

Can We Still Afford Innovative Surgical Procedures?

A structure and process analysis of the cost coverage of surgical therapy for patients with breast cancer in Germany with health economic evaluation examples based on superparamagnetic marking

Können wir uns innovative OP-Verfahren noch leisten?

Eine Struktur- und Prozessanalyse zur Kostendeckung der operativen Therapie der Patientin bzw. des Patienten mit einem Mammakarzinom in Deutschland mit gesundheitsökonomischen Evaluierungsbeispielen anhand superparamagnetischer Markierungen




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ABSTRACT

Introduction Hospitals are currently facing major financial challenges. Due to the high incidence of breast cancer and the complex range of associated services, surgical treatment of breast cancer is a particular case in point when it comes to the question of cost coverage for innovative versus established procedures by the service providers. The aim of this study is to shed light from a healthcare economics perspective on the current situation of hospitals in Germany with regard to their different structures and processes for breast-conserving therapy.

Materials and methods An online questionnaire with 46 questions was developed and made available to hospitals that are members of the AGO [German Working Group for Gynecological Oncology] Breast Committee and AWOgyn [German Working Group for Cosmetic, Plastic and Reconstructive Surgery in Gynecology], as well as AG-certified breast centers. The questions cover various parameters for health economics analysis,

including primary case numbers, structures, and questions about tumor and sentinel marking and surgical procedures.

Results 142 hospitals or breast centers took part in the survey. 93 % of the hospitals were certified. The average number of primary cases was 264.6 per year. In over 60 % of the hospitals, the surgical procedure and surgery planning were influenced by capacity limitations of cooperation partners. “Targeted axillary dissection” was performed in 83.5 % of the hospitals, and radioactive markers were most commonly used for sentinel lymph node marking. Over 60 % of participating hospitals were highly satisfied with the marking method used.

Conclusion This structure and process analysis now makes it possible to reflect on the costs involved for hospitals of different sizes, in different regions, and with different funding models, and to use this as a basis for the economic evaluation of new surgical procedures within an overall context. In general, it is possible to make savings through innovative procedures in the surgical treatment of breast cancer.

ZUSAMMENFASSUNG

Einleitung Aktuell stehen Kliniken vor großen finanziellen Herausforderungen. Aufgrund seiner hohen Inzidenz ist das Mammakarzinom mit seinem komplexen Leistungsspektrum im Hinblick auf die operative Versorgung besonders relevant bei der Frage nach der Kostendeckung bewährter und innovativer Verfahren durch die Leistungserbringer. Das Ziel dieser Studie ist es, die aktuelle Situation von Kliniken in Deutsch-

land im Hinblick auf ihre unterschiedlichen Strukturen und Prozesse bei der brusterhaltenden Therapie aus einem gesundheitsökonomischen Blickwinkel zu beleuchten.

Material und Methoden Es wurde ein Online-Fragebogen mit 46 Fragen entwickelt und Kliniken mit Mitgliedschaft bei der Kommission Mamma der AGO e.V., der AWOgyn e.V. und der AG Zertifizierter Brustzentren bereitgestellt. Die Fragen decken verschiedene Parameter für die gesundheitsökonomische Evaluation ab, darunter die Primärfallzahlen, Strukturen sowie Fragen zu Tumor- und Sentinelmarkierung und Operationsabläufe.

Ergebnisse 142 Kliniken bzw. Brustzentren nahmen an der Befragung teil. 93 % der Häuser waren zertifiziert. Die Primärfallzahl lag im Durchschnitt bei 264,6 pro Jahr. In über 60 % der Kliniken beeinflussten Kapazitätsgrenzen der Kooperationspartner den Operationsablauf und die Operationsplanung. Die „targeted axillary dissection“ wurde in 83,5 % der Kliniken durchgeführt und die Markierung von Sentinel-Lymphknoten erfolgte am häufigsten radioaktiv. Die Zufriedenheit über die angewendeten Markierungsmethoden war bei über 60 % der Teilnehmenden hoch.

Schlussfolgerung Diese Struktur- und Prozessanalyse ermöglicht es nun, die Kostenseite für Kliniken unterschiedlicher Größe, Trägerform oder Region zu reflektieren und auf Basis dessen neue operative Verfahren im Gesamtkontext ökonomisch zu bewerten. Dabei sind auch Einsparungen durch innovative Verfahren im Rahmen der operativen Versorgung des Mammakarzinoms generell möglich.

Introduction

A structure and process analysis of the cost coverage for surgical treatment of breast cancer patients in Germany, with examples of analysis from the field of healthcare economics based on the use of superparamagnetic marking.

In Europe, 2.45 million people develop cancer every year. As the most common cancer affecting women, breast cancer represents a social and economic burden that should not be neglected. Out of a total of € 126 billion spent every year on oncological diseases in the European Union, € 28.4 billion of which is for inpatient care, an average of € 13 per inhabitant per year is spent on breast cancer. In countries such as Lithuania and Bulgaria, this figure is as low as € 2 per inhabitant per year. In comparison, at € 29 per inhabitant per year, spending in Germany is significantly higher [1]. As service providers, hospitals also face a high financial burden in the context of the healthcare economy [2]. Tariff wage adjustments and increases in value added tax are major factors adding to cost pressures. In addition, hospitals have to meet legal requirements and comply with other regulations, such as flat-rate case costs (G-DRG system) or quality assurance requirements. And that's not all – unpredictable and hard-to-calculate events such as the current Covid-19 pandemic, rising purchase prices as a result of inflation, and the enormous increase in energy prices also present the service providers with major financial challenges. In view of

this tense situation, the question arises as to whether service providers are in fact able to cover the costs of introducing new diagnostic and surgical innovations, especially in the inpatient setting.

The inpatient care of breast cancer patients is a particular case in point, and not only because of the high incidence. Diagnosis, treatment, and follow-up care require an extremely complex, time-consuming range of services involving a high personnel cost. Although providing care in the setting of a certified breast center is particularly important in the healthcare sector, funding continues to be a problem that often remains unresolved [3, 4]. The certified breast centers require additional human and material resources in order to meet the required quality parameters. At the same time, inpatient services are being consolidated, leading to a drop in revenue due to shorter inpatient stays. In the context of medical service examinations, days of inpatient care are increasingly not being recognized, which means that these visits fall below the lower threshold for the length of stay. From the point of view of the payors, aspects such as psycho-oncological care, radioactive marking for sentinel node biopsies, discussions with patients and their relatives, sociomedical advice, and other offered care support services do not justify an inpatient stay. The lack of mapping of complex surgical procedures is another problem given the currently increasing cost pressures in the healthcare sector – the DRG system is mostly lagging years behind in terms of mapping costs. This is a particular problem right now due to inflation and energy prices.

As a result of these circumstances, it may turn out that the care provided in certified breast centers is not adequately remunerated, and that surcharges are necessary in order to cover the costs of the work [5, 6]. This is particularly problematic for surgical therapies. Breast-conserving therapy (BCT) is considered standard in both invasive breast carcinoma and ductal carcinoma in situ (DCIS) [7]. Nevertheless, secondary resections are necessary in over 10 % of patients; in DCIS, they occur in almost 30 % of cases [8]. In addition to cosmetic and oncological safety aspects, consolidation of cases without an additional increase in revenue requires a better procedure for assessing the resection margin, as well as optimization of sentinel and tumor marking. Accordingly, the use of innovative surgical methods is steadily increasing. Breast centers are faced with numerous new techniques: alternative marking methods such as radionuclide marking, radar reflection, and magnetic markers, as well as alternative markers for lymph node biopsy (SLNB), such as indocyanine green (ICG) or iron oxide [9]. There is also a steady increase in the number of targeted axillary dissections (TAD), for which different clips are available – these are also associated with corresponding costs [10].

With regard to these innovative procedures, the question arises as to whether they can be mapped in the flat-rate-per-case payment system in a way that covers costs, what level of subsidization is needed in order to implement these innovations, and whether these innovations can lead to cost savings from the point of view of the breast centers, the funding bodies, and society. Currently, however, it is evident that there are no data available for Germany on the structures and processes used by different service providers to perform the different therapies. Therefore, in order to evaluate new procedures from a health economics perspective, it is first necessary to take stock of the current situation. Accordingly, the aim of this health economics study was to present the current situation of hospitals and breast centers, and then use this as a basis to compare the different surgical procedures, taking into account the various different marking methods used.

Materials and Methods

Online Questionnaire

In order to collect data from hospitals and breast centers, we developed an online questionnaire which was sent to the service providers via the email distribution lists for members of the AGO Breast Committee and AWOgyn, as well as AG-certified breast centers. The questionnaire consists of 46 questions on different parameters for health economics analysis. These include the regional location of the service provider, case numbers and funding body, questions about tumor marking in BCT, TAD and SLNB, including workflows, patient movements in the context of the surgery, and capacity limits, as well as questions about secondary resection, including rates and case consolidation. The questionnaire consists of both open-ended questions and closed questions with one or with several possible answers.

Statistical Analysis

The analysis was primarily descriptive and was performed using SPSS (28.0.0.0). Percentages and average values (mean and median) are based on the total number of responses per question.

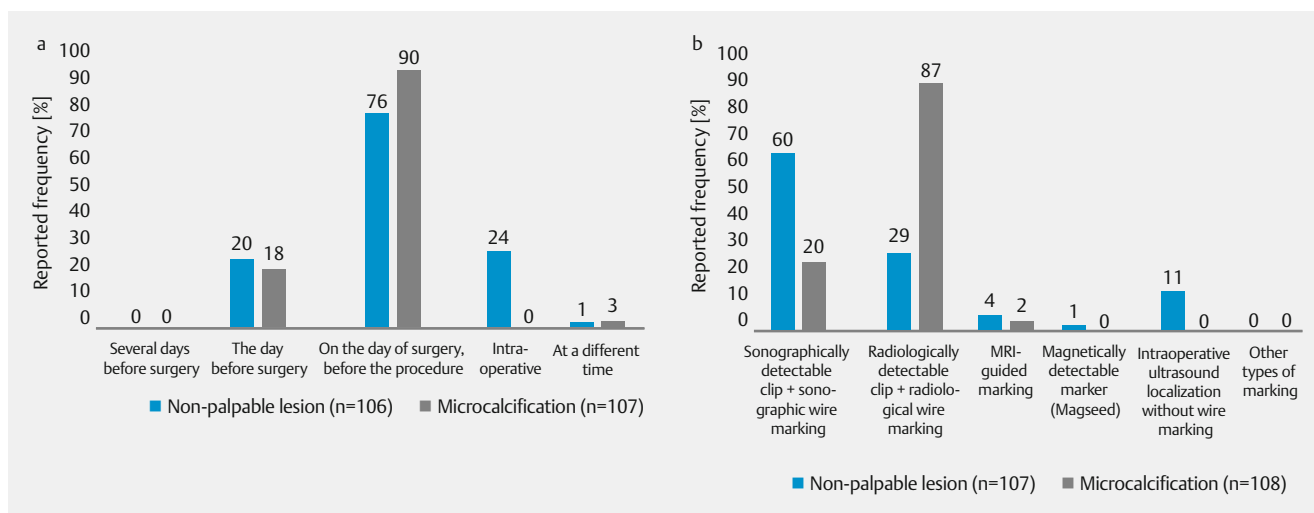
Results

Participating Cohort

From November 11, 2021 to May 15, 2022, 142 hospitals or breast centers from all over the Federal Republic of Germany took part in the survey. The highest response rate was from Bavaria with 25 completed questionnaires (18.25 %), and the lowest response rate was from Bremen and the Saarland with just one com-

► **Table 1** General information on service providers, n = 142 participants.

Regional location	n (%)
Baden-Württemberg	22 (16.06)
Bavaria	25 (18.25)
Berlin	7 (5.11)
Brandenburg	3 (2.19)
Bremen	1 (0.73)
Hamburg	7 (5.11)
Hesse	15 (10.95)
Mecklenburg-Vorpommern	2 (1.46)
Lower Saxony	7 (5.11)
North Rhine-Westphalia	23 (16.79)
Rhineland-Palatinate	8 (5.84)
Saarland	1 (0.73)
Saxony	8 (5.84)
Saxony-Anhalt	2 (1.46)
Schleswig-Holstein	3 (2.19)
Thuringia	3 (2.19)
Not stated	5 (3.52)
Funding body	n (%)
Local government	50 (35.46)
Church organizations	30 (21.28)
Private	31 (21.29)
University	30 (21.28)
Not stated	1 (0.7)
Certified	n (%)
No	4 (2.84)
Yes, by the DKG	131 (92.91)
Yes, by ÄKzert	22 (15.60)
Not stated	1 (0.7)
Number of primary cases per year	Mean (range)
Missing data points n = 3 (2.11 %)	264.62 (5–1000)



► **Fig. 1** Time of marking for localization of non-palpable lesions (focal findings) or microcalcifications. **a** Analysis of the question "When is the marking performed for non-palpable lesions (focal findings) or microcalcifications?" revealed that most hospitals and centers perform the marking on the actual day of surgery for non-palpable lesions and microcalcifications. Around one-fifth of respondents marked the lesions on the day before the operation, and 24% of respondents marked non-palpable lesions intraoperatively. **b** Analysis of the question "What localization method(s) do you use for localization of non-palpable lesions (focal findings) or microcalcifications?" revealed that, on average, the majority of hospitals and centers use sonographic procedures for non-palpable lesions and radiological procedures for detection and marking in the case of microcalcifications. All other methods, such as MRI-guided marking or magnetically detectable markers, are used significantly less frequently.

pleted questionnaire each (0.73 %). Half of the service providers were funded by local government bodies, and with four exceptions they were all certified by ÄKZert, a certification body of the Westphalia-Lippe Medical Association, and/or the German Cancer Society (DKG). The average number of primary cases was 220 (median) per year (► **Table 1**).

Marking for BCT

Inpatient admission prior to BCT was not uncommon. 125 (17 missing data points) of the hospitals and breast centers surveyed stated that they admitted an average of 38.3 % of their BCT patients the day before the operation. 64 of the respondents were also able to indicate exactly, or give an estimate of, how often the medical service opts to dispense with this day of preoperative admission. This occurred in 40.24 % of cases. The majority of non-palpable lesions and microcalcifications were marked on the day of surgery (► **Fig. 1a**). Less frequently, markings were performed the day before the operation or intraoperatively.

The most commonly used localization methods were sonographic wire marking with a sonographically detectable clip (60 %) for non-palpable lesions, and radiological wire marking with a radiologically detectable clip (87 %) for microcalcifications (► **Fig. 1b**). MRI-guided marking was performed in less than 5 % of cases. Magnetically detectable markers were only used in one percent of cases.

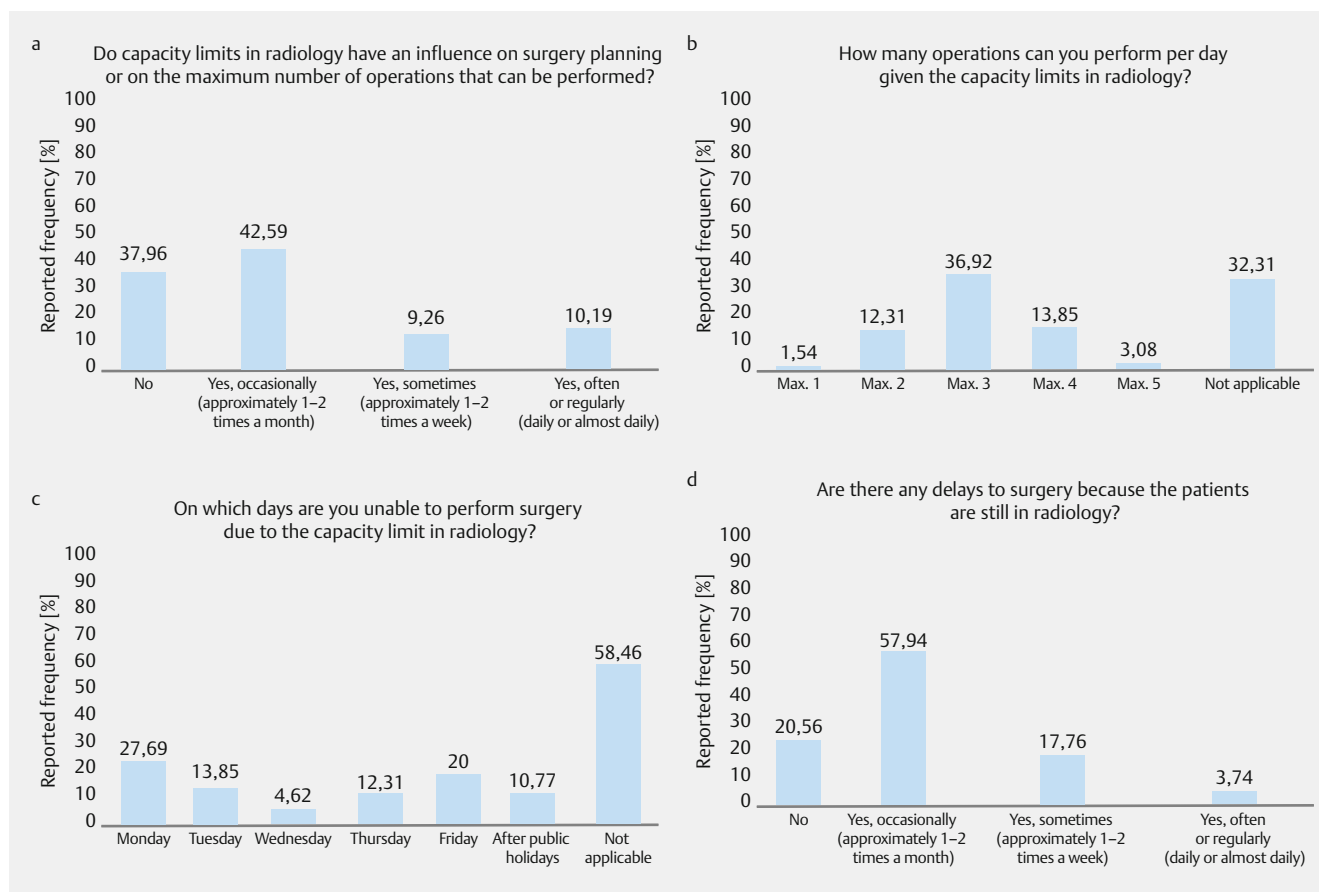
In hospitals and breast centers, sonographic wire marking was performed more often by gynecology departments than by radiology departments. On average, marking was performed by gynecology in 82 % of cases and by radiology in 35 % of cases (36 missing data points).

In over 80 % of the hospitals surveyed, the radiology providers were located on-site in the same hospital, and just as often the

► **Table 2** Radiological aspects of breast-conserving therapy.

Location of the radiology cooperation partner	n (%)
In your own hospital	118 (84.29)
In a cooperating hospital	2 (1.43)
In a cooperating medical practice	17 (12.14)
In a cooperating medical center (MVZ)	3 (2.14)
Not stated	2 (1.41)
Location of the radiology department	n (%)
In the same building	116 (82.27)
On-site (campus/clinic)	19 (13.48)
External	6 (4.26)
Not stated	1 (0.7)
Need for transport to the radiology department	n (%)
No	75 (53.19)
Yes, transport is on foot accompanied by nursing staff	28 (19.86)
Yes, an internal transport service is provided	34 (24.11)
Yes, transport is provided by an external service	1 (0.71)
Other	3 (2.13)
Not stated	1 (0.7)

radiology department was located in the same building. 75 of the respondents (53.19 %) stated that transport to the radiology provider was not necessary. If required, transport was mostly provided by an internal service (24.11 %). Just one percent of respondents required an external transport service, e. g., from a



► **Fig. 2 Consequences of capacity limitations in radiology.** **a** The majority of hospitals and breast centers surveyed reported that capacity limitations in radiology had an influence on surgery planning and the number of operations that could be performed. In 10.19% of cases, this occurs every day or nearly every day ($n = 108$). **b** Most hospitals were able to perform a maximum of 3 operations per day. In just over 10% of cases, it was possible to perform a maximum of 2 and 4 operations. The hospitals able to perform a maximum of 1 or 5 operations represented the lowest proportion ($n = 65$), at well below 5%. **c** Due to capacity limitations, the hospitals surveyed reported that operations could not be performed on some days, mainly on Mondays and Fridays. The least affected day was Wednesday ($n = 65$). **d** Almost 80% of hospitals and breast centers reported delays in the surgical procedure because patients were still in the radiology department. However, in 57.94% of cases, this occurred very rarely. In contrast, this occurred daily or almost daily in 3.74% of cases ($n = 107$).

taxi company (► **Table 2**). 18 hospitals were able to quantify the cost of transporting patients to the radiology department. This was € 11.39 on average.

Capacity limitations in radiology have a not insignificant influence on surgery planning and implementation in many hospitals and breast centers (► **Fig. 2**). In more than half of the hospitals, surgery planning and the maximum number of operations that could be performed were affected by capacity limits in radiology at least once to twice a month, and in 10% of cases this occurred either daily or almost daily (► **Fig. 2a**). Most hospitals are able to perform a maximum of three operations per day, and only 3% are able to perform a maximum of five operations per day (► **Fig. 2b**). The availability of radiology services also had a significant influence on which days surgery could not be performed. Mondays (27.7%) and Fridays (20%) appear to be more affected than, for example, Wednesdays (4.6%) (► **Fig. 2c**). Problems affecting the surgical workflow may occur if patients have to spend longer in radiology due to delays. This occurred at times in nearly

80% of the hospitals, although only in rarer cases did it occur often or regularly (► **Fig. 2d**).

Secondary Resection Rate

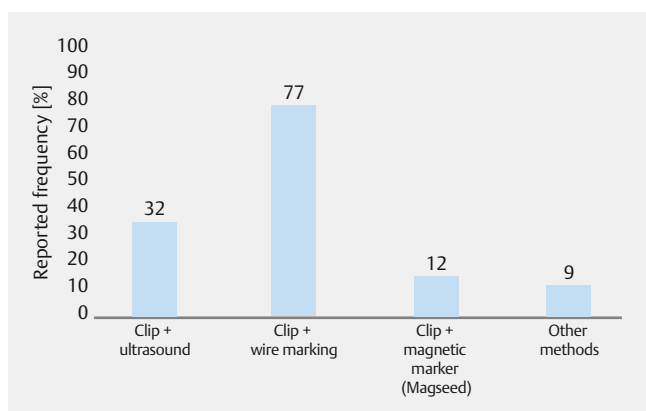
The average secondary resection rate was 11.53% ($n = 100$) in the hospitals and breast centers surveyed. In cases where secondary resection was necessary, it was most often (60%) performed during a second inpatient stay less than two weeks after the initial operation. In 38% of cases secondary resection was performed more than 2 weeks after initial surgery, and in 11% of cases it was performed as an outpatient procedure. Secondary resection was only performed during the initial inpatient stay in 10% of cases. On average, secondary resections were consolidated with other procedures in 60.08% of cases ($n = 78$).

TAD

TAD has already been performed by 83.5% of the service providers surveyed. The most commonly used methods for preoperative or intraoperative localization of target lymph nodes (TLN) were

► **Table 3** Performance of “targeted axillary dissection” (TAD) in the hospitals or centers surveyed.

General performance of TAD	n (%)
Yes	86 (83.50)
No	17 (16.50)
Not stated	39 (27.46)
Number of marked TLNs	Frequency (%)
1	90
2	12
3 or more	1



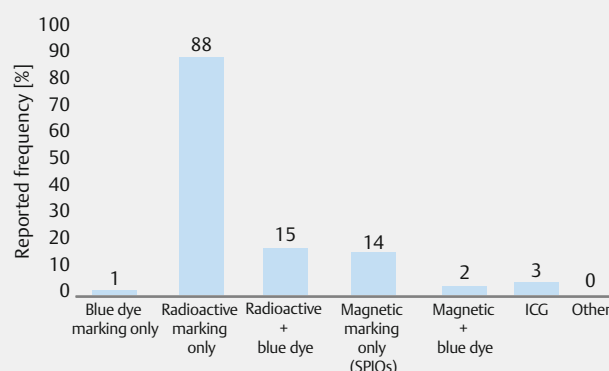
► **Fig. 3** Methods for preoperative/intraoperative localization of TLN (n = 86). Clip + wire marking was most commonly used for localization of TLN. Less frequently, clip + sonography or magnetic markers (Magseed) were used.

clip + wire marking (77 %), clip + sonography (32 %), and clip + magnetic marker (12 %). In most cases only one TLN was marked (90 %); in one percent of cases, three or more TLNs were marked (► **Table 3**, ► **Fig. 3**). On average, clinically relevant migration of the TAD marking was observed in 10.92 % of cases, and the marked TLN could not be found in 9.28 % of cases.

SLNB

The hospitals and centers surveyed reported that they most commonly used radioactive marking for SLNB (88 %). In 15 % of cases, radioactive marking was combined with blue dye marking; blue dye marking alone is used in only 1 % of SLNB cases. Magnetic marking with superparamagnetic iron oxide nanoparticles was already used in 14 % of cases (► **Fig. 4**). Furthermore, the service providers surveyed used the 2-day protocol more often than the 1-day protocol to perform radioactive marking of sentinel lymph nodes (SLN) (83 % compared to 31 %).

In the context of SLNB, patients need to be taken to the nuclear medicine department. However, 47 of the respondents (47.96 %) stated that transport to the nuclear medicine department was not required. In cases where it was required, the respondents stated that transport was mostly provided by an internal service



► **Fig. 4** Methods for SLNB (n = 101). In the majority of cases (88 %), SLNB was performed using radioactive marking. Other methods, such as the combination of radioactive marking with blue dye marking, or magnetic marking, were used in 15 % and 14 % of cases respectively (ICG: indocyanine green; SPIO: superparamagnetic iron oxide).

(18.37 %). In 16.33 % of cases an external transport service was needed, such as a taxi company. The cost for patient transport was reported by 23 hospitals; at € 16.96 on average, this was slightly higher than the cost for patient transport to radiology departments.

Satisfaction with Marking Procedures

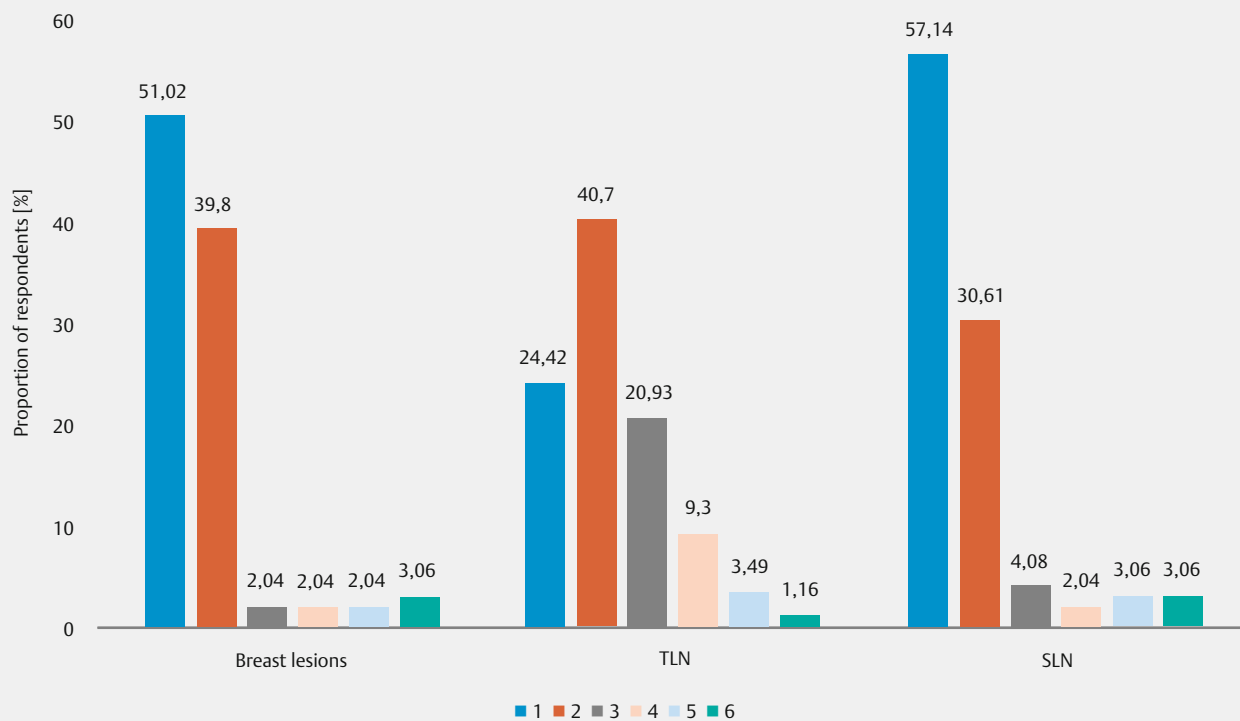
To assess the satisfaction level of the service providers, i. e., the physicians, they were asked to assign scores to the marking methods. The scores followed the grading system used in German schools, in which 1 is the highest mark. The majority of marking methods used for breast lesions, TLN, and SLN were given scores of 1 and 2, although at 40.70 % the score of 2 was most often assigned for TLN markings. The weighted mean scores were 1.73 for breast lesions, 2.30 for TLN, and 1.72 for SLN (► **Fig. 5**).

Physicians' Freedom of Choice

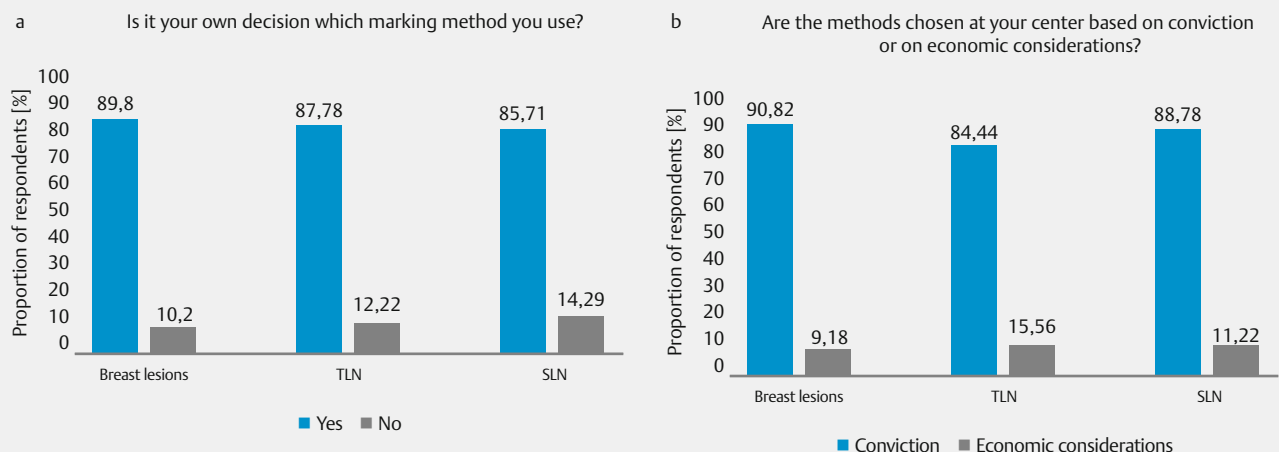
Over 80 % of respondents stated that it was their own decision which marking methods they used, and that they made these decisions based on their convictions and not due to economic reasons (► **Fig. 6a** and ► **Fig. 6b**). However, it should be noted that for every 7th to 10th service provider, the physicians were not free to choose the appropriate procedure, and economic factors played a major role. In this context it is all the more important to reflect on how the cost of procedures can be covered depending on the structure and processes in place at the respective hospital or breast center.

Discussion

In order to assess traditional and newer procedures in BCT or for localization in the axilla from a health economics perspective, it was first necessary to survey the current situation among service providers. This study sheds light for the first time on the situation currently facing a representative number of hospitals and breast



► **Fig. 5 Satisfaction with the marking methods used (n = 98).** Satisfaction with the marking procedures used at the different hospitals for breast lesions, TLN, and SLN was scored based on the grading system used in German schools (1 = very good, 2 = good, 3 = satisfactory, 4 = adequate, 5 = some deficiencies, 6 = inadequate). The majority of hospitals and breast centers surveyed were satisfied with the procedures used, and gave them scores of 1 and 2. The TLN markings received a comparatively poorer rating, with a score of 3 from 20.93 % and 4 from 9.3 % of the hospitals.



► **Fig. 6 Service providers' decision-making freedom (n = 98).** **a** The vast majority of hospitals and breast centers surveyed stated that it was their own decision which marking method to use. **b** The majority of the hospitals and breast centers surveyed also stated that the decisions on which marking method to choose were based on conviction. However, for TLN marking, 15.56 % stated that economic considerations determine the choice of method.

centers with different funding bodies and with different primary case numbers throughout Germany. This means it is now possible to analyze the different diagnostic and surgical procedures based on this data, and calculate the costs for hospitals and breast centers. Our publication thus provides a basis which serves as a pre-

requisite for making observations on the current situation in Germany from a health economics perspective.

The available data show, for example, that in some areas of BCT there is distinct potential for process optimization. For example, patients still have pre-surgery appointments prior to being admit-

ted for inpatient care, even though in 40 % of cases the medical service dispenses with this option. Furthermore, a large proportion of ultrasound-guided wire markings are performed by gynecology departments, but in 35 % of cases they are performed by radiology. As the results show, this circumstance can lead to subsequent restrictions in surgery planning and implementation due to capacity limitations in radiology. In each case, well over half of the respondents stated that these capacity limits had an influence on surgery planning, could impact workflows due to time delays, and also affected the maximum number of operations that could be performed. The dependence of surgical services on collaboration with other disciplines is a point that should not be neglected. Particularly when evaluating new marking procedures, the time spent on specimen radiography and ultrasound also needs to be taken into account, because ultimately, every minute of surgery means a financial expense. It should also be remembered that we are currently facing a shortage of nursing care. This applies in particular to specialized care settings, such as surgery and anesthesiology. Many hospitals report massive limitations in surgical capacity. Newer marking methods, such as magnetic markers (Magseed), could lead to potential savings as they allow greater flexibility in surgery planning and use of radiological resources, as well as a more efficient operation process [11, 12]. Currently, however, a special cost reimbursement for this indication is still lacking in the German market.

The respondents' data on secondary resections revealed an average rate of 11.53 %; this is comparable to the data from the Institute for Quality Assurance and Transparency in Healthcare (IQTIG) from 2019 and 2020, in which the reported rates were 11.62 % and 11.32 % respectively [8]. In this context, the aspect of case consolidation is also of relevance; according to the available data, consolidation occurs in 60 % of cases. This also leads to additional costs for histopathological diagnostics, the operation itself, or the inpatient stay, without generating any additional revenue. Accordingly, innovative procedures for optimizing the intraoperative assessment of the incision margin may actually lead to cost savings, even if they initially appear to create additional costs. The available data allow future calculations for each individual hospital based on different case numbers as well as structures and processes.

The results for the use of TAD are surprising. Use of this method in Germany appears to be significantly higher than expected. Over 80 % of service providers reported that TAD was performed at their clinic, even though the data on long-term safety are still weak. As one of the newer, innovative procedures, this result is indicative of rapid adoption in clinical practice and implementation of the recommendations of the AGO Breast Committee [13, 14]. However, in addition to the frequent use of TAD, a relatively high rate of marked TLNs that could not be detected was also reported (9.28 %). False-negative rates in the literature are somewhat lower [15]. In their initial studies, Caudle et al. and Boughy et al. reported false-negative rates of 4.2 % and 6.8 %, respectively [10, 16]. Another study reported an identification rate of 95.8 % for clipped lymph nodes [17]. In light of this, there may still be a need to optimize this procedure in Germany. For example, a recent study from Austria showed that it had been possible to identify all TLNs marked with Magseed (40/40; 100 %) for TAD procedures [18].

Accordingly, the choice of marking method could have a major influence on surgical success and possible follow-up costs.

The results for SLNB showed that radioactive marking is still by far the most commonly used method (88 %; 15 % for radioactive marking combined with blue dye marking versus 14 % for magnetic marking). Dependence on nuclear medicine departments led to limitations (e. g., limit to the number of daily markings, no marking on certain days of the week, e. g., after weekends and public holidays); this both reduced flexibility and led to higher costs. If marking was performed with superparamagnetic iron oxide nanoparticles instead, this eliminated the costs for patient transport and nuclear medicine. This can be calculated, for example, on the basis of the available data.

Taking into account the average cost of € 16.96 for 16.33 % of patients requiring external transport, transport costs alone in Germany amount to approximately € 135 715 per year. Using the average case number from this survey as well as the average rates of SLNB (all cN0 cases), for an average of 167 SLNBs performed per center at a cost of € 476 per SLNB for nuclear medicine plus transport costs, a total of € 23 465 779 per year is spent in Germany on radioactive marking at 294 centers. In contrast, magnetic marking requires the purchase of the appropriate measuring device (Sentimag) and the iron oxide particles (Magtrace). Depreciation over 5 years, with 167 SLNBs per center per year, results in a total of € 15 458 128.93, yielding potential savings of € 8 007 650.93 in total, or € 27 236.91 per center. In addition, magnetic marking has already been proven several times to be no less effective than radioactive marking, and therefore represents a good alternative, not only from a health economics point of view [19, 20]. Furthermore, in this context it is also necessary to take into account bottlenecks in the supply of technetium, such as occurred in November/December 2022 [21].

The focus of surgical treatment is on guideline-compliant, multimodal therapy with the active involvement of the informed patient, not on measures driven by austerity; therefore, diagnostic and surgical services must be mapped in all their complexity, and remunerated accordingly. From the perspective of the funding bodies as well as the society, there is definitely potential for savings. It is certainly the case that innovative procedures do not always lead to higher overall costs; in fact, they can even lead to cost reductions in the overall context. In order to assess this, it is necessary to perform health economics analyses based on the current situation; this is now possible based on the data from this study.

One of the limitations of this kind of study is that while it is representative of the participating hospitals and breast centers, the results are not very meaningful for those hospitals that did not participate – even if they have similar case numbers or the same funding body. Furthermore, the data collected are based on information provided voluntarily by the participants; there was no review of quality reports, control reports, or the like. In addition, there is some ambiguity relating to missing information, as it is not possible to evaluate whether the respondents genuinely didn't know some of the answers, or whether they were unwilling to answer certain questions. Furthermore, when entering individual parameters, no mutual limitation was applied, which meant that the sum of individual values amounted to over 100 % – this

could also be explained by the combination of different procedures in individual patients. Because the survey was anonymous, it was not possible to ask questions about this. However, these limitations are balanced by the very high number of participating hospitals and breast centers from all regions of Germany, which provide a representative picture.

Conclusion

This structure and process analysis makes it possible to reflect on the costs for hospitals and breast centers of different sizes and funding models and from different regions, and, with reference to these new procedures, to evaluate the cost of surgical care in the overall context, as shown in the present example. It is generally possible to achieve savings through innovative procedures in the context of the surgical care of breast cancer patients. In this regard, it is not only the primary costs that must be considered. To make an assessment, it is necessary to perform a cost-benefit analysis based on the hospital structure and case numbers.

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Conflict of Interest

MPL: Honorare für Vorträge und Advisory von Lilly, AstraZeneca, MSD, Roche, Novartis, Pfizer, Eisai, Exact Sciences, Daiichi-Sankyo, Grünenthal, Gilead, Pierre Fabre, PharmaMar, pfm, Samantree und Endomag; Reisekosten von AstraZeneca, Roche und Pfizer; Editorialboard für medac. HCK: Honorare für Vorträge und Advisory Boards von Pfizer, Novartis, Seagen, Roche, Genomic Health/Exact Sciences, Amgen, AstraZeneca, Riemser, Carl Zeiss Meditec, TEVA, Theraclion, Janssen-Cilag, GSK, LIV Pharma, Lilly, SurgVision, Onkowissen, Gilead, Daiichi Sankyo, Sysmex und MSD, Reisekosten von Carl Zeiss meditec, LIV Pharma, Novartis, Amgen, Pfizer, Daiichi Sankyo, Tesaro und Onkowissen und Anteile von Theraclion SA und Phaon Scientific GmbH. MT: Honorare für Vorträge und Advisory Boards von Agendia, Amgen, AstraZeneca, Art Tempi, Aurikamed, Becton/Dickinson, Biom'Up, ClearCut, Clovis, Connect Medica Daiichi Sankyo, Eisai, Exact Sciences, Gilead Science, Grünenthal, GSK, Hexal, I-Med-Institute, Lilly, Medtronic, MCI, MSD, Norgine, Neodynamics, Novartis, Onkowissen, Organon, Pfizer, pfm Medical, Pierre-Fabre, Roche, RTI Surgical, Seagen, Sirius Pintuition, Sysmex, Reisekosten von Amgen, Art Tempi, AstraZeneca, Clearcut, Clovis, Connect Medica, Daiichi Sankyo, Eisai, Exact Sciences, Hexal, I-Med-Institute, Lilly, MCI, Medtronic, MSD, Neodynamics, Norgine, Novartis, Pfizer, pfm Medical, Roche, RTI Surgical, Seagen, Manuskript-Support von Amgen, ClearCut, Clovis, pfm medical, Roche, Servier, Studienfinanzierung von Exact Science und Endomag, Studienhonorare von AstraZeneca, Biom'Up, Celgene, Clearcut, Neodynamics, Novartis, pfm medical, Roche, RTI Surgical, Kongressunterstützung: Amgen, AstraZeneca, Celgene, Daiichi Sanyko, Hexal, Neodynamics, Novartis, Pfizer, Roche.

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