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# **CONSEQUENCES OF OUTSOURCING REFERRALS FOR MAGNETIC RESONANCE EXAMINATIONS**

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To my sons who brought light into my life.



## ABSTRACT

**Background:** Rapid developments in imaging technology affecting its day-to-day clinical use continue to increase the workload in diagnostic radiology. Along with demands for ever more effective healthcare, these are two important factors for which outsourcing might be a potential solution. Outsourcing radiological examinations is a challenge and increases the need for cooperation between different health care units. Delegating a radiological examination is associated with administrative work while external examinations change the work flow and create a complex situation that is difficult to review both qualitatively and quantitatively. The impact of outsourcing magnetic resonance (MR) examinations to external units in a zero-based budgeting health care system is not known. This impact can be studied both from the perspective of healthcare work flow as well as from that of the patients.

**Aims:** The overall aim of this thesis was to examine the consequences of radiology departments' outsourcing MR referrals to external private radiology units. The aim of Study I was to investigate differences in management/turnaround time, patient waiting time, quality and costs between MR examinations performed in a University hospital and examinations outsourced to private units. The aim of Study II was to explore the experiences of referring physicians and patients when referrals for MR examinations are outsourced from a University hospital.

**Material and Methods:** Consecutive outsourced MR examinations requested by the Department of Oncology during the first quarters of 2005 and 2006 were selected for the first study. Examinations performed by the University Hospital's Radiology Department (Group A, n = 97) were compared to matched examinations outsourced to private units (Group B, n = 97). In Study II, interviews were held with one group of referring physicians (n = 10, Group  $\beta$ ) from orthopedic and oncology clinics representing clinics with large volumes of MR referrals and one group of patients (n = 160, Group  $\alpha$ ) referred for MR examinations.

**Results:** In Study I, the time from writing a referral to obtaining the report was significantly longer in Group A than in Group B. For referrals without a preferred timeframe, the waiting time was shorter for outsourced examinations than those not outsourced. No significant difference in the number of examinations requiring additional imaging was observed between the two groups. Fewer examinations in Group A needed additional work for re-interpretation of images than in Group B (14% vs. 28%). The average cost for an MR examination in Group A was calculated to be €16.80, and €10.80 in Group B.

In Study II, all the referring physicians agreed that the quality of outsourced examinations was frequently inferior to that of examinations performed in the University Hospital's Radiology Department and requests for additional re-interpretation work led to higher costs for their clinics. Sixty-nine percent of the patients interviewed stated that they could neither choose nor influence the location to which their examination was referred. Aspects that influenced the patient's choice of radiology department were: short waiting time 79% (127/160), ease of travelling to the radiology department 68% (110 /160), and short distance to their home or work 58%

(93/160). For 40 % (60/160) of the patients, a short time in the waiting room was related to a positive response regarding returning for a further MR examination. From the patient's perspective better information concerning the MR examination, more instructions during the procedure, the staff's attitude and the level of expertise of the staff were key factors defining quality of care.

**Conclusion:**

- Outsourcing magnetic resonance examinations is one potential solution for reducing patient waiting time.
- Outsourced examinations more frequently need re-assessment at the University Hospital than examinations that are not outsourced.
- The discrepancy between patients and referring physicians indicates that there is insufficient communication between referring physicians and the radiological departments.
- When considering outsourcing, the needs of the patients, of the referring physicians and of the radiological departments must all be considered, to optimize patient care.
- Reduction of additional costs incurred for re-interpretation, improvements in organizing outsourcing and the cost drivers of outsourced MR examinations should all be studied further.

## **LIST OF PUBLICATIONS**

### **I. Effects of outsourcing magnetic resonance examinations from a public University hospital to a private agent**

Parvin Tavakol<sup>1</sup>, Fausto Labruto<sup>2</sup>, Lott Bergstrand<sup>2</sup> and Lennart Blomqvist<sup>2</sup>

### **II. Patients' and referring physicians' perceptions of the effects of outsourcing magnetic resonance examinations from a Swedish University hospital to a private unit**

Parvin Tavakol<sup>1</sup>, Peter Aspelin<sup>1</sup>, Fausto Labruto<sup>2</sup>, Lott Bergstrand<sup>3</sup> and Lennart Blomqvist<sup>2</sup>

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## **LIST OF ABBREVIATIONS**

MR	Magnetic Resonance
PACS	Picture Archiving and Communication System
RIS	Radiology Information System
HIS	Hospital Information System
ZBB	Zero-Based Budgeting



# 1 INTRODUCTION

*“The concept of equal access to quality care for equal need is central to most health care systems”* (1, page 1335). Healthcare systems are constantly facing the challenge of reducing costs while maintaining quality patient care. Governments are more cost conscious and one reason for this is that health care expenditures are increasing faster than other sectors of the world economy (2). Much of the rise in health care costs can be attributed to advances in medical technology such as diagnostic radiological investigations (3). Diagnostic imaging has become a rate-limiting and an economy-limiting factor in medical care (4), and, because radiology equipment is expensive, diagnostic imaging has become a target in reviews of medical costs (5). Indecision about how best to balance public and private sectors in the financing and provision of healthcare services is a major challenge. Patients may have to wait, sometimes for an unacceptably long time, for elective care in the public system and one solution healthcare managers use to address this challenge is outsourcing (6, 7). The national policy of a “healthcare guarantee” enforced in Sweden requires that patients with any kind of disease should be granted specialized hospital care within a maximum of 90 days (8). In this setting, early diagnosis plays a crucial role.

Workloads have increased in diagnostic radiology departments because of the rapid development of imaging technology and the higher demand for access to comprehensive health care services.

## 1.1 DIAGNOSTIC IMAGING: ONE IMPORTANT PART OF THE CONTINUUM OF CARE

Approximately five billion radiological examinations are carried out annually worldwide (9). Part of this growing number of diagnostic examinations is due to continuous improvements in both the high level of imaging quality and the fast delivery of digital information. A Swedish radiology department generally performs between 20,000 and 200,000 radiological examinations and treatments annually (10). The use of radiological services has increased over the past 30 years and today, very few important decisions concerning patient treatments are taken without the support of radiological examinations. Radiological examinations provide objective data about the human body and its functions and are often more reliable than subjective clinical investigations (11, 12). Any radiological examination consists of at least four major aspects: the assessment of the referral and subsequent preparations for the examination, the examination itself, its interpretation and the communication of the examination results, leading to the treatment decision. The radiology department is responsible for the whole chain of diagnostic examination processes in patient care (13).

### **1.1.1 The impact of developing technology on radiology department**

The expansion of technology provides more definite and more varied opportunities for diagnosing illnesses. Advances in image quality for demonstrating tissue differentiation have radically increased diagnostic information and in many cases technology is now capable of showing pathology without even requiring a histological reference (14). In the early 1980s, MRI was a new diagnostic technique, which was used to image organs such as the brain and spine. Today the increasing number of indications for MRI has contributed to requests from a far larger number of patients (15). Technological improvements in digital imaging have enabled the images to be post-processed and transferred easily to any location that has access to the corresponding system (16). In order to provide interpretations from radiology coverage during night times and weekends, many hospitals outsource diagnostic imaging to external units within the country or abroad (17, 18). The concept of teleradiology is that a radiology report is best written by the cheapest well-trained radiologist available. Indeed, teleradiology puts other providers of diagnostic imaging worldwide in competition with the in-house radiologist (11). Due to the speedy transmission of images and reports, teleradiology has become a substantial alternative for delivering diagnostic services (19).

Network communication of images between radiologists and clinicians is now a viable option, allowing clinicians to obtain an expert opinion from radiologists through teleradiology services (20). The use of diagnostic imaging technologies also implies that referring physicians can quickly obtain the result of interpretation and images of radiological examinations and can even view images themselves in some situations. Increased use of the digital imaging Picture Archiving and Communication System (PACS) has changed conditions within the radiology system. A combination of using computer systems such as the Radiology Information System (RIS), Hospital Information System (HIS) and PACS facilitates the archiving, distribution and transferal of data and images within and across different health organizations (21) and creates a lot of opportunities.

## **1.2 THE CONCEPT OF OUTSOURCING**

According to Paul Davies (2004), outsourcing can be defined as contracting or subcontracting some portion of a business such as manufacturing, processing, marketing, etc., to outside organizations (22). Outsourcing radiological services can either refer to distant interpretation of the examination and having a report written by an external radiology service; distant performance of the examination with interpretation at the hospital, or outsourcing both the performance and interpretation to an external radiological department (23, 24).

The concept of outsourcing is to enhance a business or an organization's efficiency through better, cheaper and faster product. Outsourcing has been around for as long as

work specialization has existed and today companies frequently use the outsourcing model to carry out specific functions, such as payroll, billing and data entry (25). Outsourcing is an old phenomenon with new implications and it triggers different opinions. Outsourcing is also defined as a method or solution for improved efficiency and productivity that leads to increased production or service (26). Outsourcing is a corporate strategy which focuses on a specific mission and how to accomplish it best and achieve a competitive advantage (27).

However, the concept of outsourcing means that a producer should produce those goods/services which they can produce most competitively and let other producers produce goods/services at which they are more efficient. *“Allocating good production to the most competitive producer will lead to a global economy that is maximally efficient in terms of producing the most goods for the least cost”*(28, page 654).

### **1.2.1 Outsourcing of diagnostic medicine**

Consumer-driven, global healthcare has opened the market for outsourcing medical care. Cost reduction and limited resources are two huge reasons for outsourcing medical care (29). A shortage of radiologists and an exploding demand for radiological examinations force many healthcare organizations to find offshore outsourcing tasks even in diagnostic medicine. In short, radiology is increasingly being outsourced due to technological advancements, shortage of expertise, increasing demand, economic constraints and transitioning radiology from an analog world to a digital one (30). Teleradiology is the electronic transmission of diagnostic images to various remote places, for the purposes of image interpretation or consultation (31) and it is a customary way of outsourcing diagnostic imaging.

Some studies have demonstrated the negative effects that outsourcing has on radiology interpretation, which often leads to additional reviewing of the outsourced examinations by the local radiologists (32). But outsourcing can also bring advantages for healthcare systems, communities, institutions, departments, individual healthcare practitioners and patients. The benefit of outsourcing diagnostic imaging may be its availability to an expanded network of radiologists and other professionals, by providing easy access to diagnostic images and interpretation (23).

## **1.3 THE UNIVERSITY HOSPITAL’S ORGANIZATION AND OUTSOURCING RADIOLOGICAL EXAMINATION**

When resources in a Hospital cannot be balanced with demand, this can lead to an increase in patient waiting times. This is also true when there is an imbalance between radiological resources and the demands placed upon them, despite internal measures taken to make the radiology department more effective. Such measures may include use of the equipment outside office hours and more efficient prioritizing or outsourcing of

radiological examinations. In this environment, and in an effort to maintain acceptable availability for patients and workload for radiology department staff, some hospitals outsource a percentage of their requested radiological examinations to external private units. The policy of the Karolinska University Hospital in Solna during the study period was that referring clinicians could only send radiological referrals internally within the hospital. Outsourcing implies that the radiology department rather than the referring physician makes the final decision as to where the examination can be performed. The Radiology Department at the Karolinska University Hospital in Solna outsources between 10 and 20% of its referrals to external hospitals or radiology departments, usually private radiology units.

Outsourcing from our hospital to private units causes additional administrative work. It affects the management of diagnostic images and reports. Figure 1 shows the different phases that a referral in paper format passed through before the digitization of the Radiology Department and Figure 2 shows these phases for a digital referral seven years after digitization. An essential aspect of efficiency for an organization is its ability to change (33). Usually an organization with a larger sociological network has greater difficulties in convincing and directing all staff to accept or adopt changes (34). The University Hospital is a large organization with many activities. The inability to accept change within an organization is most evident when technology changes human professional roles and work practices (33, 35).

However, a previous study has shown that the efficiency of radiology departments can improve when existing devices are used more than simply during office hours (36). In practice, opportunities for doing this are limited because of staff shortages and an inability to recruit staff given the financial restrictions of a zero-based budgeting (ZBB) system, which is the University Hospital's current budgeting system.

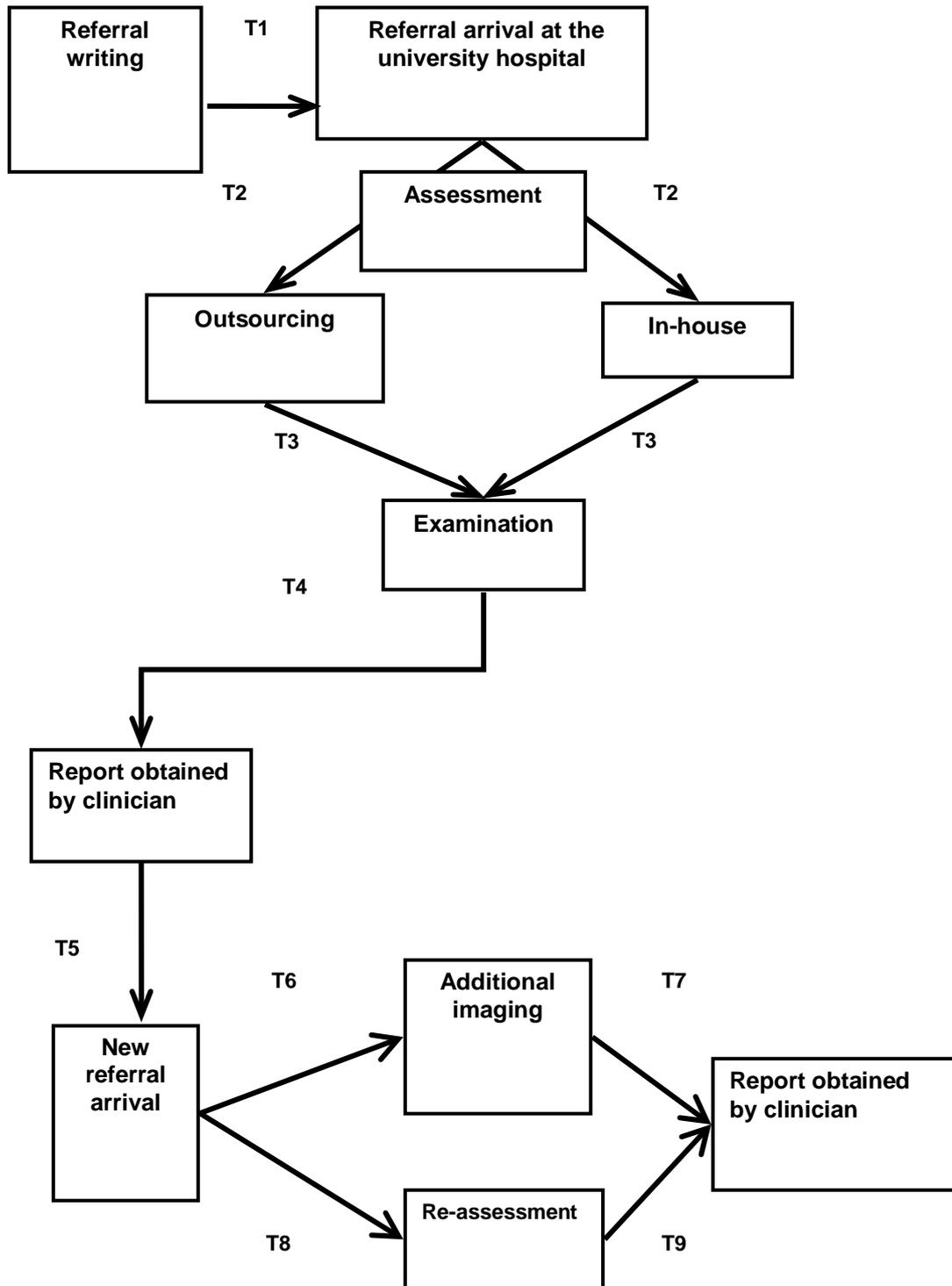


Figure 1. The different stages a radiological examination referral in a paper format passes through, from writing the referral to obtaining the report. In most cases, the process is straightforward, moving from the stage when the referral is written (T1) to the stage when the report is signed by the radiologist (T4). However, in some cases, additional imaging is needed, or the examination must be re-assessed. In these cases, the referral must continue through the extra stages of writing a new referral through to obtaining the additional report (T5–T9). This means that it takes a longer time for the clinician to obtain the report.

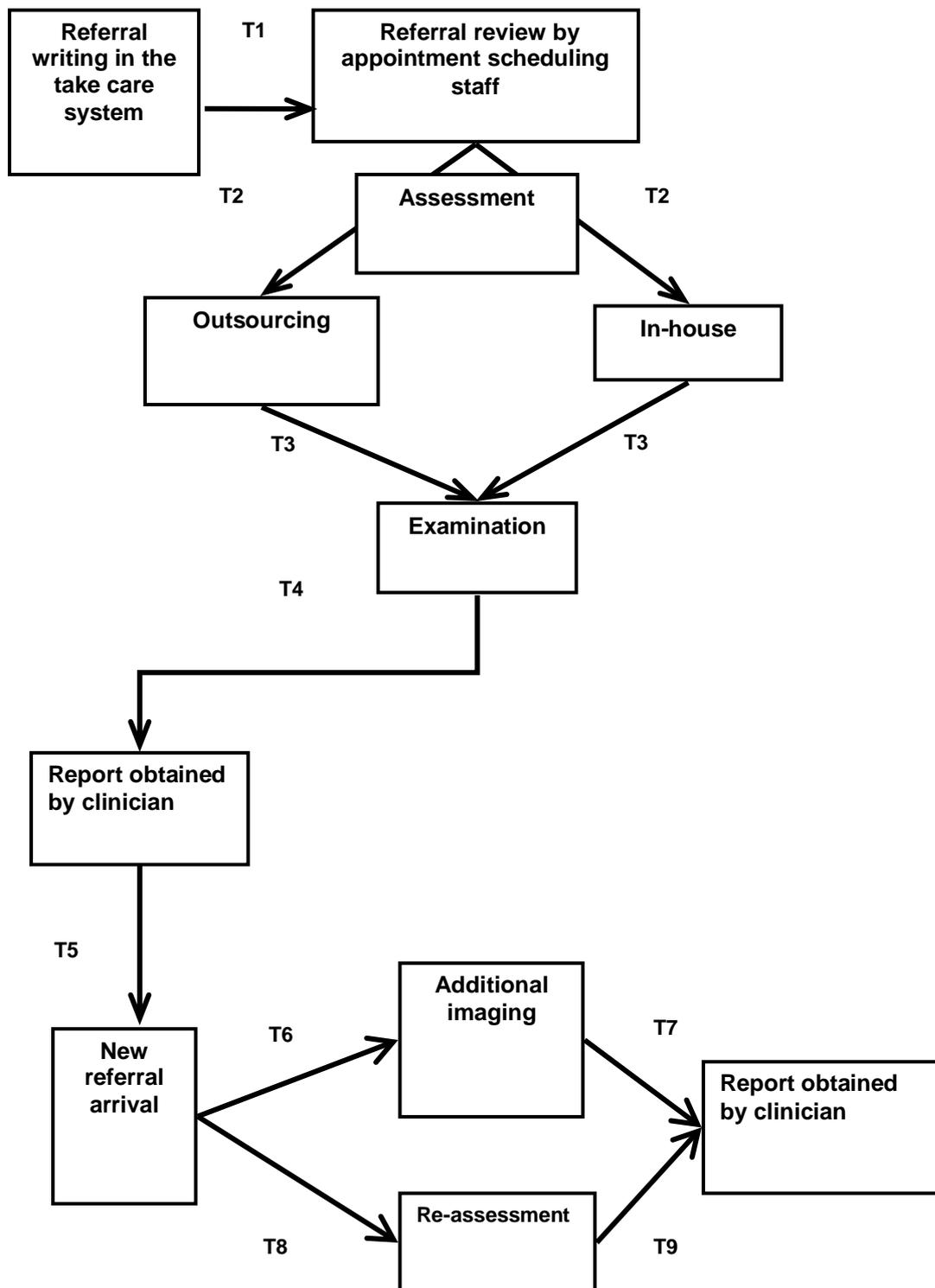


Figure 2. The different stages a digital radiological examination referral passes through, from writing the referral to obtaining the report. In most cases, the process is straightforward, moving from the stage when the referral is written (T1) to the stage when the report is signed by the radiologist (T4). However, in some cases, additional imaging is needed, or the examination must be re-assessed. In these cases, the referral must continue through the extra stages of writing a new referral through to obtaining the additional report (T5–T9). This means that it takes a longer time for the clinician to obtain the report.

### **1.3.1 Zero-based budgeting**

Zero-based budgeting, which is defined as a management tool, was developed in 1969 and promptly found favor in industry, government and hospitals (37). ZBB provides a systematic basis for resource allocation by forcing activities to be ranked according to priority. ZBB is an operating, planning and budgeting process that requires each manager to justify the entire budget request in detail on the basis of purpose and cost-benefit analysis (38). The analysis should cover the profitability of the activity, alternative options for action, performance measurement and the consequences of not performing the activity. This is unlike traditional budgeting in which past expenditures are assumed to continue (39, 40). The advantages of ZBB are that it is a useful tool in terms of efficiency because managers may have detailed information that will highlight redundant activities or increase efforts within an organization. ZBB facilitates the allocation of resources by focusing attention on the actual resources that are required in order to achieve productivity regardless of the percentage increase or decrease compared to the previous year (41). It also prevents unnecessary bureaucracy and affords a balanced partnership between the finance professionals and the budget holders in the analytical and decision-making processes. The disadvantage of the ZBB method is that managers have limited incentives for making the system more efficient, and this is particularly true for large organizations with various activities and priorities (39). Outsourcing radiological examinations from the University Hospital to private units also affects the patient who has to attend a different clinic or hospital for the radiological examination.

### **1.3.2 Patient impression of healthcare quality**

The patient's impression of healthcare quality is important and valuable in understanding perceived quality in health care services. Patients' perceived quality of care is measured annually by the National Patient Survey in Sweden. The results are used to improve healthcare quality by providing a foundation for improvement plans, where the patient's perspective is a major focus (42). Patients should be evaluators of care: they are the primary source of information on the care-provider's performance and their contributions in defining the factors of quality are appreciated (43). It is most important that patients become part of the solution to improve the quality of care (44). One definite way to develop quality of care is to focus on the patient's views on the care they receive and their expectations of it (45, 46). A positive relationship between a patient's satisfaction and their response to medical treatment was reported as early as the 1950s (47). Patient satisfaction involves physical, mental, emotional, cultural and social factors which make it a subjective and complex concept (48). Patient satisfaction is a useful indicator for measuring the quality of healthcare services, and thus many questionnaires have been developed over recent years (49, 50). Patient satisfaction tools that assess patients' perceptions should include patients' expectations, because expectations are the ideas that patients have about the quality of care they should receive. Expectations are what patients measure their observations against and for that reason different patients in the same situations and surroundings could experience

different levels of satisfaction (51). Studies concerning patient satisfaction related to radiological examinations are rare. Although a considerable number of patients undergo MR examinations on a daily basis, the patient's experience of MR examinations is mainly unexplored. Therefore it is important to study this experience with the aim of improving quality of care based on the patients' needs.

## **2 AIM OF THE THESIS**

The overall aim of this thesis was to examine the consequences of radiology department outsourcing of MR referrals to external private radiology units.

Specific aims:

The aim of Study I was to investigate differences in management/turnaround time, patient waiting time, quality and costs between MR examinations performed in a University Hospital and examinations outsourced to private units.

The aim of Study II was to explore the experiences of referring physicians and patients when referrals for MR examinations from a University Hospital are outsourced. The aim was also to explore aspects of care that influence a patient's satisfaction.

## **3 MATERIAL AND METHODS**

### **3.1 MATERIALS**

#### **3.1.1 Study I**

A sample of outsourced MR examinations representative of the years 2005 and 2006 was selected based on the following criteria: all consecutive MR examinations of adult patients requested by the Department of Oncology at our hospital in the first quarters of 2005 and 2006, and delegated by our department to private units (Group B = outsourced). Excluded from the study were referrals marked as “emergency” and all neurological examinations. The groups consisted of 37 examinations for 2005 and 60 examinations for 2006. As a control group, an equal number of MR examinations that were not delegated to external private units, i.e. performed and interpreted within our radiology department, matched for type of examination was selected (Group A = in-house).

#### **3.1.2 Study II**

One group of referring physicians (Group  $\beta$ ,  $n = 10$ ) from Orthopedic and Oncology departments at our hospital representing clinics with large volumes of MR referrals. One group of patients (Group  $\alpha$ ,  $n = 160$ ) referred for MR examinations, either to the University hospital or to external private units.

### **3.2.1 Data collection methods**

#### **3.2.1.1 Study I**

With the help of the HIS and RIS software available at our hospital, we obtained the management/turnaround time of each examination by calculating the number of days between the date when the referral for the radiological examination was written and the date when the radiological report was completed.

All referrals were read and grouped (outsourced and in-house) into two categories: those where a preferred timeframe was specified and those where there was no such timeframe. When a timeframe was indicated in the referral, it was also separately noted if the preferred timeframe was exceeded or not, and by how many days. When no timeframe was indicated, the number of days the patient had to wait for the examination was calculated.

The percentage of examinations that had to be re-done and re-interpreted was used as a surrogate marker for examination quality. This information was obtained from the RIS. As a parameter reflecting the quality of the interpretations, the percentage of

examinations that the requesting department asked to have re-interpreted/demonstrated at the University hospital was chosen.

The cost of each examination was obtained and added to the cost of re-assessment (when applicable) for calculating the total costs. The cost of the examination per se varied between 2005 and 2006. Moreover, the cost of re-interpretation (demonstrations) varied from year to year and also according to the type of re-interpretation (demonstration) required (Table 1).

The administrative work for each referral sent from our University hospital for outsourcing was calculated on the basis of minutes of work dedicated to each referral by three different personnel categories at our institution:

1. Personnel in charge of picture archiving.
2. Personnel in charge of booking the examination.
3. Consultant radiologist needed to make decisions about outsourcing the requested examination.

By multiplying the average salary per minute of each personnel category with the number of minutes dedicated to each referral, we obtained an average cost for administrative work and expressed it in Euros (€).

**Table 1. Types of re-assessment in both groups A and B. Investigations in Group B required more extensive re-assessment. The re-assessment is separated into four different categories with increasing cost depending on the complexity of the re-assessment and the time needed.**

Type of re-assessment	Number of re-assessments Group A	Number of re-assessments Group B	Cost
Simple	5	1	56 €
Comprehensive	5	21	112 €
Review	1	-	116 €
Time-consuming	2	5	448 €
<b>Total cost</b>	<b>1852 €</b>	<b>4648 €</b>	

### **3.2.1.2 Study II**

One hundred and sixty patients (Group A, n = 160) referred for MR examinations, either to the University Hospital or to private external units, were interviewed over a four-month period. The patient interviews took place in three radiology departments immediately after the patients had completed their MR examination. This study was conducted at the two private units that received most outsourced referrals and at our University Hospital. For practical reasons, the interviews were scheduled on three days per week over a two-week period in each radiology department: Monday, Tuesday and Wednesday during the first week and Wednesday, Thursday and Friday during the second week. Sixty patients at each private unit and 40 patients at the University Hospital were interviewed. The average duration of each interview was 20 minutes.

The interview had a structured design which consisted of open-ended questions and alternative questions (52). The questions were divided into a number of domains (53) which refer to several aspects of care, e.g. the caring attitude of the staff, waiting time, availability and the patient's freedom of choice regarding radiology clinic. Each question regarding these health care experiences and related to the MR examination was followed by a question that asked how these particular details are important for the patient (54).

Separately, ten referring physicians (Group B, n=10) from orthopedic (n=5) and oncology (n=5) departments representing clinics with large volumes of MR referrals were interviewed using a snowball sampling technique (55). Interviews with the referring physicians had an unstructured design and consisted of open-ended questions and follow-up questions to obtain answers potentially covering broader perspectives (56). The average duration of each interview was 25 minutes.

## **3.2.2 Data analysis**

### **3.2.2.1 Study I**

Data concerning the management/turnaround time were expressed as median together with 95% confidence intervals and were analyzed by the Mann-Whitney U statistic. Differences were considered significant for  $P < 0.05$ .

Statistical analysis of data concerning the patients' waiting times was expressed as mean together with 95% confidence intervals. Those data were analyzed by unpaired t-test and differences were considered significant for  $P < 0.05$ .

Numbers of examinations that needed to be re-done or completed, as well as the number of examinations that needed to be re-interpreted, were expressed as absolute value / n and percentage values. Differences were tested with the Fischer test and considered significant for  $P < 0.05$ . Examination costs were expressed in Euros.

### 3.2.2.2 Study II

The content of the comments (data from open-ended questions) was analyzed using the qualitative content analysis method (57). A conventional content analysis offers a quantification of textual material for statistical analysis, while a qualitative content analysis approach provides a deeper analysis of the numerical data as well as descriptive information by highlighting significant meanings and gathering them into a set of categories and themes (58, 59). In order to pick up relevant information, sentences in the interviews that were clear and created context were transcribed (60). All transcripts were read several times with the purpose of reaching a deeper understanding of the patient's and referring physician's answers. Words or phrases (meaning units) which were regarded as significant were highlighted.

Subsequently, in a number of meetings between the researchers, the 'meaning units' were condensed into short codes and then grouped into different subcategories. Subcategories of a similar context were gathered into broader categories and these categories were grouped into a theme (Fig. 3). The categories and themes resulting from the analysis of the patient interview texts are shown in Table 2 and those for referring physicians in Table 3.

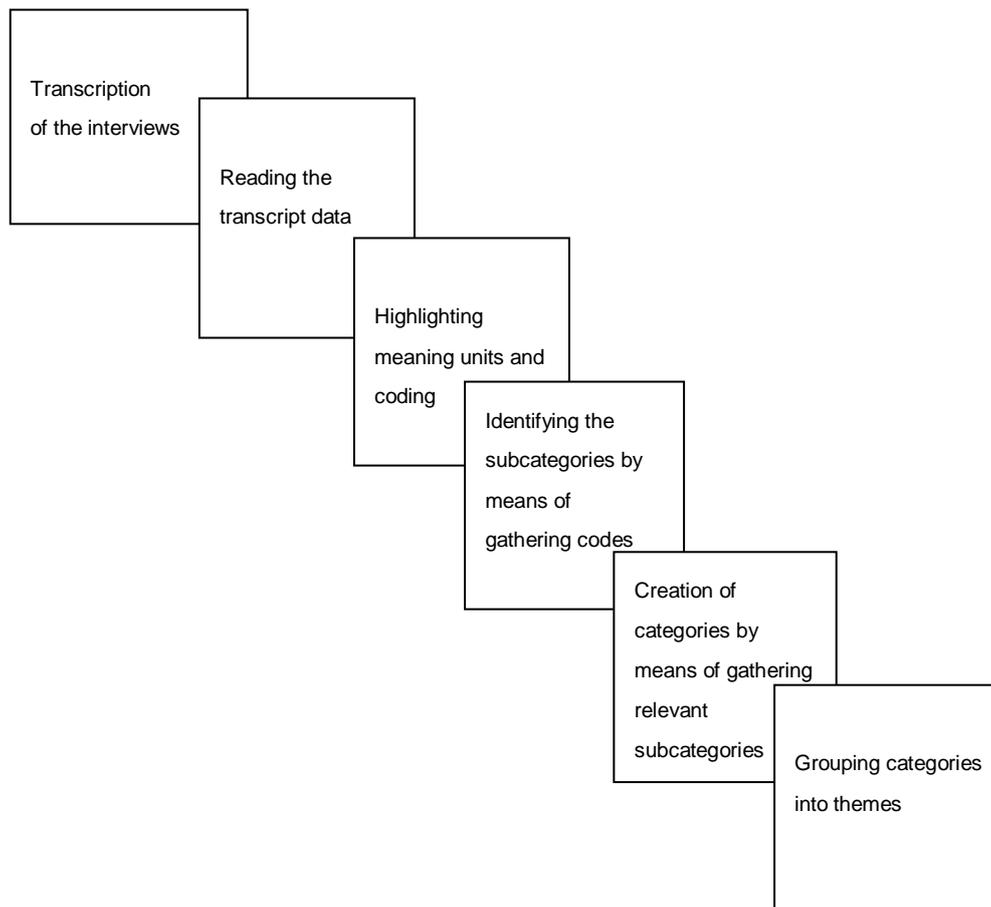


Figure 3. The different phases of interview analysis.

**Table 2. Categories and theme that emerged from the patient interviews**

Categories	Theme
Patients' autonomy	
Waiting time	Patients' perceptions of care and outsourcing related to MR examination
Quality of care	

**Table 3. Categories and theme that emerged from the referring physician interviews**

Categories	Theme
The practical impact	
Referring physician's consideration with regard to outsourcing	Physicians' perceptions of outsourcing - a variety of views on the consequences
Radiological services	
The emotional impact	
Strategy to avoid outsourcing	

### **3.3.1 Ethical considerations**

The project was assessed by the local Ethics Committee (Dnr 2006/1128 -31/4) and was regarded as quality assurance work.

#### ***3.3.3.1 Human participants***

According to ethical principles (61) in Sweden, every researcher has a responsibility to protect the participants in an investigation and to consider four ethical principles. These are: the need for the information, informed consent, confidentiality and usefulness. Participation was voluntary and all informants were free to make an independent decision. Each interview began with information about informed consent according to the 17th paragraph of the Ethics Act regarding consent for research (SFS 2003:460). Each patient gave consent verbally before the interview. All participants were verbally informed about the overall purpose of the research and its main features. All participants were ensured confidentiality about their identity as a participant. Tapes and documents which were subject to confidentiality were kept away from outsiders and the statements used as citations do not disclose the informants' identities (61).

Finally all participants were informed that the data gained through the interviews would only be used in this study for the purpose of providing knowledge through understanding their experience. Data were collected by one of the researchers (PTO).

## 4 RESULTS

### 4.1 STUDY I

In group A and B, 37 examinations were identified for 2005 and 60 examinations for 2006 respectively. Due to missing files in the archive system, a precise calculation of the management/ turnaround time and patient waiting times was not possible in 4 cases.

#### 4.1.1 The time between writing and obtain the report

The median management/ turnaround time for in-house examinations (Group A) was 66 days (range 60 – 75) while for outsourced examinations (Group B) it was 33 days (range 29 – 39). The time elapsed before obtaining the report was significantly shorter in Group B than in Group A (Table 4).

**Table 4. Management times (in days) for in-house (A) and outsourced (B) examination**

GROUPS	MEDIAN	95% CONFIDENCE INTERVAL	RANGE	SIGNIFICANCE*
A (n=93)	66	60-75	0-187	P < 0.0001
B (n=93)	33	29-39	0-92	

\* Mann-Whitney U-statistic = 1634.5. The two-tailed P value is < 0.0001

#### 4.1.2 Patient waiting time

The referring physician specified a preferred timeframe for the examination in 59/93 (63%) of the referrals in Group A and 65/93 (69%) in Group B. This timeframe was not met in 37 of the cases in Group A and in 34 of the cases in Group B. In these cases the waiting time exceeded the requested time, on average, by 18 (range 1–77) days in Group A and by 22 (range 1–73) days in Group B ( $P = 0.4$ ). Thus, we observed a difference in the management of examinations with preferred timeframe, but this difference was not statistically significant (Table 5). The referring physician did not specify a preferred timeframe for the examination in 34/93 (36%) cases in Group A or for 28/93 (30%) cases in Group B. The waiting time in these cases amounted to 55 (range 2–106) days for Group A and 36 (range 15–81) days for Group B ( $P < 0.001$ ). Thus, we observed a significantly shorter waiting time for outsourced examinations, when no preferred timeframe was indicated on the referral, compared to the in-house group (Table 6).

**Table 5. Waiting times (in days) for in-house (A) and outsourced (B) examinations with a specified timeframe**

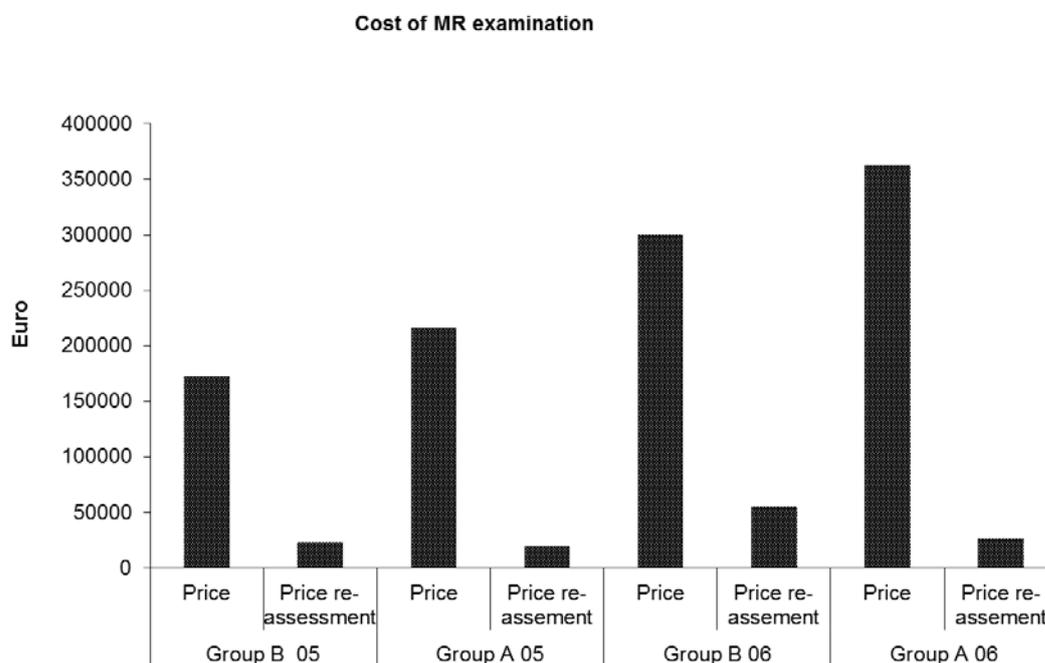
Groups	Mean	Standard deviation	Range	P value
A (N = 37)	18.2	20	1-77	04
B (N = 34)	22.1	21	1-73	

**Table 6. Waiting times (days) for in-house (A) and outsourced (B) examinations without a specified preferred timeframe**

Groups	Mean	Standard deviation	Range	P value
A (N = 34)	55	23.3	12-106	<0.001
B (N = 28)	36	14.3	15-81	

### 4.1.3 Costs of the examinations

The total cost of Group A examinations was €7, 979.90, plus €1,852 Euros for re-interpretation, for a total of €9, 831.90, giving an average cost of €16.80 per examination. The total cost of Group B examinations was €4, 900, plus €4,648 for re-assessments for a total of €9,548, giving an average cost of €10.80 per examination. Examinations in Group B were significantly less costly than examinations in Group A, even when taking into account the increased incidence of re-assessments (Fig.4).



**Fig. 4 Total costs in Euros for the MR examinations plus costs for re-assessment in Group A (in-house) were, on average, higher than those in Group B (outsourced) during 2005 (05) and 2006 (06)**

#### 4.1.4 Costs of the administrative work

The average time dedicated to each request was set to 2 minutes for picture archiving (average monthly cost €2,628); 24 minutes for scheduling (average monthly cost €3,014) and 5 minutes for the consultant radiologist (average monthly cost €8,299). An average administrative cost of €13 for each request was obtained (Table 7). The calculated administrative cost for registration and scheduling a subsequent re-assessment request was €5 per request.

**Table 7. Cost of administrative work for each request. All costs are expressed in Euros.**

	Staff, archiving office	Staff, appointment and scheduling office	Consultant radiologist
Average monthly cost	2628	3014	8299
Average cost per minute	0.3	0.3	0.9
Average time dedicated to each request (minutes)	2	24	5
Average cost for each category	0.5	8	4.5
Total cost	13		

#### **4.1.5 Quality of the examinations**

No examination in either group needed to be redone or needed additional imaging. Thus no differences in the quality of the examinations could be found between Group A and Group B.

#### **4.1.6 Quality of the interpretations**

In Group A, a re-assessment request was issued by the referring department in 13 out of 97 examinations (14%): 11 pelvic, one head and neck and one abdominal examination.

In Group B, such requests involved 27 out of 97 examinations (28%): 17 pelvic, one head and neck, three musculoskeletal and six abdominal examinations ( $P > 0.032$ ).

## **4.2 STUDY II**

### **4.2.1 Referring physicians' perceptions of outsourcing radiological services**

#### ***4.2.1.1 The practical impact***

The experience of all the referring physicians interviewed was that it often takes a longer time to manage outsourced examinations and also that many of the outsourced examinations cause additional work because they need to be re-assessed by the radiologists in the University Hospital. Their opinions were that examination results were frequently not comprehensive, especially with regard to comparison with previous examinations. Moreover, all the physicians thought that their department had to pay twice for an outsourced radiological examination because re-assessment was needed. Five out of ten clinicians had encountered insufficient documentation in the patients' files when MR examinations were outsourced.

#### ***4.2.1.2 Referring physicians' considerations with regard to outsourcing***

All referring physicians would consider outsourcing if the patient requested it or if the location of the outsourced units was geographically more convenient for the patient. Three physicians would not consider outsourcing if the external units did not share a common patient file system with the hospital. Four of the physicians would consider outsourcing if the external units provided the same quality as in-house examinations.

#### ***4.2.1.3 Radiological services***

When referring physicians were asked, "What are your expectations of a radiology department in addition to providing high quality interpretation?" six of them answered that multi-disciplinary conferences provide a mutual, knowledge-enriching forum for improving expertise. Seven of the referring physicians responded that consulting radiologists play a crucial role in enhancing their understanding of the radiological interpretations and images. Five referring physicians answered that they would like unlimited access to the radiological images. All physicians interviewed were very satisfied with the multi-disciplinary conferences that the University Hospital provided.

#### ***4.2.1.4 The emotional impact***

All the referring physicians had more faith in radiologists' expertise at the University Hospital and they were upset to observe that it was the lack of resources that forced the radiology department to outsource some of their referrals to private units.

#### ***4.2.1.5 Strategy to avoid outsourcing***

Five out of ten referring physicians indicated that they sometimes purposely requested that MR examinations be performed on shorter notice than clinically indicated, hoping that the examination would be performed at the University Hospital.

### 4.3. PATIENT GROUPS

Of the 160 patients who participated in this study, 67 were men and 93 were women, all between 18 and 82 years old (median 53 years). The most common MR examinations these patients had undergone were those of the knee or spine, which together constituted 58% of the examinations (Fig. 5).

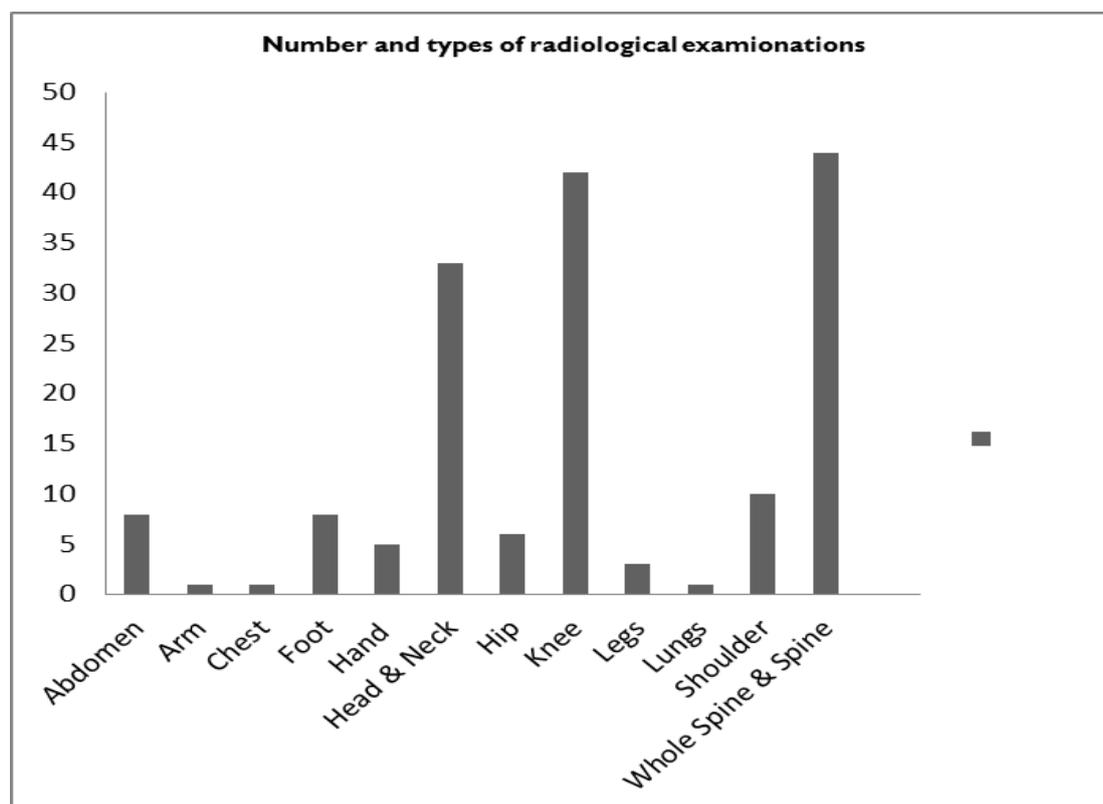
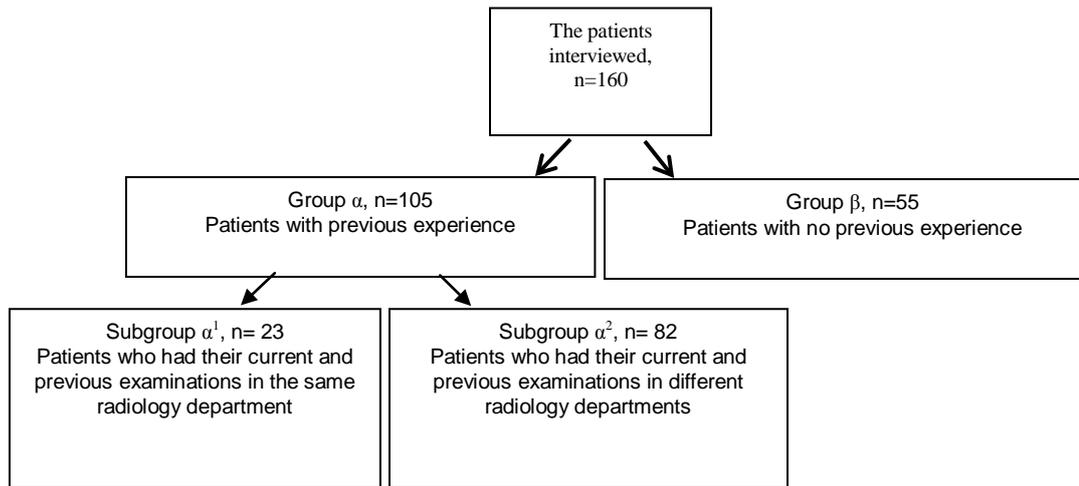


Figure 5. MR examinations: number of examinations of different anatomic regions

Two different groups of patients were separated in the analysis: those who had previously had an MR examination (Group  $\alpha$ ,  $n=105$ , 65%) and those who had not (Group  $\beta$ ,  $n=55$ , 34%).

Group  $\alpha$  consisted of two smaller subgroups, namely patients who had their current and previous MR examinations in one radiology department (Subgroup  $\alpha^1$ ,  $n=23$ , 14%) and patients who had their previous and current MR examinations in different radiology departments (Subgroup  $\alpha^2$ ,  $n=82$ , 51%). See Figure 6. Twenty four of the patients (24/160, 15%) had had MR examinations in both the University Hospital and private radiology units.



**Figure 6. Number of patients interviewed, stratified according to previous experience and radiology department**

### **4.3.1 Patients' perceptions of care and outsourcing related to MR-examination**

#### ***4.3.1.1 Patients' autonomy***

When patients were asked whether they could choose or influence where their MR examination would be performed, 27% of the patients answered Yes, 69% answered No and 4% replied Partly. When patients were asked how important this freedom of choice was, 23% replied that it was of major importance, 30% great importance, 24% little importance, 11% no importance and 11% had no opinion on the issue.

Aspects that influence the patient's choice of radiology department were: short waiting time 79% (127/160), ease of travelling to the radiology department 68% (110 /160) and short distance to their home or work 58% (93/160). For 40% (60/160) of the patients, a short time in the waiting room was related to a positive response regarding returning for a further MR examination. Eighty-nine of the patients in this study (56%) believed that it was their physician who decided where their MR examination should be performed.

#### ***4.3.1.2 Waiting time***

Twenty-nine percent of the patients had waited less than one week between their referral and the MR examination; 60% between one to four weeks; 6% between one to two months; 2% had waited three months or more and 3% did not know. When patients were asked what an acceptable waiting time for an MR examination would be, 23% answered less than one week, 65% one to four weeks, 9% one to two months and 3% did not have an opinion.

### **4.3.2 Patient experience of care related to the MR examinations**

Ninety-two percent of the patients were very satisfied with the service and attitude of the staff during their MR examination and 8% were satisfied. Fifty-nine percent of the patients answered that the attitude of the staff was of major importance, 40% that it was of great importance and 1% of no importance.

When asked whether patients felt well taken care of by the staff, 91% responded that they strongly agreed and 9% agreed to a large extent. Fifty-three percent found this point of major importance, 44% of great importance, 2% of no importance and 1% could not take a position.

When asked about their MR experience, 64% of the patients answered that it was very good, 32% good, 3% bad and 1% had no opinion.

When asked whether the staff could have done anything to improve the MR examination, 87% responded No and 13% responded Yes. Those who responded positively commented that they would have liked to have better information about the examination (48%) and more instructions during the procedure (52%).

## **5 DISCUSSION**

### **5.2 MANAGEMENT TIME**

Our retrospective study demonstrates that outsourced MR examinations from a University Hospital to private radiological units were associated with shorter overall management/turnaround time compared to matched examinations that were conducted in-house. On the other hand, according to the ten referring physicians interviewed, it was felt that it takes a longer time to manage outsourced examinations.

Informant: “We lose so much time sending images [examinations] out [to the private units] and consequently reviewing them again.”

There are some theories about the perception of time and a common statement is that temporal and non-temporal variables may have an impact on the perception (62). Perception of time (duration) can be influenced by non-temporal characteristics of an activity. Whether being either passive or active may affect the subjective judgment of duration, active time perceives shorter than passive (63). Radiology departments could improve the perceived quality regarding management time by establishing routines towards involvement (active variable) of the referring clinics regarding outsourcing diagnostic imaging (64, 65).

### **5.3 PATIENT WAITING TIME**

This study showed that MR examinations outsourced from the University Hospital to private radiological units were performed within the requested timeframes just as often as those performed in-house. Sixty percent of the patients waited between one to four weeks from the date of their referrals until the MR examinations were performed and 65% of the patients regarded that as acceptable. This indicates that the radiology departments at the University Hospital and the private radiology units together are meeting the patients' expectations fairly well.

### **5.4 COSTS OF THE EXAMINATIONS**

The results of the quantitative phase of the study showed that outsourcing MR examinations did not increase costs but in fact led to a calculated total decrease in costs. On the other hand, the referring physicians (the qualitative phase) were of the opinion that outsourced MR examinations were accompanied by higher overall costs. Health care providers, who observe negative outcomes from outsourcing and consequent difficulties for their institutions, often use the tools of legislation and reimbursement as protection (66). The only protection against the outsourcing of medical services in our digitally globalized world is to offer the maximum quality of care at the minimum cost (67, 68).

The results of our studies must be put in the context of the Swedish healthcare system and the perspective of the Zero-Based Budgeting system in the University Hospital. Within this system, hospital departments have a defined budget where each procedure performed is regarded as a cost. If these budget estimates are exceeded, the customers/patients become a burden on, rather than an asset to, the radiology department. University hospitals are also usually large organizations with a range of administrative, research and educational activities and costs in such a setting are difficult to calculate and compensate

since the different activities are performed together. On the other hand, private radiological units could be driven by productivity and the number of patients examined. Such organizations are more flexible and might accustom themselves more easily to changes in the need for radiological procedures.

The complexity of outsourcing requires thorough economic evaluations rather than a superficial cost analysis (69). However, our studies did not investigate ways of making the outsourcing of radiological examinations cheaper. In fact, the present system for outsourcing radiological services from the University Hospital was developed without any defined criteria and also without any formalized cooperation between the public and private units. It is possible that the benefits of outsourcing could be improved if such cooperation could be organized within the health care system, especially if communication between private units, the referring physicians and the radiology departments could then be improved.

## **5.5 QUALITY OF THE INTERPRETATIONS**

We observed a statistically significant difference concerning the need for additional interpretation between in-house and outsourced MR examinations. All the referring physicians interviewed also experienced lower quality regarding the reports on outsourced examinations. The reason might be that the referring physicians felt more comfortable with the radiologists at the University Hospital because they work more closely with them than with those in the external units. Examinations in the outsourced group required more extensive re-assessment. The higher frequency of re-assessment in this group can be explained by the fact that most of the in-house examinations were demonstrated for the clinicians at the regular weekly conferences held between them and the radiologists. One disadvantage of the use of communication networks systems between the referring physicians and the radiologist might be the increased risk of loss of important patient information, and the reduced opportunities for maintaining a professional bond between both groups (70).

The quality of outsourced reports is a challenge not only for the referring physicians at the University Hospital, who assume that outsourced radiological examinations often need additional imaging, but also for referring radiologists and those radiologists who produce the reports on outsourced examinations. For these radiologists, the amount of available clinical information is sometimes limited, as is access to patient file systems available at the University Hospital.

Outsourced examinations that are re-assessed at multi-disciplinary conferences may also represent a challenge for in-house radiologists. Outsourced radiological examinations are not necessarily performed to the standards that the hospital uses.

Our study showed that the experience of outsourcing radiological examinations differs between referring physicians and the patients. The referring physicians' opinions on outsourcing relate to their previous experience of what constitutes quality in a radiological report. Patients' experiences of outsourcing relate to integration of services. Referring

radiologists want to maintain acceptable patient waiting times and their experiences regarding outsourcing radiological referrals deserve to be studied. Although outsourcing diagnostic imaging at our hospital can be justified by reducing patient waiting time, it may also have a positive impact on the quality of patient care. This is especially true if it focuses on improved access to specialized care that would otherwise be inaccessible, and if it also allows patients to get services from the best provider (71). Outsourcing that is focused on quality may also have other advantages, particularly for patients, and even internal providers may welcome outsourcing that reduces their high workload (72).

With respect to examination quality, we chose the number of examinations re-assessed, re-imaged or repeated as surrogate markers. We did not review the examinations to look for specific details in imaging quality. It was not possible to fully remove information on the MR images that revealed where they were performed. The results might have been different if we had been able to review details in imaging quality. This study also did not take into account the impact on diagnostic accuracy of outsourcing radiological services. While the effects on the patients' health by outsourcing radiological examinations may not be relevant in the short term, they could be of major importance in the long term. Without a doubt, the diagnostic accuracy of outsourced radiological examinations and its impact on patients' health should also be studied.

## **5.6 RADIOLOGICAL SERVICES**

According to seven of the referring physicians, consulting radiologists play a crucial role in enhancing their understanding of radiological interpretations and images and the fact is that we observed a larger number of requested re-assessments in the group of outsourced examinations. This might reflect an inferior interpretation quality of the outsourced examinations but it also indicates a need for direct communication between radiologists and referring clinicians at the University Hospital and the departments that take care of outsourced examinations. Direct communication with radiologists at a radiology conference is a service which the private units do not provide yet and a public healthcare-based, organized system for networking in radiology does not yet exist widely. Outsourcing of medical care provokes changes in many healthcare organizations, indicating the need to rebuild a new functional structure for medical services (73).

...the outsourcing of health care will grow; it will challenge traditional arrangements between patients and both physicians and institutions; it will require rapid and thoughtful development of new ethical, legal, and quality standards; and it will be controversial (74, p. 665).

The University Hospital Radiology Department's communications plans should include communicating organizational objectives and priorities with diverse, internal and external private units. This would provide internal customer service through identifying referring clinicians' needs/expectations and would allow for a shared, radiologist-clinician decision-making process regarding outsourcing MR examinations (75).

Radiology departments that support multidisciplinary teamwork with referring clinicians and facilitate communication between radiologist and referring clinicians can improve patient outcome. Proper communication between health care professionals is a basic prerequisite for the delivery of quality patient care (76).

## **5.7 CONSEQUENCE OF OUTSOURCING**

One limitation with the outsourced examinations is the communication of the results to the clinicians. One way to prevent this problem could be outsourcing the examination but not its interpretation. Other negative consequence of outsourcing is that it may lead to a rarer variety of the radiological examinations having a negative impact on both radiologists and radiographers' professional education. Outsourcing could also limit in-house investment in both apparatus and personnel recruitment in the long term. Reduced investment might reduce future revenues and indicate either a decreased ability to create value or the loss of effectiveness. Investment that might involve capital costs today could well lead to future value creation (77).

Outsourcing is one of the major issues in health care today. Two of the issues related to public health care outsourcing are concerned firstly with the quality and correctness of the services and secondly with cost effectiveness (31, 35). Outsourcing MR examinations from the University Hospital's Radiology Department involves the issue of timely diagnosis and treatment for patients. The desired results from outsourcing are to reduce both patient waiting times and workload pressure on in-house staffs. However, the reality seems to be that outsourcing radiological services is accompanied with administrative work that makes the system less efficient. The referring physicians prefer that the MR examinations be performed at the University Hospital and not outsourced.

Informant: "We want all the examinations to be performed here [at the University Hospital]."

All ten physicians were aware that lack of resources forces the Radiology Department to outsource its services and argue that the negative results of outsourcing could have been obviated by directing more resources into the University Hospital.

The results also showed that patients in general had an overall positive experience when being sent to private radiology units. It is important to consider whether the benefits of outsourcing can exceed the negative consequences (78). The balance between the consideration of quality patient care and being driven by cost-effectiveness is a major challenge for healthcare.

## **5.8 PATIENTS' AUTONOMY AND THEIR EXPERIENCE OF CARE**

Our study showed that 69% of the patients were of the opinion that they could neither choose nor influence where they would have their MR examination. The Swedish healthcare system is designed to make patients more involved in making decisions about their own health. According to health professionals, one important dimension of autonomy refers to making decisions and choices freely (79). Fifty-six percent of the

patients (89/160) believed that it was their referring physician who decided where the MR examination should be performed, whereas in reality this was a decision made by the Radiology Department. It is natural that the patients, being unaware of the hospital's policy, generally want the physician to take on the role of decision-maker (80). The physician is the closest link between the patient and the Radiology Department. Patients often believe that the physician interprets their radiology examinations because patients and their diagnostic radiologist never meet. *“Legally, the radiologist is accountable to the patient, but in most cases, the patient has had no say in the selection of the radiologist”* (81, page 334). Either the in-house or external radiologist is supposed to provide the diagnosis. Although radiologists play a crucial role in patients' healthcare, the radiologists and radiology services are invisible to them. The outsourced radiologists are even less connected with the patients and the referring physicians (82).

It appeared from the study results that patients would have liked to have better information about the examination and more instructions during the procedure. Often patients scheduled for an MR examination receive a written invitation that encloses some information about the MR procedure. The advantage of written information is that patients can read the information as many times as they need (83, 84). The advantage of oral information is that it provides an opportunity for communication between the patient and staff that can remove possible misunderstandings (85). Previous studies have shown that communication is a very important aspect of quality patient care (86, 87, 88, 89).

## **5.9 COMMENTS**

### **5.9.1. Study I**

The study has some limitations. Firstly, a sample of examinations from a two-year period and from one oncology referring department was selected. Secondly we believed that the oncological clinic is representative of a department requiring many complicated radiological examinations. Even though this view was later confirmed when we used the snowball technique in the choice of referring clinic, the results may have been different if other referring clinic had been selected. It must also be taken into account that the decision to outsource the examination by the radiologist may introduce a bias within the selected examinations. The outsourced referrals may have been those with a preferred, specified, shorter timeframe than those at the hospital. Another limitation of this study is its focus on the time periods of the first quarters of 2005 and 2006. At that time, the PACS system had only recently been implemented in the hospital. It is likely that the PACS system was not yet used as optimally as in private units with longer experience with PACS. Our study did not investigate these differences, but it hampered our ability to obtain the correct data for our calculations concerning the total cost.

### **5.9.2 Study II**

The limitations of this study are that the referring physician's interview had an unstructured design and consisted of open-ended questions, while the patient's interview was designed more like a verbal questionnaire. This consisted of alternative and open-ended questions and follow-up questions also were permitted (90). These interviews may result in a biased sample by attracting respondents who could or were willing to participate for a specific reason. Another limitation is that this study assessed the outsourcing experience and it is possible that personal views influenced that experience. How different people perceive outsourcing depends on their subjective interpretation of the phenomenon. Finally, the analysis may represent an insider perspective (91), because all the authors work in the Radiology Department of the University Hospital. Even if the results of our studies are not generalizable, we believe that this study could be of interest to other public hospitals which choose outsourcing as one solution for making their department more efficient.

## **6 CONCLUSION**

Outsourcing magnetic resonance examinations is one potential solution for reducing patient waiting times. Outsourced examinations need more frequent re-assessment. The discrepancy between patients and referring physicians indicates that there is insufficient communication between referring physicians and the radiological departments. When considering outsourcing, the needs of the patients, of the referring physicians, as well as those of the radiological departments must all be considered, to optimize patient care. For better planning of radiological services, radiology departments must consider the customers' needs. Issues that could benefit from further study include ways in which to reduce the additional costs incurred for re-interpretation; improving the efficiency of the outsourcing process, and defining the cost drivers of outsourced MR examinations. The management structure in radiology departments should also be studied, to promote better understanding.

## **7 MAIN RESULTS**

In summary, the results of the study showed that outsourcing MR examinations from a public University Hospital to private radiology units was associated with shorter overall patient waiting times compared to in-house examinations. Outsourced examinations were more frequently re-assessed at the University Hospital, indicating a lower quality of the interpretation of the outsourced examinations and/or a need for conference communication regarding the report. However, with everything taken into account, outsourcing the examinations led to an overall decrease in costs. The referring physicians interviewed had negative opinions about outsourcing. The patients interviewed in this study had a generally positive experience of being sent to private radiology units. The key factors of quality care that have positive impacts on patients who undergo MR examinations are: adequate information concerning the MR examination, more instructions during the procedure, the staff's attitude and their level of expertise.

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