (AJCC) Cancer Staging Manual [15] were included.

Treatment characteristics: Type of first surgery was classified into breast-conserving surgery, mastectomy, and mastectomy with immediate breast reconstruction (IBR) on the same day as the mastectomy. Chemotherapy was defined as neoadjuvant when initiated before surgery.

For analysis of patients transferring to another hospital we defined two groups; 1. patients who underwent primary surgery and 2. patients who underwent neoadjuvant chemotherapy (NAC) followed by surgery. Hospital transfer was defined as a transfer between diagnosis and primary surgery or between diagnosis and start of NAC.

Hospital characteristics: Hospitals were categorized according to hospital type as district hospitals, teaching hospitals (not affiliated with a medical faculty), medical faculty affiliated university hospitals and cancer-specific hospitals (only treating cancer patients).

To evaluate the impact of transfer on time to treatment, we calculated time in days between biopsy-proven breast cancer and first treatment, being primary surgery or initiation of NAC for patients with and without hospital transfer.

Statistical analysis

Differences in characteristics between patients with or without hospital transfer were analyzed using chi-square tests. A p-value <0.05 was considered statistically significant. A logistic regression model was used to determine characteristics predictive for hospital transfer and was presented as the odds ratio (OR) with a 95% confidence interval (CI). Characteristics that had a $p < 0.10$ in univariable analysis were included in a multivariable model. Secondly, to adjust for possible treatment by indication bias between the different types of surgery, we used propensity score matching (PSM) to match patients on having the same chance of a specific surgery based on patient, tumor and axillary lymph node treatment characteristics. Time to treatment in patients with and without hospital transfer were compared using Wilcoxon-Mann-Whitney tests. All statistical analyses were performed with STATA (version 13.1, 2013, Texas).

Results

Study population

Between 2014 and 2016, 41,413 female patients with invasive breast cancer who met our eligibility criteria were included. In total, 33,930 patients underwent primary surgery and 7483 patients received NAC. Patient, tumor and treatment characteristics are listed in Table 1.

Mean age was 60.5 (standard deviation 12.5) years. In the primary surgery group 22,106 patients (65.2%) underwent breast-conserving surgery and 11.824 patients (34.8%) underwent ablative surgery. The use of IBR increased from 19.5% to 24.2% over the 3-year period. Over the years the percentage of patients receiving NAC increased from 15.1% to 18.3%. Off all patients, 14,683 (35.5%) patients were diagnosed in a district hospital, 23,287 (56.2%) patients in a teaching hospital, 2491 (6.0%) patients in a university hospital and 952 (2.3%) in a cancer-specific hospital.

Hospital transfer after diagnosis

In total, 3517 patients (8.5%) transferred hospital between diagnosis and first treatment. The hospital transfer during the 3-year period is presented in Fig. 1. In patients treated with primary surgery, the overall percentage of hospital transfer was 4.9% ($n = 1665$) whereas in patients treated with NAC, 24.8% of patients ($n = 1852$) transferred hospital between diagnosis and initiation of NAC. The total percentage of patients transferring hospital between NAC and surgery was 16.9%. Of the patients transferring hospital between diagnoses and NAC, 50.7% returned to the hospital of diagnosis after completion of NAC.

Over the years, the percentage of patients treated with primary surgery who transferred hospital increased significantly from 4.5% to 5.0% ($p = 0.014$) whereas for those who started with NAC this percentage decreased from 30.7% to 14.6% ($p=<0.001$). The percentage of patients who transferred hospital between NAC and surgery decreased from 22.5% to 8.4% ($p=<0.001$).

Table 1
Patient, tumor and treatment characteristics with percentage of patients who transfer hospital.

		Diagnosis and primary surgery			p-value	Diagnosis and neoadjuvant chemotherapy			p-value
		All patients	Hospital transfer			All patients	Hospital transfer		
		N (%)	No	Yes		N (%)	No	Yes	
Number of patients		33,930 (100.0)	95.1	4.9		7,483 (100.0)	75.3	24.8	
Year of diagnosis	2014	11,728 (34.6)	95.6	4.5	0.014	2,147 (28.7)	69.4	30.7	**<0.001**
	2015	11,001 (32.4)	94.8	5.3		2,729 (36.5)	70.2	29.8	
	2016	11,201 (33.0)	95.0	5.0		2,607 (34.8)	85.4	14.6	
Age (years)	<40	953 (2.8)	86.3	13.8	**<0.001**	1,088 (14.5)	68.7	31.3	**<0.001**
	40–49	4,084 (12.0)	92.3	7.7		2,476 (33.1)	74.8	25.2	
	50–59	8,532 (25.2)	94.7	5.3		2,189 (29.3)	76.8	23.2	
	60–69	10,689 (31.5)	95.8	5.2		1,473 (19.7)	78.7	21.3	
	70–79	7,039 (20.8)	96.8	3.2		240 (3.2)	73.8	26.3	
	≥80	2,633 (7.8)	96.6	3.4		17 (0.2)	76.8	23.5	
Socio-economic staus	Low	11,739 (35.4)	94.6	5.4	**<0.001**	2,319 (31.0)	73.6	26.4	**0.001**
	Average	11,593 (34.9)	95.8	4.2		2,584 (34.5)	78.3	21.7	
	High	10,598 (31.9)	94.9	5.1		2,580 (34.5)	73.7	26.3	
Differentiation grade	Well	8,893 (26.2)	95.4	4.6	**0.011**	598 (8.0)	82.1	17.9	**<0.001**
	Moderately	16,160 (47.6)	95.1	4.9		2,558 (34.2)	74.4	25.7	
	Poorly	7,850 (23.1)	95.2	4.8		2,031 (27.1)	73.7	26.3	
	Unknown	1,027 (3.0)	91.1	8.9		2,296 (30.7)	75.9	24.1	
Histology	Ductal	27,227 (80.2)	95.1	4.9	**0.002**	6,446 (86.1)	75.8	24.2	**<0.001**
	Lobular	4,138 (12.2)	95.7	4.3		743 (9.9)	75.1	24.9	
	Other	2,565 (7.6)	93.8	6.2		294 (3.9)	64.3	35.7	
Tumor stage	1	23,451 (69.1)	95.0	5.0	0.175	586 (7.8)	73.9	26.1	0.361
	2a	7,981 (23.5)	95.1	4.9		2,517 (33.6)	75.4	24.6	
	2b	1,773 (5.2)	96.3	3.7		2,218 (29.6)	75.1	24.9	
	3	509 (1.5)	94.3	5.7		1,832 (24.5)	76.4	23.6	
	4	216 (0.6)	94.9	5.1		330 (4.4)	71.5	28.5	
Receptor status	Triple negative	2,784 (8.2)	95.7	4.3	0.244	1,521 (20.3)	72.9	27.2	**0.001**
	Her-2 positive	3,259 (9.6)	94.6	5.4		1,915 (25.6)	75.2	24.8	
	HR+/HER2 negative	25,617 (78.5)	95.1	4.9		3,889 (52.0)	75.7	24.3	
	Unknown	1,270 (3.7)	94.9	5.1		158 (2.1)	87.3	12.7	
Sentinel node	No	3,468 (10.2)	95.8	4.2	**0.037**	NA	NA	NA	-
Biopsy	Yes	30,462 (89.8)	95.0	5.0		NA	NA	NA	
Axillary lymph node	No	30,178 (88.9)	95.0	5.0	**0.016**	NA	NA	NA	-
Dissection	Yes	3,752 (11.1)	95.9	4.1		NA	NA	NA	
Type of surgery	BCS	22,106 (65.2)	95.7	4.3	**<0.001**	NA	NA	NA	-
	Mastectomy	9,170 (27.0)	96.1	3.9		NA	NA	NA	
	Mastectomy with IBR	2,654 (7.8)	86.3	13.8		NA	NA	NA	

Hospital transfer is expressed as percentage. The total of percentages might be above 100% due to rounded percentages.
Abbreviations: CI, confidence interval; HR, hormone receptor; IBR, immediate breast reconstruction; BCS, breast-conserving surgery; NA, not available.

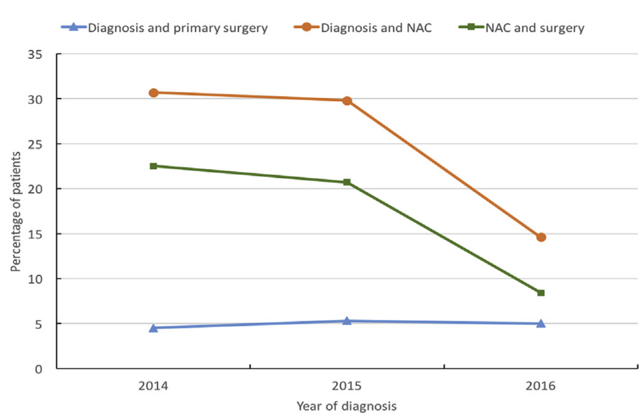

Fig. 1. Proportion of patients that transfer hospital after diagnosis between 2014 and 2016.

Patients transferring hospital between diagnosis and surgery

The number of patients treated with primary surgery according to hospital type before and after hospital transfer is shown in Fig. 2. Patients diagnosed in a district hospital most frequently transferred hospital and those diagnosed in a teaching hospital least frequently transferred hospital. When hospital transfer occurred, patients most commonly transferred towards a teaching hospital.

Characteristics predictive of hospital transfer are listed in Table 2. Multivariable analyses demonstrated that especially patients younger than 40 years of age (OR 2.72, 95%-CI 2.19–3.39) and patients who underwent a mastectomy with IBR (OR 2.81, 95%-CI 2.45–3.22) were more likely to transfer hospital. The association between younger age (<40 years) and hospital transfer was independent of the type of surgical therapy (data not shown). After adjusting for treatment by indication bias using PSM, patients undergoing a mastectomy with IBR still had a higher likelihood of hospital transfer (OR 1.07, 95%-CI 1.04–1.09). In other words, as patients were equally likely to obtain a certain type of surgery given their characteristics, these analyses provide the effect that can be attributed to the type of surgery itself rather than the indication for treatment. Hospital transfer was more likely among patients with a low SES, and patients with an unknown differentiation grade, histologic findings categorized as 'other' or tumor stage 3 were more likely to transfer hospital.

Patients transferring hospital between diagnosis and NAC

The number of patients treated with NAC according to hospital type before and after hospital transfer is shown in Fig. 3. Patients diagnosed in a district hospital most frequently transferred hospital and those diagnosed in a cancer-specific hospital least frequently

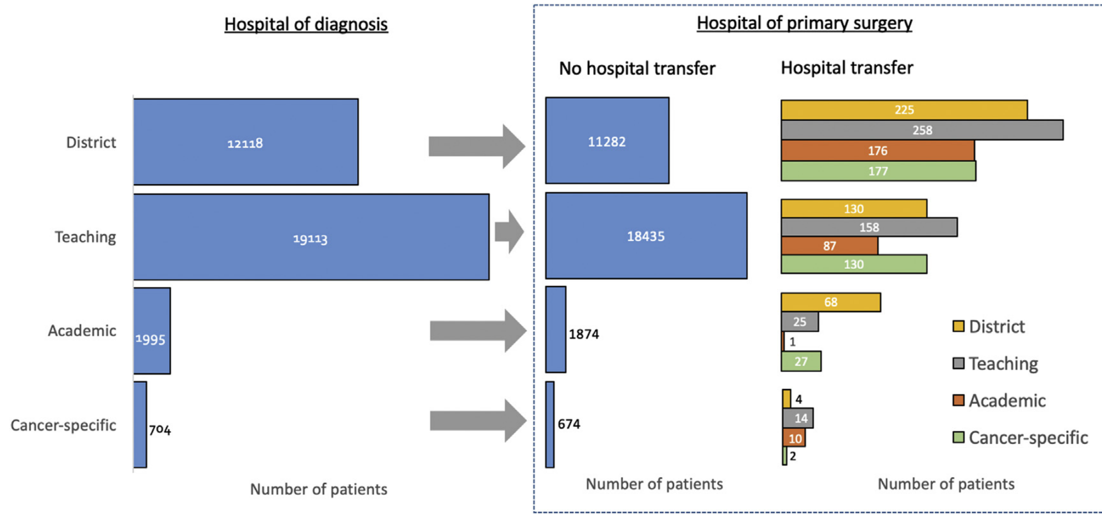

Fig. 2. Number of patients treated with primary surgery who transfer hospital according to type of hospital.

Table 2
Univariable and multivariable analysis of predictors for a transfer in hospital between diagnosis and first treatment.

		Diagnosis and primary surgery		Diagnosis and neoadjuvant chemotherapy	
		univariable	multivariable	univariable	multivariable
		OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Year of inclusion	2014	ref.	ref.	2.59 (2.25–2.99)	**2.90 (2.50–3.37)**
	2015	1.19 (1.05–1.34)	**1.19 (1.05–1.34)**	2.49 (2.17–2.85)	**2.63 (2.29–3.01)**
	2016	1.14 (1.01–1.29)	**1.15 (1.02–1.30)**	ref.	ref.
Age (years)	<40	3.6 (2.93–4.43)	**2.72 (2.19–3.39)**	1.68 (1.41–2.01)	**1.71 (1.42–2.05)**
	40–49	1.89 (1.63–2.20)	**1.59 (1.36–1.85)**	1.24 (1.06–1.45)	**1.23 (1.05–1.44)**
	50–59	1.27 (1.11–1.45)	**1.16 (1.01–1.32)**	1.11 (0.95–1.30)	1.11 (0.94–1.31)
	60–69	ref.	ref.	ref.	ref.
	70–79	0.74 (0.63–0.87)	**0.78 (0.66–0.91)**	1.31 (0.96–1.80)	1.36 (0.99–1.88)
	≥80	0.79 (0.63–1.00)	0.86 (0.68–1.09)	1.14 (0.37–3.51)	1.18 (0.37–3.75)
Socio-economic status	Low	1.2 (1.061.35)	**1.23 (1.09–1.39)**	1.25 (1.09–1.42)	**1.23 (1.07–1.41)**
	Average	ref.	ref.	ref.	ref.
	High	1.13 (0.99–1.27)	1.07 (0.95–1.22)	1.25 (1.10–1.42)	**1.24 (1.09–1.41)**
Differentiation grade	Well	ref.	ref.	ref.	ref.
	Moderately	1.06 (0.94–1.20)	1.05 (0.92–1.19)	1.58 (1.26–1.99)	**1.67 (1.32–2.11)**
	Poorly	1.03 (0.89–1.19)	0.94 (0.81–1.09)	1.64 (1.30–2.07)	**1.65 (1.29–2.12)**
	Unknown	2.01 (1.58–2.54)	**1.87 (1.47–2.38)**	1.46 (1.16–1.84)	1.18 (0.93–1.50)
Histology	Ductal	ref.	ref.	ref.	ref.
	Lobular	0.88 (0.75–1.04)	0.93 (0.79–1.10)	1.04 (0.87–1.24)	1.16 (0.96–1.40)
	Other	1.29 (1.09–1.53)	**1.29 (1.09–1.54)**	1.74 (1.36–2.22)	**1.82 (1.41–2.35)**
Tumor stage	1	ref.	ref.	ref.	–
	2a	0.98 (0.87–1.10)	1.00 (0.88–1.14)	0.92 (0.75–1.13)	–
	2b	0.74 (0.57–0.95)	0.87 (0.66–1.17)	0.94 (0.76–1.16)	–
	3	1.15 (0.79–1.68)	**1.58 (1.04–2.40)**	0.88 (0.71–1.08)	–
	4	1.02 (0.56–1.88)	1.26 (0.67–2.36)	1.13 (0.83–1.52)	–
Receptor status	Triple negative	0.88 (0.72–1.06)	–	1.16a (1.02–1.33)	1.15 (0.99–1.34)
	Her-2 positive	1.12 (0.95–1.31)	–	1.03 (0.91–1.17)	1.05 (0.92–1.20)
	HR+/HER-2 negative	ref.	–	ref.	ref.
	Unknown	1.05 (0.81–1.35)	–	0.45 (0.28–0.73)	**0.34 (0.21–0.56)**
Sentinel node	No	0.83 (0.70–0.99)	1.04 (0.84–1.30)	–	–
biopsy	Yes	ref.	ref.	–	–
Axillary lymph node	No	ref.	ref.	–	–
dissection	Yes	0.81 (0.69–0.96)	**0.77 (0.62–0.96)**	**-**	**-**
Type of surgery	BCS	ref.	ref.	–	–
	Mastectomy	0.91 (0.80–1.03)	0.99 (0.86–1.13)	–	–
	Mastectomy with IBR	3.58 (3.14–4.07)	**2.81 (2.45–3.22)**	**-**	**-**

Abbreviations: OR, odds ratio; CI, confidence interval; HR, hormone receptor; BCS, breast-conserving surgery; IBR, immediate breast reconstruction.

transferred hospital. When hospital transfer occurred, patients most commonly transferred towards a district hospital.

Multivariable analyses demonstrated that hospital transfer was particularly more likely in patients included in 2014 (OR 2.90, 95%-CI 2.50–3.37) and 2015 (OR 2.63, 95%-CI 2.29–3.01) and patients younger than 40 years of age (OR 1.71, 95%-CI 1.42–2.05). Patients with a low or high SES were more likely to transfer hospital compared to patients with a moderate SES. Patients with moderately or poorly differentiated tumors and those who had 'other' histologic findings were more likely to transfer hospital. The

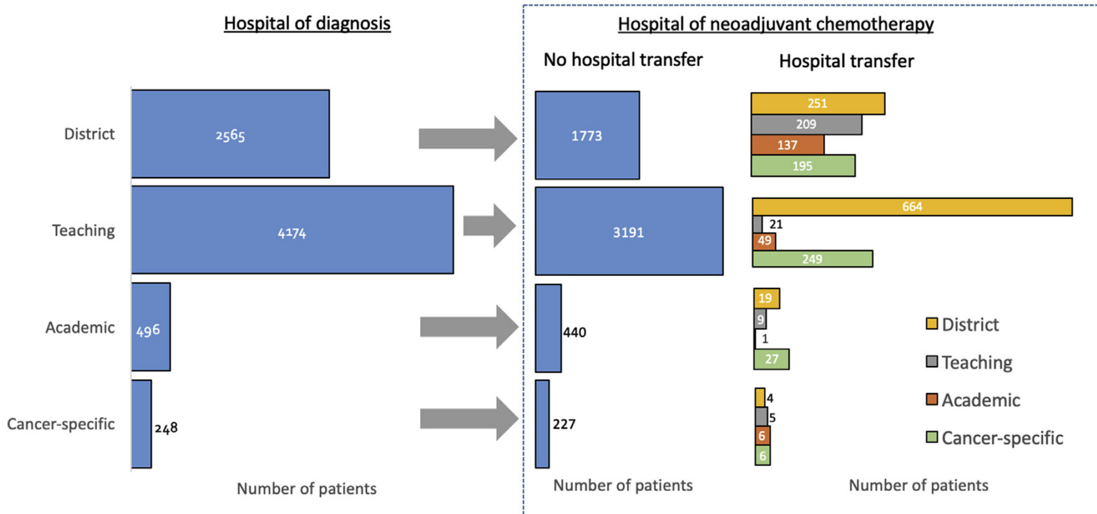

Fig. 3. Number of patients treated with neoadjuvant chemotherapy who transfer hospital according to type of hospital.

receptor status of the tumor was not predictive for hospital transfer.

Time from diagnosis to first treatment

The times from diagnosis to primary surgery and from diagnoses to NAC are listed in Table 3. Both were significantly longer for patients who transferred hospital compared with those who did not. Median time from diagnosis to treatment was prolonged for all different treatment modalities; breast-conserving surgery by 5 days ($p < 0.001$), mastectomy by 7 days ($p < 0.001$), mastectomy with IBR by 9 days ($p < 0.001$) and NAC by 1 day ($p < 0.001$).

Discussion

Our study shows that over a 3-year period in total 3517 (8.5%) patients transferred to another hospital between diagnosis and first treatment; 4.8% of patients transferred before primary surgery and almost 25% of patients transferred before the start of NAC. Looking at all patients, a hospital transfer most commonly occurred when diagnosed in a district hospital. Hospital transfer in patients undergoing primary surgery was most likely in younger patients (aged <40 years) and in patients who underwent a mastectomy with IBR. In patients treated with NAC, hospital transfer between diagnosis and NAC was most likely in patients included in the earlier years (2014 and 2015) and younger age (<40 years). Patients who transferred hospital had a significant delay from diagnosis to first treatment for all different treatment modalities, though the largest impact was reported for patients undergoing primary surgery.

International variation exists in the extent of patients who transfer hospital after diagnosis [10–12,16–18], though no population-based studies focusing on this subject exist. Surprisingly, the overall percentage of patients who transfer hospital in our study was much lower than the recently reported 36.6% in the study by Bleicher et al. [12]. Their study focused on the impact of hospital transfer between diagnosis and surgery on treatment delay, in non-neoadjuvant treated patients diagnosed at Commission on Cancer (CoC)-accredited Hospitals in the US. Contrary to our findings, they reported a large increase in hospital transfer of 29.1%–39.6% over time rather than a decrease as reported in the present study. It is not yet clear how this should be explained.

Although their analysis did not adjust for other factors, Bleicher et al. also reported that younger patients were more likely to transfer hospital [12]. Among other factors, they showed that type of insurance and ethnicity were predictive for hospital transfer. These data are not registered in the NCR-database and could therefore not be included in our analyses. Contrary to our study, hospital selection bias may exist in the study of Bleicher et al. as only patients were included from CoC-accredited hospitals, whereas the present study included all Dutch hospitals. It is unclear if the higher hospital transfer reported by Bleicher could be the result of the increasing use of IBR in the US [19], as presence of IBR was not reported. The higher hospital transfer in the US could also be due to more centralization of breast cancer surgery, which would result in more hospital transfer after diagnosis. Bleicher et al. suggested that the increase in hospital transfer might be among other things due to the increasing use of second opinions, though a report by Kurian et al. in 2016 showed that only up to 10% of breast cancer patients seek a second opinion in the US [12,20]. Another explanation for the discrepancy in hospital transfer is that patients in the US might be directed to specific hospitals for treatment by

Table 3
Time (days) from diagnosis to first treatment by transfer of hospital status.

	No transfer of hospital		Transfer of hospital		
	Median	ICR	Median	ICR	p-value
Time from diagnosis to surgery	23	18–31	32	23–45	<0.001
Breast-conserving surgery	22	17–29	29	21–40	<0.001
Mastectomy without immediate reconstruction	25	19–32	30	21–43	<0.001
Mastectomy with immediate reconstruction	34	27–44	43	33–58	<0.001
Time from diagnosis to neoadjuvant chemotherapy	27	21–33	28	22–36	<0.001

Abbreviations: ICR, interquartile range.

insurance companies in comparison to patients in the Netherlands due to differences in medical insurance coverage. Dutch patients can freely transfer between hospitals based on their own preferences and are not obligated to receive treatment in specific hospitals because of insurance coverage as every patient has a minimal coverage, which covers the costs for treatment in any hospital.

Our findings on the impact of hospital transfer on time to treatment are in line with Bleicher et al. and prior studies from the US [10–12]. Bleicher et al. showed an independent association between hospital transfer and treatment delay in all different treatment modalities. Unfortunately, they did not differentiate between mastectomy with and without IBR, as our study adds that hospital transfer for this latter group will prolong time to treatment by 9 days additionally to the delay compared to breast-conserving surgery. The increase in time to treatment is most likely due to the more complex logistic organization of IBR [8,21]. Hospital transfer might complicate time management by requiring patients to register in the new hospital and consult new physicians. Future research could focus on how hospital transfer specifically prolongs time to treatment. The delaying impact of transferring hospital in our study is most likely without clinical implications for patients treated with NAC as hospital transfer delayed treatment by only one day.

Our conclusions that patients who underwent a mastectomy with IBR are more likely to transfer hospital confirm the results of a prior study by Liederbach et al. though they did not adjust for other characteristics nor for treatment by indication bias. It is likely that the higher percentage of hospital transfer in these patients is due to organizational capabilities or medical expertise to perform an IBR, because wide variation in the use of IBR between hospitals exists on national and international level [1,22–24]. The association between mastectomy with IBR and hospital transfer is not likely to be entirely explained by lack of reconstructive surgical expertise, because only two Dutch hospitals do not carry out IBR at least once annually [7,22]. Hospital transfer could not be explained by the type of IBR as hospital transfer was comparable between different types of IBR such as reconstruction with autologe tissue or prosthesis, as subsequent analysis showed no significant difference ($p = 0.994$). A previous study showed that variation in the use of IBR between Dutch hospitals could not be explained by collaborations between hospitals and that the variation was only partly explained by hospital organizational factors [22]. Unfortunately, our study did not have the information on the number of plastic surgeons in hospitals and therefore we could not include this in our analysis as the expertise and incorporation of plastic surgeons in the breast care team is likely to explain the chance of receiving IBR.

Unfortunately, we could not compare our results regarding predictive characteristics for hospital transfer between diagnosis and NAC to previous research, as this was not studied before. The much higher percentage of hospital transfer when treated with NAC in comparison to those who underwent primary surgery could not be explained by lack of expertise in NAC treatment, because all Dutch hospitals that provide breast cancer care also administer NAC [7]. Nonetheless, variation between Dutch hospitals does exist in the use of NAC in patients with locally advanced breast cancer [25]. Surprisingly, hospital transfer decreased significantly in the most recent year in our results. This decrease could not be explained by a change in characteristics between 2014 versus 2016 as subsequent analyses showed comparable predictive characteristics (data not shown). Moreover, the number of hospitals that administered NAC remained the same over the 3-year period. Despite the fact that no significant changes occurred in the Dutch guidelines regarding NAC during the 3-year period, the increasing use of NAC may have created more expertise in district hospitals, thereby overcoming the necessity to transfer hospital.

Limitations

Our study has several limitations. The reader should bear in mind that the reported hospital transfer could be an overestimation when hospital transfer was reported between hospitals that actually had a non-official collaboration. Examples of official collaborations are known in which one hospital performs most of the diagnostics and the other hospital performs the treatment. However, official collaborations of hospitals are updated annually in the NCR-database. Limitations subsequent to the use of a database are that it could not account for possibly unmeasured confounders (e.g. patients' preference, comorbidities or travel distance to hospital) that could influence hospital transfer. Extrapolating our results to other countries must be done with cautiousness as healthcare and referral agreements might differ between countries. However, the predictive factors in our population for hospital transfer are in accordance with those previously described from the US.

Conclusions

Almost 5% of the Dutch patients undergoing primary surgery and up to one-fourth for patients treated with NAC transfer to another hospital after diagnosis. One of the more significant findings of this study is that hospital transfer is mainly associated with age below 40 years and with mastectomy with IBR. While patients undergoing mastectomy with IBR are known to have prolonged time to surgery compared to breast-conserving surgery or mastectomy, our findings suggest that especially these patients are at risk for additional treatment delay due to the delaying impact of hospital transfer. These findings extend the knowledge of patients at risk for discontinuity of care and challenges hospitals to improve timely care for patients who transfer hospital.

Ethical approval

This type of study does not require approval from an ethics committee in the Netherlands according to Central Committee on Research involving Human Subjects (CCMO) and the study was approved by the Privacy Review Board of the NCR.

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