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Cost comparison between stereotactic large-core-needle biopsy versus surgical excision biopsy in The Netherlands

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Abstract

Yearly, approximately 7200 Dutch women with non-palpable breast lesions are referred for a diagnostic surgical excision biopsy. Recently, less invasive alternatives such as stereotactic large-core-needle biopsy have emerged. The aim of this study was to compare the costs of surgical excision biopsy and large-core-needle biopsy. As stereotactic equipment is expensive, the costs of large-core-needle biopsy depend on the extent of centralisation of this facility. Therefore, we assessed the extent of economies of scale in four different scenarios of (de)centralisation. We collected cost data in five Dutch hospitals. The cost of surgical excision biopsy amounted to 1184 Euros. In cases where large-core-needle biopsy would be employed decentralised in all 114 hospitals in The Netherlands, the average costs were estimated to be 1186 Euros compared with 572 Euros in a centralised scenario with involvement of 10 hospitals. Therefore, centralisation of stereotactic equipment for core-needle biopsies would be advisable from an economic perspective.

Keywords: Costs and costs analysis; Hospital economics; Breast neoplasms; Biopsy; Needle; Diagnostic techniques; Surgical

1. Introduction

In The Netherlands, 10 000 new breast cancers are detected yearly and some 24 000 women are suspected of having breast cancer every year [1]. Of these women, approximately 7200 have non-palpable breast lesions [1]. Generally, a surgical excision biopsy is carried out in order to obtain diagnostic material for histopathological examination. Although this procedure is accurate, it is invasive, requires general anaesthesia, hospitalisation for 1–2 days and is costly. In addition, patients should anticipate mutilation of the skin and breast tissue, even in cases of a benign diagnosis. Recently, less invasive alternatives such as stereotactic large-core-needle biopsy have emerged. Stereotactic core-needle biopsy can be performed in an outpatient setting, is less invasive and mutilating and has potential for savings.

In 1997, the multicentre COBRA (COre Biopsy after RAdiological localisation) study was started in The Netherlands to assess the diagnostic accuracy and cost-effectiveness of stereotactic core-needle biopsy compared with surgical excision biopsy. In this multicentre study, a total of 973 women were planned for stereotactic large core-needle biopsy. In cases where no malignancy was found in the core-needle specimen, women also underwent a surgical excision biopsy to confirm the diagnosis.

The current study was extended as part of the COBRA study, focusing on the cost comparison of stereotactic core-needle biopsy and surgical excision biopsy. As the stereotactic equipment is rather expensive, the costs per procedure depend considerably on the extent of centralisation of this facility. Therefore, we

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paid special attention to the economies of scale regarding the stereotactic core-needle biopsy.

2. Patient and methods

2.1. COBRA study

The results of the COBRA study on the diagnostic accuracy of stereotactic large-core-needle biopsy are reported elsewhere (data not shown). In summary, between June 1997 and February 2000, 973 patients with 1023 non-palpable lesions were enrolled in 19 Dutch hospitals. All patients were planned for stereotactic large-core-needle biopsy. Biopsies were taken with a 14-gauge biopsy needle and a long-throw (22 mm) biopsy gun. The biopsies were performed on an image-guided stereotactic unit (Fisher Imaging Denver or Lorad Stereoguide Danbury). Whenever needle biopsy revealed an invasive carcinoma, definitive surgical therapy was carried out (including axillary dissection or sentinel node biopsy in cases of invasive breast cancer). If no invasive malignancy was found in the large-core-needle biopsy specimens, needle localised open breast biopsy was performed to verify that the cancer had not been missed.

45 patients withdrew from participation. Of the biopsy procedures that were actually initiated, 11% was cancelled due to technical reasons (for example, because the lesion was located too close to the chest wall or because the breast was too small for adequate compression or needle excursion). In another 13 cases (1.3%), the pathologist was unable to make a histopathological diagnosis, because the needle biopsy procedure yielded insufficient diagnostic material.

In short, 852 lesions were available for analysis. A total of 20% of patients diagnosed with large-core biopsy had to undergo a second surgical procedure because of an unsuccessful procedure or inconclusive results on core biopsy. In addition, a small proportion of the patients with benign diagnosis on large-core-needle biopsy appeared to have cancer after surgical excision biopsy. Therefore, we suggest that mammographic follow-up of all patients with a benign diagnosis on large-core-needle biopsy is performed.

2.2. Data collection

Within the framework of the COBRA study, we collected cost data in five Dutch hospitals, including one university hospital and one cancer institute.

We calculated the overall costs of the following procedures: stereotactic large-core-needle biopsy (in three hospitals), surgical biopsy (in two hospitals), needle localisation preceding surgical biopsy (three hospitals), histopathological examination of both core and surgical excision biopsy (three hospitals), recovery (two hospitals), day-care (one hospital) and hospital day (two hospitals). In The Netherlands, three methods for wire localisation are used to localise non-palpable breast lesions: needle localisation with use of (a) stereotactic add-on equipment, (b) ultrasound or (c) grid. We assessed the costs of these three procedures. All costs are presented in Euros (1 Euro = 2.20371 DFl). Costs were based on the year 1999.

2.3. Cost calculation methods

The costs of the biopsy procedures and histopathological examination were calculated using the bottom-up method, in which costs are calculated by directly tracing resources (e.g. labour and materials). For the biopsy procedures, we used registration forms to record start and end time of the activities of personnel and medical staff. In addition, the use of materials and equipment was recorded. The staff involved filled out these forms for a limited number of procedures (15–25 biopsy procedures per hospital). Time spent on indirect activities (e.g. preparation, clearing, calibration) was estimated by the staff.

Information on the direct input of personnel, materials and equipment for the histopathological examination of core and needle biopsy was recorded once by the pathologist and the head of the department. The Appendix gives an overview of the data that were collected for the calculation of the direct costs of these procedures.

Furthermore, we used a questionnaire to obtain information on the indirect costs of all procedures: i.e. administration and management costs, housing and cleaning costs and overhead costs. The financial department of the hospitals filled out this questionnaire. The overall costs for each procedure were subsequently calculated using the following methodology. The time input of personnel was multiplied by the average hourly wage costs (including social premiums) for each specific staff category. The hourly wage for medical staff in general hospitals was based on the average annual income as reported in a publication on specialists' fees and a 50-h working week and was estimated to be 82 Euro per hour [2]. For medical staff employed in the university hospital an hourly wage of 52 Euro was used, based on information of the financial department of this hospital. The costs of materials were calculated by multiplying the average volume per article by the unit price. The costs of equipment consisted of depreciation, interest and maintenance costs. The annual depreciation and interest costs were calculated using the annuity method. The annuity was based on the acquisition costs, the economic life and an interest rate of 5%. The annuity and the annual maintenance costs were divided by the annual number of operating hours, which resulted in

the operating costs per hour. The equipment costs per procedure were based on the average time per procedure multiplied by the costs per operating hour. The costs of administration and management per procedure were calculated by dividing the annual administration and management costs for the specific department by the annual number of procedures. To determine the housing costs per procedure, we first calculated the average housing costs per square metre (the annual costs related to housing divided by the total number of square metres in the hospital). Then we calculated the costs per operating hour, using the following formula: (housing tariff× number of square metres of specific room)/number of operating hours. The housing costs per procedure were subsequently calculated, based on the average time per procedure. The cleaning costs per procedure were calculated likewise. In addition, a surcharge for overhead costs was assigned. This surcharge was based on the proportion between indirect costs (costs of supporting departments) and direct costs (costs of patient-related departments).

We assessed the costs for recovery (after surgery), day care and the cost per hospital day in two hospitals. These costs were calculated by using a top-down calculation: the annual costs of these departments (including housing and cleaning costs and overheads) were divided by the annual production.

On the basis of the unit costs for these procedures in the local hospitals we calculated an average weighted price for each procedure. We used different weights for the costs measured in the university hospital and in the general hospitals or cancer clinic. These weights were based on the proportion of outpatient visits in university and general hospitals in The Netherlands (respectively, 14 and 86%). To obtain one price for needle localisation, we investigated the proportional use of the three procedures (stereotactic add-on, ultrasound and grid) in The Netherlands among the participating hospitals.

2.4. Costs per patient

The length of hospitalisation for the diagnostic excision biopsy was based on prospective data from the COBRA study. Eleven percent of the planned stereotactic large-core-needle biopsy procedures had to be cancelled for technical reasons. These failed procedures took a shorter time and required less material. Accordingly, we distinguished between a successful and a failed large-core-needle biopsy. In cases where a procedure failed, however, patients had to undergo a surgical excision biopsy. The costs of these surgical procedures were taken into account. Furthermore, the additional costs of a surgical procedure after large-core-needle biopsy were calculated for patients with inconclusive results on large-core-needle biopsy (e.g. normal breast tissue, high risk lesions and ductal carcinoma *in situ* (DCIS) underestimates). For patients with a benign diagnosis on large-core-needle biopsy, the costs of mammographic follow-up were added. These additional costs were based on charges.

2.5. Economies of scale

As the acquisition costs of stereotactic equipment are rather high (265 000 Euro), we assessed the extent of economies of scale resulting from centralisation of stereotactic core-needle biopsy in The Netherlands. We distinguished four scenarios of centralisation. In scenario 1, we assumed that all 114 hospitals in The Netherlands would have stereotactic equipment installed. In scenario 4, we assumed that only 10 hospitals would set up this facility. In scenarios 2 and 3, we assumed that all hospitals with more than 300 beds (89 hospitals) and 600 beds (37 hospitals), respectively, would purchase stereotactic equipment. For the cost calculation of these four different scenarios, we assumed the costs of equipment (depreciation, interest and maintenance costs) and the costs of housing and cleaning of the room to be fixed. We assumed all other costs to be variable. Furthermore, the calculation of number of procedures per centre for the four scenarios and the subsequent costs per procedure was based on the assumption that there would be a complete (100%) substitution of surgical excision biopsy by stereotactic large-core-needle biopsy. This assumption was challenged by means of sensitivity analyses.

2.6. Patient costs

Because centralised core-needle biopsy would increase patient costs for travelling, we also estimated the time and travel costs for the four scenarios. The valuation of time costs was based on the average hourly wage (13.95 Euro) for a woman aged 57 years, the average age of women participating in the COBRA study [3]. For travel costs, we calculated 0.23 Euro per h, in accordance with Dutch guidelines [4]. The average travelling distance per scenario was calculated to conform with the guidelines in the Dutch Manual for costing in health care. We assumed that the average travelling speed would be 40 km/h.

3. Results

3.1. Healthcare costs

3.1.1. Costs of surgical excision biopsy

Table 1 shows the costs ensued from surgical excision biopsy. We calculated unit prices for the three methods of wire localisation. The average costs of needle localisation, based on the relative frequency of the three

Table 1
Costs of surgical excision biopsy (in Euros)

	Wire localisation	Excision biopsy	Histopathology	Recovery	Hospialisation	Total costs
Operating personnel	35	77[a]	57	5	159	
Medical staff	23	196[b]	29	1	47	
Materials	43	94	10	2	13	
Equipment costs	8	18	8	0	0	
Administration and management	7	17	8	0	9	
Housing and cleaning costs	3	103	7	2	49	
Overheads	17	41	19	2	75	
Total costs	136	546	138	12	352	1184

p.p., per person; OR, operating room.
[a] 3 OR-nurses, time input: 67 min per person.
[b] One surgeon and one resident, time input: 58 min p.p., one anaesthetist, time input: 75 min.

localisation methods used, amounted to 136 Euro. The methods were stereotactic add-on: 56%, (156 Euro), ultrasound 23% (99 Euro) and grid 21% (120 Euro). The average costs of the surgical biopsy procedure amounted to 546 Euro. The costs of histopathological examination of a surgical specimen were estimated to be 138 Euro. In the COBRA study, 483 patients underwent surgical excision biopsy after large-core-needle biopsy. Of these patients, 46% were treated in day care. The average costs for day care amounted to 190 Euro. The other 54% were hospitalised. The average length of stay was 3.0 days. This includes patients with complications, such as haematoma, wound infection, etc. The total costs in case of hospitalisation amounted to 490 Euro. Hence, the average hospitalisation costs after surgical excision biopsy were 352 Euro. The average costs for recovery after surgical biopsy amounted to 23 Euro; these costs apply to the 54% of the patients with a clinical admission. In total, the average costs for a patient with a non-palpable breast lesion diagnosed by means of surgical excision biopsy amounted to 1184 Euro.

3.1.2. Costs of core-needle biopsy

The variable costs per core-needle procedure amounted to 223 Euros for a successful and 130 Euros for a failed procedure (Table 2a). Table 2b shows the annual fixed costs related to stereotactic equipment. The costs of the histopathological examination of the core biopsy were 43 Euros (Table 2c), which is considerably less expensive than the examination of the surgical specimen. This is due to the fact that a core-needle biopsy specimen is much smaller than a surgical biopsy, which makes the examination less time- and material-consuming.

In the COBRA study, 11% of the planned core-needle biopsy procedures had to be cancelled, mainly due to technical reasons. For these failed procedures, the costs of surgical excision biopsy were added (1184 Euro). Another 9% of the patients underwent a surgical excision biopsy as well, to exclude any missed anomalies. In addition, we added the costs of a follow-up mammography (65 Euro) for all patients with a benign large-core-needle biopsy diagnosis (38%).

The average costs for a core-needle procedure for the four scenarios of centralisation are presented in Table 3. If all 114 hospitals purchased stereotactic equipment, the average number of procedures per hospital would reach 63 per year. The costs per procedure would then

Table 2
(a) Variable costs in (in Euros) of core-needle biopsy

Variable costs	Successful core needle biopsy	Failed core needle biopsy
Technicians	78[a]	52[b]
Medical staff	64[c]	43[d]
Materials	50	4
Administration and management	6	6
Overheads	25	25
Total variable costs per procedure	223	130

(b) Annual fixed costs (Euro) of core-needle biopsy

Fixed costs	
Depreciation and interest[e]	34 721
Maintenance	2688
Housing/cleaning[f]	5546
Total fixed costs per year	42 955

(c) Histopathological examination core biopsy

Operating personnel	11
Medical staff	13
Materials	1
Equipment costs	2
Administration and management	9
Housing and cleaning costs	3
Overheads	6
Total	45

[a] Two technicians, time input: 111 min per person.
[b] Two technicians, time input: 74 min per person.
[c] One radiologist/resident, time input: 51 min per person.
[d] One radiologist resident, time input: 34 min per person.
[e] Acquisition costs of stereotactic unit: 264.629 Euros, economic life was estimated to be 10 years.
[f] The annual housing and cleaning costs were based on a 16 m^2 room.

Table 3
Average costs (in Euros) per patient diagnosed with stereotactic core-needle biopsy for the four scenarios of centralisation

	Scenario 1	Scenario 2	Scenario 3	Scenario 4
No. hospitals	114	89	37	10
No. procedures/year[a]	63	81	195	720
Stereotactic core-needle procedure[a]	886	738	432	272
Histopathalogical examination core biopsy[b]	40	40	40	40
Surgical procedure[c]	237	237	237	237
Mammographic follow-up[d]	25	25	25	25
Total costs	1188	1040	734	574

[a] Based on a 100% substitution rate.
[b] Only in case of successful procedure (89%×40 Euros).
[c] 20%×1184 Euros.
[d] 38%×65 Euros.

amount to 886 Euros. If only 10 hospitals set up stereotactic equipment, the average number of procedures would reach 720 per year. Assuming four core-needle procedures per day and 200 workable days per year, all 720 procedures can be performed in one stereotactic unit. This would result in a cost per procedure of 272 Euros. Accordingly, including the costs of the histopathological examination and the additional costs of the surgical excision procedures, the estimated costs per core-needle biopsy procedure ranged from 1188 Euros in scenario 1 to 574 Euros in scenario 4.

Fig. 1 visualises the potential cost savings per patient within healthcare if all surgical excision biopsies are replaced by core-needle biopsies for the four scenarios of centralisation. This figure shows that the economies of scale are considerable. If stereotactic equipment was made available in all hospitals, the costs would be comparable to those of excision biopsy, leading to no cost savings within healthcare. However, in a strictly centralised scenario (scenario 4), the annual cost savings would reach 612 Euros per patient. For The Netherlands, this would mean potential costs savings within health care of 4.4 million Euro per year (scenario 4). For scenarios 2 and 3, the respective annual savings would be 1.1 and 3.3 million Euros.

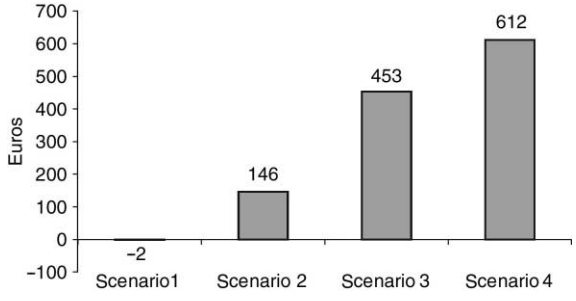

Fig. 1. Cost savings per patient, based on 100% substitution of surgical excision biopsy by core-needle biopsy for the four scenarios of centralisation (only healthcare costs).

3.2. Patient costs

If all hospitals in The Netherlands set up stereotactic equipment (scenario 1), the average patient costs for time and travelling would be approximately 8 Euros per patient (Table 4). The patient costs would be 28 Euros in the most centralised scenario (scenario 4). As surgical excision biopsy is currently performed in all hospitals, the patient costs for surgical excision biopsy are similar to scenario 1.

3.2.1. Sensitivity analyses

The cost calculation of a stereotactic core-needle procedure for the four scenarios of decentralisation and the presented costs savings in healthcare were based on the assumption that all surgical biopsies would be replaced by core-needle biopsies. This would mean that in the most centralised scenario all women with non-palpable breast lesions would be referred to hospitals with stereotactic equipment. Presently, however, not all physicians might be willing to refer their patients, especially if available in only a limited number of centres. They, or their patients, might prefer examination in their own hospital using conventional surgical excision biopsy. With increasing distance or older patients, their reluctance might increase. Accordingly, we carried out sensitivity analyses to assess the potential cost savings in healthcare for varying levels of substitution. In these analyses, we assumed that the substitution rate would decrease as the level of centralisation increases. In the first sensitivity analysis, we assumed that the substitution rate would decrease by 10% for increasing levels of centralisation. For scenario 1, we assumed 100% substitution, for scenario 2, 90%, for scenario 3, 80% and for scenario 4, 70%. In a second sensitivity analysis, we assumed a decrease of 20% for increasing levels of centralisation; i.e. for scenario 1, 100% substitution, scenario 2, 80%, scenario 3, 60% and scenario 4, 40%.

Table 5 presents the results of these sensitivity analyses regarding the cost savings in healthcare. In cases

Table 4
Patient costs (Euros) for stereotactic core-needle biopsy for the four scenarios of centralisation

	Scenario 1	Scenario 2	Scenario 3	Scenario 4
No. hospitals	114	89	37	10
Average distance to hospital (km)	7	8	13	24
Travel and time costs	8	9	15	28

where only 70% of the eligible patients would be diagnosed with stereotactic core-needle biopsy in the most centralised scenario, the expected cost savings within healthcare would amount to approximately 3.1 million Euro per year. If we assume that only 40% of all patients would be diagnosed using stereotactic core-needle biopsy in the most centralised scenario, the annual savings would be reduced to approximately 1.8 million Euros.

4. Discussion

The present study indicates that the replacement of surgical excision biopsy by core-needle biopsy has the potential for considerable cost savings in healthcare. However, no cost savings can be expected if the equipment for stereotactic core-needle biopsy is placed in all the hospitals in The Netherlands. The amount of savings is highly dependent on the extent of centralisation of this facility. If stereotactic core-needle biopsy is centralised in 10 hospitals, this would result in an approximately 50% of savings of direct medical costs compared with surgical excision biopsy. The additional patient costs due to centralisation would be quite limited. This is due to the fact that it is only a one-time procedure and travelling distances in The Netherlands are generally short.

In addition, data from the literature regarding the costs of core-needle biopsy, although scarce, indicates that stereotactic core-needle biopsy is 4–6 times less expensive than surgical excision biopsy [5–8]. However, these findings are based on Medicare charges, which generally do not reflect actual costs.

Nevertheless, the results reported in this study should be interpreted cautiously, because the direct cost comparison between surgical excision biopsy and core-needle biopsy does not take into account all of the relevant issues. Firstly, in a setting without large-core-needle biopsy, approximately 16% of all patients with malignancies do not need a therapeutic operation anymore because the malignancy is completely excised during the excision biopsy (data not shown). Therefore, the ultimate cost difference between excision biopsy and core biopsy might be somewhat overestimated. Moreover, the costs of false-negative or false-positive diagnosis on either large-core-needle of excision biopsy are not accounted for in this comparison. Finally, we did not take into account the time costs of patients for the biopsy procedures. As, in general, patients are hospitalised, these costs will be higher for surgical excision biopsy. A full economic evaluation of core-needle biopsy compared with surgical excision biopsy should formally address these issues.

Furthermore, some remarks should be made regarding the calculated cost differences between the four scenarios for centralisation. Firstly, we did not take into account the effects of experience and expertise. When more procedures are performed in one centre this might result in fewer failures, better quality and shorter procedure time. In addition, the investment in the education of medical personnel will be lower when this facility is centralised. So, the savings in the centralised scenarios might have been underestimated to some extent.

However, in the base case analysis we assumed that all surgical excision biopsies would be replaced by core-needle biopsies. Presumably, it will be more realistic that the substitution will take some time, especially if stereotactic procedures are more centralised. If the travel distance is longer, physicians and patients might prefer the surgical excision biopsy which is available in their own centre. So, the results of the sensitivity

Table 5
Sensitivity analyses: costs savings (in Euros) in healthcare due to substitution surgial excision biopsy by stereotactic large-core needle biopsy for different assumptions regarding the substitution rate

		Scenario 1 (114 hospitals)	Scenario 2 (89 hospital)	Scenario 3 (37 hospitals)	Scenario 4 (10 hospitals)
Base case	Substitution rate	100%	100%	100%	100%
	cost savings ($\times 10^3$)	−12	1051	3261	4408
Sensitivity 1	Substitution rate	100%	90%	80%	70%
	cost savings ($\times 10^3$)	−12	946	2608	3086
Sensitivity 2	substitution rate	100%	80%	60%	40%
	costs savings ($\times 10^3$)	−12	841	1956	1764

analyses might give a better estimation of the expected cost savings during the first years after the introduction of stereotactic large-core-needle biopsy for the four scenarios. However, it is difficult to estimate the exact extent of substitution.

The indication criteria might expand due to the introduction of core-needle biopsy. As this procedure is less invasive and less mutilating than an excision biopsy, physicians might not strictly follow referral criteria and decide to refer more women for this procedure. This would lead to a higher number of procedures per centre and a decrease of the average cost per procedure. However, the total costs for biopsies in The Netherlands would obviously increase. The ultimate cost differences between the four scenarios of centralisation would depend on all of these factors.

Only a few economic evaluations pay attention to the economies of scale of new facilities in healthcare. The average costs per procedure are often based on implicit assumptions regarding the occupation of equipment. Especially in healthcare interventions where equipment is costly, such as procedures in radiology, this lack of attention is not justified and might lead to flawed decisions. The present study demonstrated that the cost differences due to economies of scale are considerable. Therefore, it is important to identify the break-even point (occupancy rate) at which the costs of a new technology are the same as those of the existing technology. This information will be useful for both national and local decision-makers.

We feel that centralisation of stereotactic equipment for core-needle biopsies would be advisable at least from an economic point of view. Additional patient costs for time and travelling remain limited and therefore less relevant. Despite the professional drive to remain up to date, hospitals and insurance companies should consider this issue when deciding on the efficient use of this technique.

More detailed information on cost calculations is available on request.

The COBRA study group

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Appendix

This table shows which information was gathered on the direct costs of the different procedures. Part of the information was recorded in a number of procedures per hospital, by using registration forms. Other information was recorded one time.

Stereotactic large-core-needle biopsy	Registration form	One-time registration	Needle localisation	Registration form	One-time registration
Personnel costs			Personnel costs		
No. technicians	x		No. technicians	x	
Time start preparation by technicians	x		Time start preparation by technicians	x	
Time end cleaning room by technicians	x		Time end cleaning room by technicians	x	
Time arrival radiologist/resident	x		Time arrival radiologist	x	
Time departure radiologist/resident	x		Time departure radiologist	x	
Time needed for assessment mammogram by radiologist/resident		x	Time needed for inspection biopsy by radiologist	x	
Time needed for calibration by technicians		x	Time needed for inspection biopsy by technician	x	
Average wage per staff category		x	Average wage per staff category		x
% Social premiums		x	% Social premiums		x
Material costs			Material costs		
No. biopsy needle	x		No. biopsy needle	x	
No. sterile needle guide	x		No. needle guide	x	
No. X-ray	x		No. X-ray	x	
Cost per unit		x	Costs per unit		x
Total costs other materials		x	Total costs other materials		x
Equipment costs			Equipment costs		
Acquisition costs equipment		x	Acquisition costs equipment		x
Economic life		x	Economic life		x
Annual number of procedures		x	Annual number of procedures		x
Annual maintenance costs		x	Annual maintenance costs		x

Appendix continued

Surgical excision biopsy	Registration form	One-time registration	Histopathological examination core biopsy and surgical excision biopsy	One-time registration
Personnel costs			Personnel costs	
No operating room nurses	x		Time pathologist/resident for:	x
No. medical staff (anaesthetist, surgeon, resident)	x		Cutting out materials	x
Time start preparation surgery	x		Examination/reporting	x
Time start surgical procedure	x		Analyst time per cassette	x
Time end surgical procedure	x		Average no. cassettes per biopsy	x
Time needed for preparation by anaesthetist and surgeon		x	% Colouring	x
Time needed for preparation and cleaning by operating room-nurses		x	Additional analyst time for colouring	x
Average wage per staff category		x	Average wage per staff category	x
% Social premiums		x	% Social premiums	x
Material costs			Material costs	
Use anaesthesia	x		Material costs per cassette	x
Costs surgery materials		x	Additional material costs for colouring	x
Costs anaesthesia materials		x		
Costs anaesthesia per unit		x		
Equipment costs			Equipment costs	
Acquisition costs equipment		x	Acquisition costs equipment	x
Economic life		x	economic life	x
Annual number of procedures		x	Annual number of procedures	x
Annual maintenance costs		x	Annual maintenance costs	x

References

1. Koning HJ de. The effects and costs of breast cancer screening. Thesis, Institute for Public Health, Erasmus University Rotterdam. 9 June 1993.
2. Groeneveld JF. Specialistenhonoraria (Specialists' fees). *Medisch Contact* 1996, **27/28**, 919–921.
3. Statistics Netherlands. Voorburg/Heerlen, 2000.
4. Oostenbrink JB, Koopmanschap MA, Rutten FFH. Handleiding voor kostenonderzoek, methoden en richtlijnprijzen voor economische evaluaties in de gezondheidszor. Guidelines for costing research, methods and guide line prices for economic evaluations in health care. iMTA, 21 February 2000 (in Dutch).
5. Liberman L, Fahs MC, Dershaw DD, Bonaccio E, Abramson AF, Cohen MA, Hann LE. Impact of stereotactic core breast biopsy on cost of diagnosis. *Radiology* 1995, **195**, 633–637.
6. Hrung JM, Langlotz CP, Orel SG, Fox KR, Schnall MD, Schwartz JS. Cost-effectiveness of MR imaging and core-needle biopsy in the preoperative work-up of suspicious breast lesions. *Radiology* 1999, **213**, 39–49.
7. Lee CH, Egglin TK, Philpotts L, Mainiero MB, Tocino I. Cost-effectiveness of stereotactic core needle biopsy: analysis by means of mammographic findings. *Radiology* 1997, **202**, 849–854.
8. Logan-Young W, Dawson AE, Wilbur DC, Avila EE, Tomkiewicz ZM, Sheils LA, Laczin JA, Taylor AS. The cost-effectiveness of fine-needle aspiration cytology and 14-gauge core needle biopsy compared with open surgical biopsy in the diagnosis of breast carcinoma. *Cancer* 1998, **82**, 1867–1873.