

The impact of contracts on outsourcing computed tomography examinations from a Swedish public university hospital to a private radiology unit

P.T. Olofsson ^{a, *}, P. Aspelin ^b, J. Bohlin ^c, L. Blomqvist ^a

^a Department of Molecular Medicine and Surgery (MMK), K1, Stockholm, Sweden

^b Department of Clinical Science, Intervention and Technology at Karolinska Institutet, Division of Medical Imaging and Technology, Stockholm, Sweden

^c Department of Radiology, Karolinska University Hospital in Solna, Stockholm, Sweden

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ABSTRACT

Introduction: After years of outsourcing without detailed contracts from one of Sweden's largest university hospitals to external radiology units, the hospital started to use a specific contract for outsourcing computed tomography (CT) examinations. The purpose of this study was to compare the cost-effectiveness of two outsourcing approaches, where examinations were performed either with a detailed, specific contract (with-contract) or without (no-contract), between a hospital radiology department and private external units.

Methods: This retrospective study included a group of electively outsourced CT-examinations (n = 132) and a control group of in-house CT-examinations (n = 132), selected from the three different types of CT-examinations referred from the Departments of Oncology and Hematology.

These examinations were randomly selected from four different groups over two time periods of one year each, one being outsourcing without a contract (no-contract, during 2013), one time period with a specific contract (with-contract, during 2014) and two control groups of examinations performed in-house within both these time periods. We compared outsourced examinations (both no-contract and with-contract groups) and in-house examinations. The comparison of these groups include five parameters; management-time, patient waiting-time, the quality of the examinations, - image interpretations and costs.

Results: During 2013, management-time for CT-examinations was longer in the outsourced group (no-contract) than in the in-house group, with a statistical significance (P = 0.002). Fewer examinations performed in-house and in the with-contract group needed re-interpretation than in the no-contract group. CT-examinations in the with-contract group were associated with shorter overall management-time, patient waiting time and lower costs compared to the no-contract group.

Conclusion: Using a contract with detailed specifications for outsourcing CT-examinations may be an effective way of reducing patient waiting time. Outsourcing based on a well-founded contract can be cost-effective, compared with outsourcing without a detailed plan for the services required.

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Introduction

In the late twentieth century, healthcare systems in many countries began to outsource medical care services. Previous studies have shown that radiology services are being increasingly

outsourced for many reasons: technological advancements, shortage of expertise, increasing demand, financial constraints and transitioning radiology from an analog world to a digital one.^{1–5} Outsourcing can bring benefits for healthcare systems, communities, institutions, departments, individual healthcare practitioners and patients. One advantage of outsourcing radiological examinations may be its availability to an expanded network of radiologists and other professionals, by providing easy access to diagnostic images and interpretation.⁶ Many public hospitals around the world outsource radiological services⁷ and the

* Corresponding author.

E-mail addresses: parvin.olofsson@vardforbundet.se, parvin.tavakol@ki.se (P.T. Olofsson), Peter.Aspelin@ki.se (P. Aspelin), jan.bohlin@karolinska.se (J. Bohlin), Lennart.K.Blomqvist@ki.se (L. Blomqvist).

outsourcing itself becomes a crucial task for the healthcare provider.⁸ According to Peter Holbrook, “This is not an issue of whether or not to outsource public services but about how public bodies allow the markets to be shaped and the sort of firms they choose.”⁹ The decision to outsource radiological examinations requires consideration of several issues such as quality, costs and benefits, because the choice of one external radiology unit over another will not only have an impact on the individual patient’s health, but also on healthcare resources for society as a whole.^{10,11} In a previous study,¹² we discussed the consequences of outsourcing radiological examinations from a university hospital to external units, when this is done without any procurement specifications in the contract between the sending and receiving departments. The results of that study showed that outsourced examinations need reassessment at the University Hospital more frequently than examinations that were not outsourced. Outsourced examinations that are reinterpreted at the University Hospital may also represent a challenge for in-house radiologists, because the outsourced radiological examinations are not necessarily performed to the standards that the hospital uses.¹² Since that study, the University Hospital has initiated a new contract for outsourcing CT-examination referrals to a private radiology unit.

According to this contract, both in-house and outsourced CT-examinations should be performed according to the same examination protocol that the University Hospital uses and the interpretations should be made with comparison to any relevant prior imaging. The contract also includes a fixed price for a fixed number of CT-examinations with a permitted deviation of 10% fewer or greater. The CT-examination interpretations should be performed and delivered within a week. To the best of our knowledge, no previous studies have been performed to evaluate the effects of using a detailed, specific contract on outcomes for costs and patient waiting times, when both the examination and the image interpretation are outsourced.

The aim of this study was to compare the cost-effectiveness of two outsourcing approaches, either performed with a detailed, specific contract (with-contract) or without (no-contract), between a hospital radiology department and private external units.

Material and methods

This retrospective study included 264 elective CT-examinations selected from all body CT-examinations (Abdomen, Abdomen-thorax and Neck-thorax-abdomen) of adult patients referred from the Departments of Hematology and Oncology.

Types of examinations which were not commonly performed by the radiology units, e.g. thorax and thorax-upper abdomen, were excluded. Subsequent to the initial exclusion, a randomized block design was used in order to group the sample into relatively homogeneous subgroups and to decrease the variability within each group.¹³

The sufficient power in sample size was calculated using alpha of 0.05, a power of 0.80, which resulted in a sample of a minimum of 132 observations per group. Data were broken into 12 blocks (Fig. 1) with stratification according to referring clinics (Hematology and Oncology), radiological examination type (Abdomen, Abdomen-thorax and Neck-thorax-abdomen) and radiology unit in which the examinations were performed for each year (12 blocks, n = 132 for 2013 and 12 blocks, n = 132 for 2014). The last step was to classify these examinations into four different groups of CT-examinations over two time periods of 12 months each, one group being outsourced without a detailed plan for the services required (no-contract) and one time period representing contract-based outsourcing (with-contract) along with two control groups of CT-examinations performed in-house within these same time periods. Examinations performed in-house (n = 132) and the outsourced group (no-contract and with-contract, n = 132) were compared (Fig. 2).

The choice of external radiology unit

The University Hospital’s common criteria for the selection of external radiology units are: the patient’s own request; to provide better expertise, and because the unit is more geographically convenient for the patient. External units that use the same patient journal system as the hospital are preferred.

Management-time and patient waiting time

Management-time involves several phases through which a CT-examination referral must pass. These phases start with the writing of the referral and finish when the patient is informed about the examination’s results or when the radiology report has been taken into consideration in patient treatment. Sometimes referring physicians order re-interpretation, either because they need a second opinion from the internal radiologists or additional imaging is required. When examinations need to be re-assessed at the University Hospital, a referral passes through several additional phases (Fig. 3). Management-time was measured by adding up the time required for each phase.

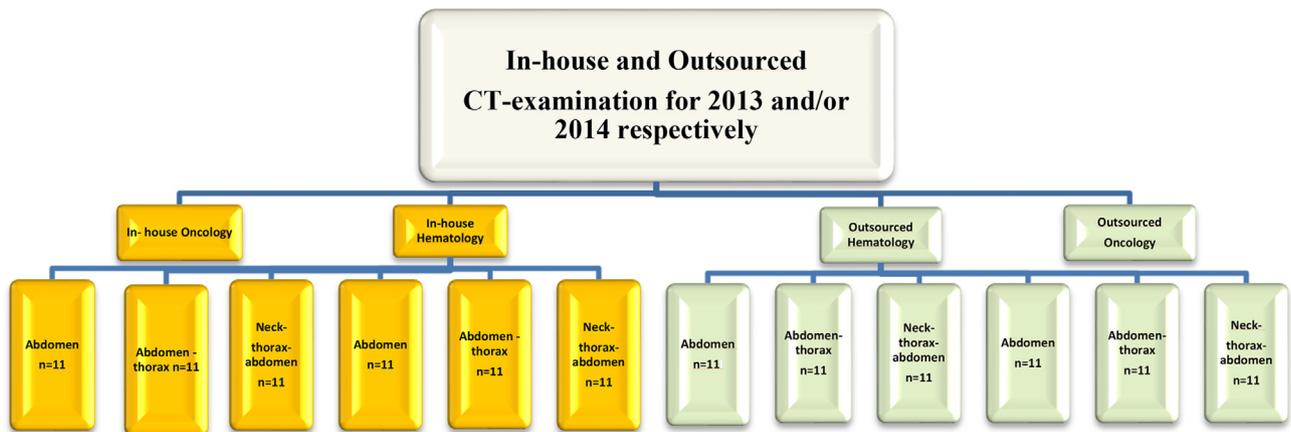


Figure 1. Twelve blocks for different types of CT-examinations with stratification according to referring clinics and radiological examinations type (12 blocks, n = 132, for year 2013 and 12 blocks, n = 132, for year 2014), which were randomly selected for the years 2013 and 2014, i.e. the year before and after the introduction of contracts to compare the in-house and outsourced CT-examinations.

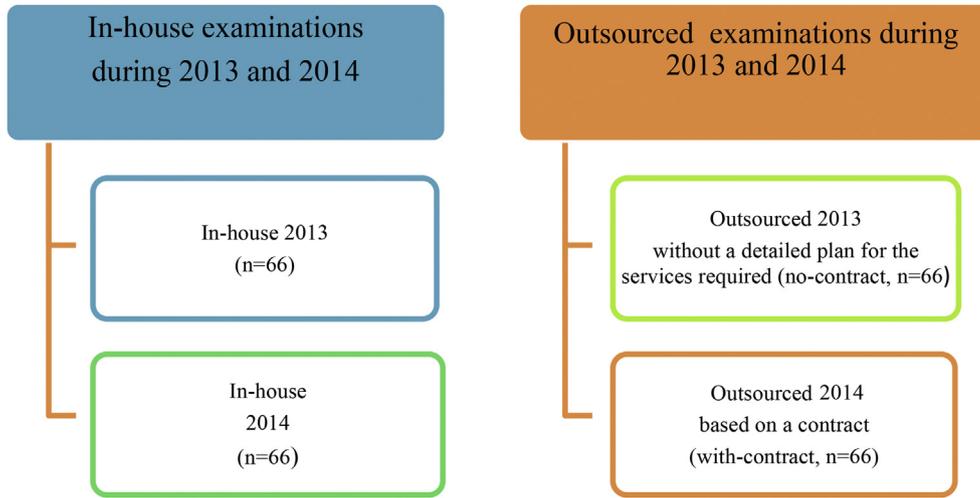


Figure 2. Shows the grouping for two main study groups (in-house and outsourced) during two time periods (2013 and 2014). The in-house group consisted of CT-examinations performed and interpreted within the Department of Radiology at the University Hospital during 2013 and 2014. The outsourced group consisted of CT-examinations outsourced without a contract specifying the detailed requirements for cooperation between the hospital and the external units during 2013 (no-contract) and examinations outsourced with a specific contract between the hospital and the external unit (with-contract).

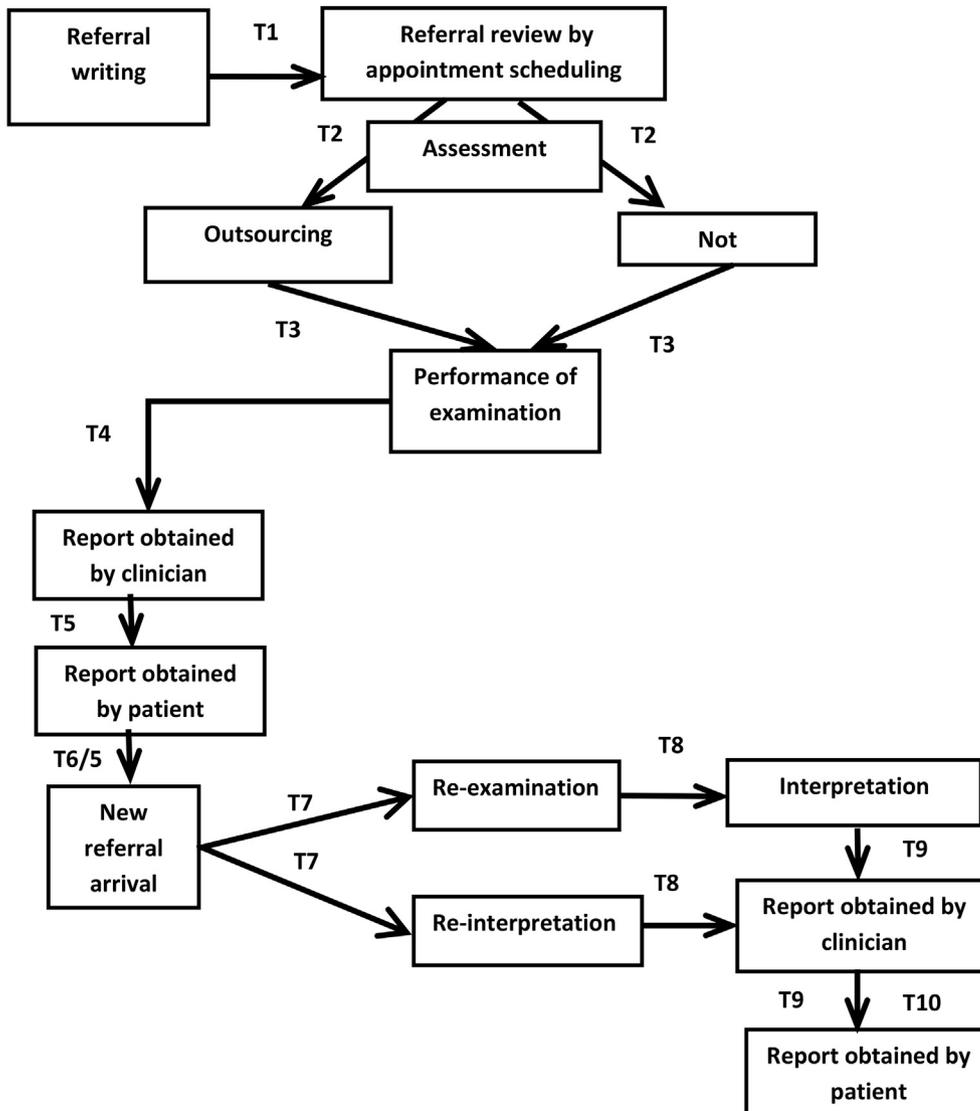


Figure 3. Modified from Fig. 1.¹² Displays the different phases a referral for a CT-examination passes through between the writing of the referral and the patient's obtaining the report. However, some examinations need additional imaging and or re-interpretation at the University Hospital. This new journey begins from phase T6/5 and ends at phase T9 or T10. In these cases, referring physicians often wait to obtain the final interpretation before they inform the patients.

Referring physicians often require a specific timeframe by which the CT-examination must be completed. Therefore, the actual examination dates were compared to the requested preferred times and this was used as a parameter indicating the patients' waiting time for their CT-examinations. In order to calculate the total patient waiting time, the actual radiology report dates were compared to the requested preferred times. The main communication platform for referrals, images and interpretation is the Picture Archiving and Communication System (PACS).

Cost-effectiveness analysis

The costs of administrative work for referrals were measured on the basis of time (in minutes) with regard to the two staff groups at the hospital: radiologists and administrative staff. The calculated cost for each CT-examination was the sum of the costs of each examination and the cost of additional re-assessments work.

Effectiveness was measured in terms of (a) the number of CT-examinations performed within the preferred requested timeframe (no delays); (b) the number of examinations that needed re-interpretation and (c) the number of examinations that needed additional imaging. In cases where CT-examinations needed re-interpretation, the impact of the re-interpretation compared to the original report was measured by consulting two experienced and independent radiologists. For each reviewed referral, the radiologist filled in the dedicated form shown in Table 1.

Data collection

Data were collected from the Picture Archiving and Communication System (PACS), the Radiology Information System (RIS) and the patients' clinical files used in the University Hospital.

Analysis

Data concerning management-time s were expressed as median along with range. The Mann–Whitney U test was used to compare groups, and differences were considered significant for P = 0.05. Patient waiting times were calculated by the number of days by which the preferred time for carrying out the CT-examination was exceeded. The comparison between the in-house and outsourced groups regarding patient waiting times was analyzed by non-parametric test. Numbers of examinations that needed re-

interpretation and re-examination were expressed as absolute value/n and percentage values. Examination costs were expressed in Euros. Changes in diagnoses and patients' treatments were compared using the dedicated form shown in Table 1. To test the level of agreement between radiologists' assessments, a kappa coefficient was used and the accepted level of statistical significance was P = 0.05.

Analyses were performed using Office Excel 2010 11.6560.6568 SP3 software by Microsoft® and SPSS software version 21.

The study was approved by the local research ethics committee.

Results

During 2013 and 2014, the Departments of Hematology and Oncology referred a total of 7757 and 8202 CT-examinations respectively to the University Hospital's Radiology Department. During 2013, some 3114 examinations (40%) were outsourced and 4643 (60%) were booked to be performed in-house. During 2014, a total of 2537 examinations (31%) were outsourced and 5665 (69%) were booked in-house.

Management-time

The total management-time was shorter (P = 0.472) in the with-contract group (37 days, range 9–185) compared to the no-contract group (43 days, range 10–243). The management-time for examinations that needed no re-interpretation was significantly longer (P = 0.002) in the no-contract group (43 days, range 10–243) than in the in-house group during 2013 (19 days, range 0–204). The differences in total management-time observed during 2014 between the in-house group (42 days, range 0–282) and the with-contract group (37 days, range 9–185) were not statistically significant (P = 0.635).

Patient waiting time

During 2013, the total number of referrals with a specified timeframe for in-house examinations was 35 (53%, 35/66) and the University Hospital met referring physicians' requirements in 23 cases. In the no-contract group, the total number of referrals with a specified timeframe was 47 (71%, 47/66) and the external radiology units were able to meet requirements in 28 cases.

Table 1
Form related to re-interpretation.

Questions	No	Yes	It doesn't change patient's treatment	Changes to patient's treatment	Changes that imply changes in further investigations	Comments
Change in findings?						
Adding new findings?						
Adding new interpretation?						
Are there any changes at all?						
Changing patient follow-up/investigations?						

Table 2
The total number of referrals with a specified timeframe for in-house and the external radiology units' CT-examinations during 2013 and 2014 and total number of referrals for which they were able to meet requirements. The table also shows the total number of referrals without a specified timeframe for in-house and outsourced CT-examinations during 2013 and 2014.

Groups	Referrals with a specified timeframe	Fulfilled the requirements	Referrals without specified timeframe
In-house 2013	35 (53%)	23/35	31 (47%)
Outsourced no-contract	47 (71%)	28/47	19 (29%)
In-house 2014	40 (61%)	28/40	26 (39%)
Outsourced with-contract	44 (67%)	29/44	22 (33%)

During 2014, the total number of referrals with a requested timeframe was 40 (61%, 40/66) for in-house examinations, and the University Hospital met referring physicians' requirements in 28 cases. In the with-contract group, the total number of referrals with a requested timeframe was 44 (67%, 44/66) and the external radiology units were able to meet requirements in 29 cases (Table 2).

When a timeframe was specified in the referrals, the waiting time for patients was shorter for the with-contract group compared to the no-contract group ($P = 0.956$) (Table 3).

Costs

The cost of administrative work for the in-house referrals is included in the University Hospital's ongoing operating costs, while the cost of the administrative work for each referral outsourced was 7.50 Euros.

CT-examinations for the in-house group during 2013 were significantly cheaper than examinations in the no-contract group, even though the costs of re-interpretation ($P = 0.007$) were taken into account. Total costs of the CT-examinations for the in-house group were significantly higher ($P < 0.0002$) than those in the with-contract group during 2014 (Fig. 4).

Re-doing of CT-examinations

No examination in either group was found to need additional imaging procedures related to the CT-examination.

Table 3

Patient waiting times in days for the no-contract and with-contract groups, for CT-examinations with specified timeframes.

Groups	Median	Range	P value
no-contract (n = 19)	6.42	(1–26)	0.956
with-contract (n = 15)	6.53	(0–18)	

Reinterpretation of CT-examinations

A total of four examinations in the in-house group had to be reinterpreted during 2013 and 2014 compared to 16 examinations in group no-contract and with-contract (6%, 4/66 vs. 24%, 16/66; $p = 0.002$). Fewer examinations in the with-contract group needed additional reinterpretation of images than in no-contract group (3%, 2/66 vs. 21%, 14/66; $p = 0.0008$).

Reinterpretation's impact on patient treatment

The results showed that a total of 20 radiology reports out of all the CT-examinations observed in this study ($n = 264$) required re-interpretation. Inter-rater agreement is shown in Table 4.

The agreement as to how a re-interpretation changes the condition of its previous interpretation (radiology report) was minor between the two reviewers (kappa value = 0.119; $P = 0.248$) as shown in Table 5.

Discussion

The results showed that during 2013 the University Hospital outsourced 40% of CT-examinations referrals while 31% were outsourced during 2014. The reason for the reduced number of outsourced CT-examinations during 2014 could be because CT-examinations performed in-house were cheaper than those outsourced. Another reason could be that, since 2014, the University Hospital's Radiology Department has employed coordinators for outsourcing CT-examinations referred from the Departments of Hematology and Oncology. The coordinators are responsible for creating a holistic overview of the hospital's ability to meet these referring Departments' requests, choosing protocols for the performance of CT-examinations, checking the delivery of outsourced radiological services and communicating with the external

Price of CT-examinations

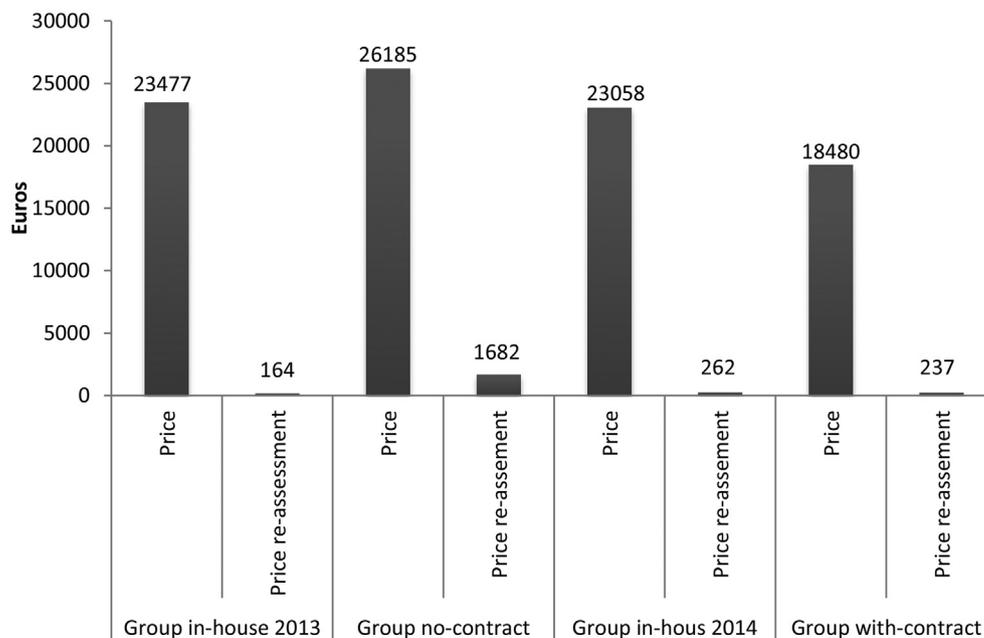


Figure 4. Total costs in Euros for the CT-examinations. Costs for re-interpretation in the no-contract group were, on average, higher than those performed in-house during 2013. Total costs for the CT-examinations plus costs for re-interpretation of the in-house examinations were, on average, higher than those in the with-contract group during 2014.

Table 4
Frequency of changes for rater one and rater two.

	Rater One	
	Frequency	Percent
No changes	7	35.0
Changes in findings, but these do not change patient treatment	0	00.0
Adds new findings, but does not change patient treatment	2	10.0
Adds new interpretation, but does not change patient treatment	3	15.0
Adds new findings and does change patient treatment	2	10.0
Adds new interpretation and does change patient treatment	6	30.0
Changes that imply changes in further investigations		
Total	20	100.0

	Rater One	
	Frequency	Percent
No changes	12	60.0
Changes in findings, but these do not change patient treatment	2	10.0
Adds new findings, but does not change patient treatment	3	15.0
Adds new interpretation, but does not change patient treatment	1	5.0
Adds new findings and does change patient treatment	0	0.0
Adds new interpretation and does change patient treatment	2	10.0
Changes that imply changes in further investigations		
Total	20	100.0

radiology unit throughout the contract. As a side effect of having this contract, this holistic approach may have influenced the strategy and decision-making processes for outsourcing,¹⁴ resulting in more efficient use of internal resources and thus fewer outsourced CT-examinations. Some studies consider decision-making as helpful tools to guide an organization's managers in determining which of their procedures or actions should be performed internally and which should be outsourced.^{15,16} Good financial management and outsourcing process management are two inseparable components of any organization.¹⁷ Cost-effectiveness is often the main argument for outsourcing radiological services.^{17,18}

We observed lower costs and shorter total management-time for the with-contract group compared to the no-contract group. The results indicate a potential benefit in outsourcing practice when there is a specific contract. As previously shown, one way to evaluate whether outsourcing can reduce costs, increase quality of service, and boost confidence in a commitment to quality, is to assess the capacity of the outsourcing contract to protect the customer's interests.^{19,20} It has been shown that cost-effectiveness analysis can be used to evaluate outsourcing capacity. Most studies about cost-effectiveness analyses are based on the perspective of cost-effectiveness to a large community and are thus considered as instruments for public economic policy.^{21,22} In our

study, we were interested in cost-effectiveness from the University Hospital's organizational perspective. However, cost-effectiveness analysis as a technique is useful for evaluating an organization's overall efficacy, because it can provide considerable insight into the cost-efficiency of any organization by ensuring that all resources are used and distributed in the best way possible to achieve the maximal favorable outcome.^{23,24}

Our results showed that fewer examinations in the with-contract group needed additional image re-interpretation than in the no-contract group. This decrease may be due to using the same performance protocol for CT-examinations and writing the interpretations with comparison to relevant previous imaging. This joint practice allows the outsourced radiology report to adopt the same style as the University Hospital Radiology Department's report, with which referring physicians are more accustomed. According to the European Society of Radiology (ESR) guidelines, the quality of radiological reports delivered by external radiologists should be on a par with those of in-house radiologists.²⁵

According to Rater One, the results showed that, the re-interpretations had changed the diagnoses in 8 cases such that they were able to influence patient treatment. According to Rater Two, there were 2 such cases. This may indicate that re-interpretation cannot be the only parameter by which to measure the quality of the radiology report.

This study has several limitations. Firstly, it is a retrospective study and there could be a risk of selection bias. The second limitation is that, since October 2014, the private radiology unit has begun to provide internet-based, multi-disciplinary conferences on a weekly basis for referring physicians. This may have been a contributing factor in the decrease in the number of referrals requiring re-interpretation. We did not study the impact of internet-based, multi-disciplinary conferences on requests for re-interpretation. The third limitation is that the impact of the re-interpretation was measured by consulting two experienced and independent radiologists who might underestimate the clinical impact of changes to reports. It might have been more appropriate to also have oncologists and/or hematologists to rate the impact. However, as we mentioned earlier interpretation is not always a measure of quality. One may thus argue that, measuring re-interpretation's impact on patient treatment may fall outside the purpose of this study. The fourth limitation is that it is unclear who the customers are in the context of our study, e.g. the University Hospital's Radiology Department, the referring Departments, the patients, or all of them. It is also important to view the results of our study within the perspective of the University Hospital's economic policy, where each department has a defined budget. According to this policy, the budget is established via justification of the previous year's results by using various indicators such as operating and maintenance costs. These indicators work well when the goal is to control the cost of providing radiological services rather than to maximize profits.^{26,27} It is important for any organization to separate the roles of customer and provider, and to use a contract as a basis for service delivery.^{28,29} Therefore, the referring clinics can be seen as the Radiology Department's customers; the patients as the referring departments' customers, and the University Hospital's Radiology Department as the private radiology unit's customer. The

Table 5
Agreement of changes for rater one and rater two.

Measure of Agreement	Value	Asymptotic Standard Error (Not assuming the null hypothesis)	Asymptotic Standard Error (Assuming the null hypothesis)	Estimated Significance
Kappa	0.119	0.110	1.156	0.248
N	20			

referring clinician's finances work well when fewer examinations need additional image reassessment. This situation does not necessarily apply for the University Hospital's Radiology Department, because that department is not using actual finance, as each year's budget is decided in advance. One can argue that, in this continuum of care, the patient is the true customer, and, although unaware of services being outsourced, deserves to receive the best quality of care. Radiological services play a central role in health-care operations and these services are an important element of patients' quality of care. Quality in healthcare is not just an abstract term, but also an extensive and important subject.^{30,31}

Another limitation could be the choice of referring department type that may have affected the results. We were only able to examine patients who were referred from two clinics, which may affect the generalizability of this study. This could also lead to an overestimation of both the advantages and disadvantages of having an outsourcing contract. However, an ideal outsourcing contract consists of several key elements such as performance and financial parameters, based on solid principles, and supported by appropriate human resources.^{29,32} We did not study the impact of outsourcing radiological examinations on human resources such as the radiologists' and radiographers' workload, work satisfaction and competence. Outsourcing routine control examinations to an external radiology unit may result in in-house radiologists and radiographers performing more complex examinations.³³ If radiologists and radiographers perform only repetitive examinations, this may affect their competence. We did not study the impact of outsourcing radiological examinations on patient safety.

Despite these limitations, we believe that our study may present an opportunity to enhance knowledge about well-founded contracts in other public hospitals which pursue the practice of outsourcing.

In conclusion, using a contract for outsourcing CT-examinations may be an effective way of reducing patient waiting time. Outsourcing based on a well-founded contract can be cost-effective, compared with outsourcing with no specific details as to the services expected.

Conflict of interest statement

The authors declare that there is no conflict of interest.

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