Master assignment Gelre Hospital Apeldoorn, Orthopaedics department

Improving insight into the costs of a total hip prosthetic treatment

Examining large costs of a total hip prosthetic treatment
by the orthopaedic department of Gelre hospitals Apeldoorn - A cost identification analysis

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Figure on frontpage: *Figure 1. Synergy & Reflexion hip cup and acetabulum*

Preface

Before you lies the product of several months of hard labour, curiosity and meetings. An end product of the study Health Sciences at the school of management and governance, University of Twente.

I would like to thank Guus van Montfort for the constructive meetings from which I always left with new ideas and energy to continue, Nicole Poldervaart for the calming meetings and reassuring me when I felt slightly overwhelmed, Fredo Schotanus for finding this assignment in the first place and lending a hand on the way, Eric Raven, the orthopaedic surgeon providing me with new insights in health care, and furthermore the colleagues of the department of purchasing & logistics, the in-house orthopaedic department (with all the nurses I was allowed to shadow), the operating room department, the pharmacy department, Maxima Medical Centre orthopaedic department, and any other departments or people I might have forgotten.

And also thank you to family & friends, and boyfriend; with a special reference to my parents for guidance, support and conversations throughout all my years of study.

H.R. van der Wijk, 2013

Management summary

Background: In a changing health care market in the Netherlands, the wish for insight in costs of treatments rises. The orthopaedic department of the Gelre hospital has expressed the wish to increase their insight into costs of a total hip replacement (THR) by determining a baseline for costs, to improve their negotiating position with the hospital and indirectly the health care insurers.
Aim of this thesis was to increase insight into costs of a total hip prosthetic treatment and provide recommendations. The main research question was: *How can insight into the costs of a total hip prosthetic treatment by the orthopaedic department of Gelre hospital Apeldoorn be increased? And what lessons can be learned from this increased insight about cost improvement?*
Methodology: Based on the literature review, we chose to look at the following large cost components: The cost of the hip prosthetic chosen by the orthopaedic department, the costs of the operating room department, and the costs of the nursing department, including medication costs. To investigate these aspects, we performed a retrospective analysis of costs for total hip prosthetic patients in 2011, a time study of the nurses in the orthopaedic nursing department, and a study of material use in the operating room. More information was gathered from several information systems in the hospitals, as well as from expert interviews. A benchmark was performed to analyze differences in efficiency levels (medical, technical and input efficiency) when performing a total hip replacement in Maxima Medical Centre, Gelre hospitals Apeldoorn, and Gelre hospitals Zutphen, compared to general benchmark data.
Results:
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Discussion: Limitations of this study were among others the time setting and the availability of data (information systems not or limited accessible). Different populations are researched for different aspects, which makes comparison more difficult.
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Conclusion:
The orthopaedic department, the Operation Room department, and the nursing department were large cost components, due to the hip prosthetic, the direct care at the nursing department and the treatment at the OR department. The benchmark shows room for improvement, on all efficiency levels.
Recommendations:
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Managementsamenvatting

Achtergrond: In een veranderende gezondheidszorg markt in Nederland, groeit de vraag naar inzicht in behandelkosten. De orthopedieafdeling van Gelre ziekenhuizen Apeldoorn wil haar inzicht in de kosten van een totale-heup-prothese-behandeling vergroten met een nulmeting en hierdoor een beter onderhandelingspositie te krijgen tegenover het ziekenhuis en zorgverzekeraars.
Doel van dit onderzoek is het inzicht te vergroten in de kosten van een Totale Heup Prothese (THP). De onderzoeksvraag van deze thesis is *Hoe kan inzicht worden vergroot in de kosten van een totale heup prothese behandeling uitgevoerd door de orthopedie afdeling van Gelre ziekenhuizen Apeldoorn? En welke lessen kunnen uit dit verbeterde inzicht gehaald worden?*.
Methode: Gebaseerd op de gevonden literatuur, hebben we enkele grote kostenposten onderzocht: De heup prothese zelf, de operatie kamer en tijd van verblijf voor de patiënt, inclusief medicatie. Om deze aspecten te onderzoeken, hebben we een retrospectieve analyse voor Totale-Heup-Prothese-patiënten uit 2011 van kosten uitgevoerd en algemene gegevens uit het elektronisch patiënten dossier verzameld. Daarnaast hebben we een tijdmetingstudie van verplegend personeel op orthopedie verpleegafdeling gedaan en een prospectieve studie van materiaalgebruik op de operatiekamer. Een benchmark met het Maxima Medisch Centrum (MMC) en Gelre Ziekenhuizen Zutphen ondersteunt de efficiëntieanalyse van een THP behandeling.
Resultaten en conclusie:
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Discussie: Beperkingen van deze studie waren onder andere de tijdsspanne en de beschikbaarheid van gegevens (informatiesystemen waren niet of beperkt toegankelijk). Voor verschillende aspecten zijn verschillende populaties onderzocht wat vergelijkingen complexer maakte.
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Conclusie
De orthopaedische afdeling, de OK afdeling en de verpleegafdeling creeëren de grootste kosten posten met onder andere de heupprothese, de directe zorg aan het bed en de handelingen en het instrumentarium op de OK afdeling. De benchmark laat ruimte voor verbetering op deze punten zien, voor alle efficiëntie levels.
Aanbevelingen:
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Chapter 1. Introduction

In July 2012, the Achmea health care insurance company gave Gelre hospitals, among 36 other Dutch hospitals, the title of "quality hospital". The insurance company performed a benchmark for all 106 hospitals in the Netherlands on the aspects of medical quality, accessibility, and patient-centeredness for four medical complaints, namely hip replacement, knee replacement, stroke, and colorectal cancer. This benchmark was performed to inform insurance clients which hospitals to chose for better care (author unknown, 2012). Earlier, in 2009, Achmea also rated Gelre hospitals as performing very well and even offered pay back of the compulsory excess of own payments to their clients if they would choose Gelre hospitals for their treatment (Zweers, 2009).

The dynamics between hospital and health care insurer in a market with increasing demand, have encouraged the orthopaedic department of Gelre hospital Apeldoorn to focus even more on cost reduction and quality performance to stay on top and to keep improving its medical care.
To gain more insight into the processes of a THR treatment, we have developed the following research question focussing on the cost part of the ambitions of the orthopaedic department:

How can insight into the costs of a total hip prosthetic treatment by the orthopaedic department of Gelre hospital Apeldoorn be increased?

Quite some research has already been performed concerning cost-benefit analyses and general calculations of cost prices for total hip prosthetic treatments. Birrell (1999), among others, estimates a large increase in the need for hip replacement over the next thirty years in the UK due to demographic changes. This change is also visible in other European countries (Kurtz, 2005).
However, a model showing exact costs for a complete treatment within a hospital and how these costs are calculated and what adjustments can be made for/ by the orthopaedic department of Gelre hospitals Apeldoorn, is still missing. The orthopaedic department has expressed their need for a baseline measurement of a THR treatment in order to increase insight into price and production negotiations with the hospital and/ or health care insurers.

Within the process of a THR treatment, we focussed on the largest cost-expenditures, such as the OR procedure, the hip prosthetic itself, and nursing days.

In the following chapters, we elaborate on the research questions (Chapter 2) and describe the background of this thesis (Chapter 3). General framework outlines of the research (Chapter 4) and a research design are presented (Chapter 5). The results, including indirect costs and a small benchmark, are presented in Chapter 6. We finish with a discussion about this research (Chapter 7) and with a conclusion answering the research questions, with recommendations for the orthopaedic department and the organisation, and future research suggestions (Chapter 8).

Chapter 2. Research questions

The research question has been outlined in the introduction. But further explanation is needed.
To gain insight into the process and increase knowledge on this topic, the following question is stated:

How can insight into the costs of a total hip prosthetic treatment by the orthopaedic department of Gelre hospital Apeldoorn be increased?

To answer this research question, several subquestions need to be answered first. The following subquestions have been distilled:

1. What does a total hip replacement consist of? (Activities, means and people in Gelre hospital Apeldoorn)
2. What are the main expenses of a total hip replacement in the Gelre hospital?
3. What cost reduction possibilities can be identified?

Chapter 3 answers the first subquestion, and after the research design for cost identification, subquestion 2 is answered in Chapter 6.

In this study only primary Total Hip Replacements (THR) are researched, excluding revisions of hip replacements. Revisions are sometimes three times as costly as a regular THR, due to longer Operating Room (OR) time, a more expensive prosthetic, longer in-house stay and a much higher antibiotic use. Revisions result in higher risk of infections, dislocations and fractures. The revisions therefore cost much more than an original hip replacement (Treacey, 1992) and will give an askew representation of the basic costs of a regular THR.

Exclusion/ inclusion
For the cost calculation all patients treated in 2011 in Gelre Apeldoorn for a THR are selected (regardless of what age, comorbidity level, type of prosthetic used, and gender), excluding revisions, and are used as research population for this research.

Chapter 3. Research setting

For the scope of this thesis a description of both the general setting, the hospital, the orthopaedics department as well as a description of the hip and treatment possibilities, is given below.

General setting

In the last few decades health care expenses in the Netherlands and other Western countries, have risen excessively. In Appendix 2, a more extended explanation of the Dutch health care system is given. For now it is relevant to state that a change in demographics, with more elderly citizens in Europe, and an increase in technological complexity of procedures and instruments have resulted in increasing costs in health care. To restrain these costs, the Dutch government encourages health care institutions and insurance companies to negotiate prices of many treatments.

Description hospital

Gelre hospitals have come into existence after merging two hospitals (Lukas and Juliana) in Apeldoorn and later on merging with the "Spittaal" hospital in Zutphen.
Gelre Apeldoorn and Gelre Zutphen share a board of directors and several supportive services. Both locations have their own managing director and medical staff. (Gelre Hospitals website, 2012)
Together the locations Apeldoorn and Zutphen have 925 beds, 182.245 first policlinic visits in 2011, 190 medical specialists and 2437 fte for employees. Moreover, there are several clinics in surrounding villages, to give care to patients. The mission statement of the Gelre hospitals expresses their desire to help people by providing care to cure or alleviate symptoms and strive for improvement and innovation (Gelre hospitals website, 2012).
In Appendix 3 more information is available on the Gelre hospitals Zutphen and Apeldoorn together.

Orthopaedic department Gelre Apeldoorn

Some departments of the hospital fully cooperate or are centralised in one location. The orthopaedic departments of Apeldoorn and Zutphen operate separately. So far few collaborations have been formed between the two, but this is on the uprise, with a possible further extension to Deventer hospital for greater purchasing and medical benefits. The focus of this research is on orthopaedics Apeldoorn, but we note that in the future the organizational structure of this department might change.

The orthopaedic department of Gelre Apeldoorn is at the moment still a 'regular' department of the hospital where possible profit goes back into the organisation. All staff is paid by the hospital, except for the orthopaedic specialists, who are paid by the health care insurers or separately by the hospital via the construction of a 'maatschap'.

In response to the aforementioned rising cost-awareness in health care institutions, departments within hospitals transform to result responsible units (resultaatverantwoordelijke eenheden [RVE]). The orthopaedics department within the Gelre Hospital in Apeldoorn also wishes to switch to this kind of organisation. This department is not yet a "RVE" but wishes to develop in that direction and aims to steer more on cost control. Therefore insight in costs and turnover is needed; to achieve the desired quality indicators.
In its striving to be a RVE, the orthopaedic department does not stand alone, other departments in the Gelre hospital already are, or are trying to become a RVE. Therefore this research can possibly be used by other departments to gain insight into their own costs. When cash flows within the hospital are more transparent, departments can steer more on costs and when departments create a financial surplus, a part could be used for investments within the department. This also applies to the orthopaedic department of Gelre hospitals Apeldoorn.

RVE stands for "Resultaat verantwoordelijke eenheid" or result responsible unit. These units are constructed in response to increasing performance-focussed financing in health care. Departments within hospitals need to show how they perform, and what achievements are accomplished in order to be able to negotiate with hospital boards and health care insurers. Often beforehand budgets and the

number of activities are set in negotiations and the RVE needs to reach these targets. Standaardt (2010) warns that the creation of RVEs should not increase the number of rules and protocols but be used as a tool to increase " capacity for responsibility concerning quality, arrangements and costs of care." When RVEs are used solely as an accountability system, the relationships between different stakeholders can become strained and effectiveness in processes will be reduced.

The hip

"The hip joint is the largest and most stable joint in the human body" (Van Nugteren, Dos, 2007). It exists of a femur and acetabulum of the pelvis. The femur is the bone in the upper leg, ending in the femoral head, a round shape that fits in a bowl shaped part of the large pelvic bone called acetabulum. Due to the rounded head of the femur and the cup-like acetabulum, the hip joint can move in several ways. It is an important joint for both balance and movement of the human body.

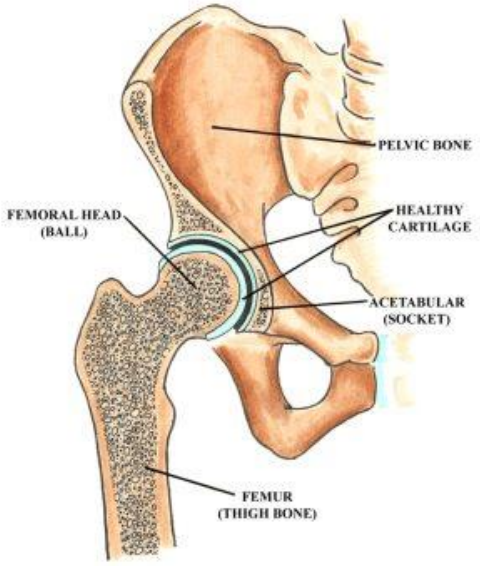

Figure 2. Hip joint

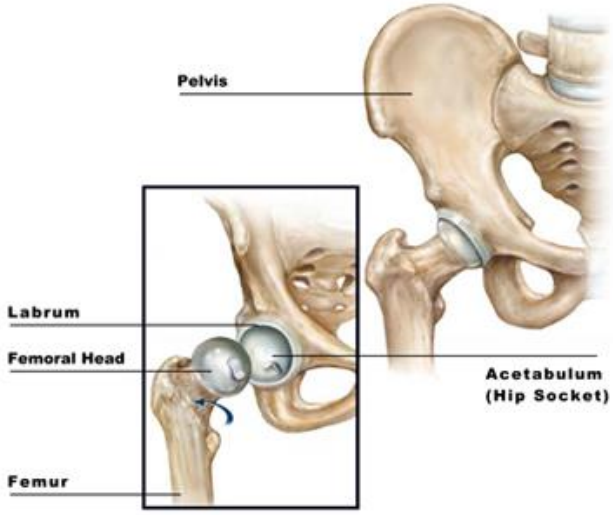

Figure 3. Hip joint with 3D look.

Arthritis

Arthritis is a disorder of the joints with inflammation. Several forms of arthritis exist, with rheumatoid arthritis as the most commonly known, attacking flexible or smaller joints. Osteo arthritis mainly occurs in the large joints and shows degeneration in the cartilage that ordinarily take care of flexible joint movements. When the cartilage wears out, pain complaints or stiffness occur. It is an irreversible process and age has a correlation with osteo arthritis but is not a cause as such (Bosomworth, 2009). In the Netherlands the number of people with hip arthritis was 238,000 (or 29.1 per 1000) in 2007, with an incidence of 27,000 (or 3.3 per 1000) (Nationaal kompas Volksgezondheid, 2012)

Hip prosthetic

A total hip prosthetic can be necessary in several cases. Elderly often have more fragile bones and when falling, have a higher risk of hip fracture. A total hip prosthetic in this case can be performed by the trauma surgery or orthopaedic department. When the original hip joint is worn out by age and usage and a patient has pain complaints, a general practitioner or specialist can offer the option of a total hip replacement.

"Around 1960 the totalhipprosthetic became (more) known as a solution to a painful, bad functioning hip joint" (Okhuijsen, 1998).

Between the years 1995 and 2005 the number of total hip prosthetics in the Netherlands has risen significantly. THRs based on arthritis went from 13,785 in 1995 to 20,715 in 2005 (Otten, 2010).

Keet (1987) has performed a cost-benefit analysis of the hip prosthetic treatment including costs of aftercare and physical therapy and Keet concluded that a total hip prosthetic offered a cost reduction of fl 14.000,- (€ 6353,-) per year for the first 5 years compared to the alternative of a conservative treatment with physical therapy and home care.

Alternatives

If a patient does not chose for hip replacement, or is not eligible for a new hip, several alternatives are possible. First one can start with conservative treatments such as physical therapy, pain medication, weight loss, medical aids or rest. If these options do not bring the desired results or have only postponed the need for an operation, the procedure of a total hip prosthetic can be chosen. For surgical treatment several options are available, such as osteotomy, where the bone is set with a wedge (made out of own bone). But this is an old-fashioned type of operation which is increasingly less performed due to better results with the THR.

Flowchart care path

In Appendix 4 a schedule is inserted about the health care path of a patient for total hip replacement in the orthopaedic department of Gelre hospitals Apeldoorn. The patient is referred by either a general practitioner or another specialist to the orthopaedic department. The patient will either already have an x-ray photo or need to have one made in the hospital. Based on these diagnostics, the orthopaedic surgeon determines a course of treatment. The patient return for another appointment, at the VSO (Verpleegkundig Spreekuur Orthopedie; Nursing Consultation hour Orthopaedics) for determining the post operative treatment, and a pre-op consult with an anaesthetist for operation approval. A day prior to the operation or on the day of the operation, the patient arrives at the orthopaedic nursing ward for an intake and stays there until the operation. Following the operation, the patient first stays in recovery until transfer to the orthopaedic nursing ward is approved. After a few days of aftercare, medication, and physical therapy, the patient is discharged to either go home or to a rehabilitation centre or a care hotel. Two weeks following discharge, the patient returns to the VSO for a check-up and after 12 weeks, 1 year and 5 years check-ups with the orthopaedic surgeon take place.
The aftercare options after discharge from the hospital are going to a care facility with rehabilitation, or going home with or without homecare. When choosing for a rehabilitation facility,

In other hospitals, the health care path is in general the same within the hospital parameters, partly because of protocols and guidelines given by the Dutch Orthopaedic Association for care of arthritis patients. This guideline can be found in Appendix 13 (in Dutch).
Some variations within these guidelines are possible, such as the choices for certain medication but also the number of staff needed for certain activities and the shaping of the care path THR patients take within the hospital. For operations it is also possible to invite an project team of expert operations assistants, that are specialised in THR operations. They are specialised in these operations and knee operations, and are attuned to another thus speeding up the process of the operation, which leads to less OR time needed.

Chapter 4. Literature review

In this chapter, a literature review is presented to show the main findings of literature research and we present a model to analyse our research results. The literature review helps us with identifying what large cost centres can be discerned, and where gaps are distinguished in research.

Review method

We searched in pubmed, Google scholar, and several medical journals for articles with combinations of the following terms and all Dutch translations of these words:

- THR (Total hip replacement)
- Total hip prosthetic
- Arthroplasty (the surgical procedure of replacing a joint)
- Elective surgery
- Hip implant
- Joint replacement
- Hip joint
- Arthritis
- Osteoarthritis
- Cost analysis

In our search we had a preference for articles from the Netherlands, Europe, and North America, because of many demographic and treatment similarities between those countries/ regions .

The exclusion terms are:

- Fracture
- Knee
- Revision
- Luxation

These terms are excluded as fractures and revisions have a different care path and the focus of this research is on hip treatment, not knee treatment.

In the next sections, we shortly describe the main findings of our literature review.

General

O'Shea (2002) calculates a cost profile for a THR with the categories of manpower, material costs and additional costs. The hip implant is one specific type of category at a cost of approx 686.20 Irish pounds (cemented, charnley acetabular), which was 8.2% of their total THR hospital costs. The costs of the length of hospital stay was a large cost category, mainly due to the quite long stay of 16.4 days. O'Shea uses several scoring models to calculate the benefits of a THR. This gives some good pointers for important cost centres in this research; hip prosthetic, operating room costs, nursing days.

Operation

Several different approaches for part of the THR treatment can be looked into and several articles analyse different approaches in operating methods and look at follow-up periods. For instance, Woolson (2004) and Lawlor (2005) compare several incision options in operations. They found no differences in bleeding, trauma to the soft tissue, or other variations in follow-up in a retrospective cohort study.

Healy *et al*. (2000) researched in a case study the possibilities of reducing the cost of operation supplies by negotiating with suppliers. They show that large decreases in costs for a hip implant are possible, up to 32%.

Hip prosthetic
Wixson *et al*. (1995) compare several hip prosthetics (cemented, uncemented and hybrid) in a prospective study up to four years on pain score and this research does not show significant differences in follow-up pain scores between the different options.
To improve hospital expenditures, a case study from the Bahrain Medical Bulletin can be found which shows that cost reduction is possible, with regard to implants and other orthopaedic items, all with a good level of quality and price (Malki et al., 2003). In this research, the hip prosthetic is one of the large cost centres researched. Looking at prices of different types of prosthetics and differences between hospitals, the hip prosthetic seems an interesting and important aspect of the THR treatment.

Physical therapy
Physical therapy is also part of the in-house treatment of patients and also the further improvement of hip movement. Freburger (2000) stated that physical therapy contributes to faster recovery and discharge, resulting in less expenses. At the moment, several experiments within Dutch hospitals take place with intensive physical therapy and strengthening patients' abilities.
For comparison between hospitals in this research, it is important to keep track of the amount of physical therapy given during the patients' stay, because it can make a significant difference in recovery. Some hospitals choose to advise physical therapy before the surgery as well, but it has not (yet) been clinically proven to improve physical functioning or reduce pain complaints (Gocen, 2004).

Economic evaluation and cost reduction
For the overall economic evaluation in this thesis, Bozic et al. (2004) have performed an interesting review of several articles on economic evaluation of hip arthroplasty. They state that of 153 studies, 81 have actual economic data and far less adhere to established criteria for a complete analysis. They point out large cost centres such as the hip implant itself, the OR and stay at the nursing department. Little research has been performed with prospective actual cost data and the focus on indirect costs is also minimal.

The Tragpi model
The Tragpi company has made a clear model for the calculations of hospital treatments with direct and indirect costs. In this model the direct costs per department are shown. This is for the orthopaedic department one of the most relevant parts, as for the baseline calculation they wish to have a clear presentation of direct costs of the large cost centres, some of which are the responsibility of other departments. The figure with the basics is given on the next page.

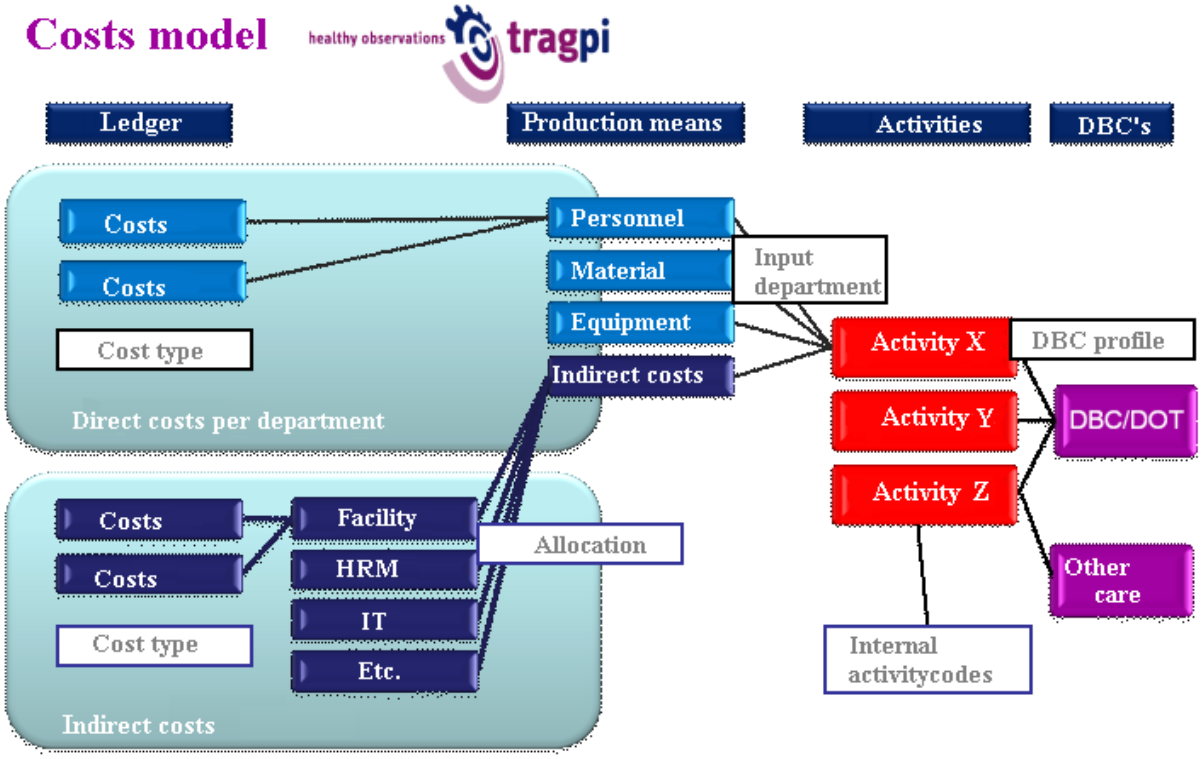

Figure 4. Cost model for calculating hospital treatments (Tragpi, 2012)

In this thesis, a model will be made to calculate an average cost pattern for a certain orthopaedic treatment. The model below, created by van Montfort, will help to compare found results and offer a framework for improvement suggestions.

Table 1. Different types of efficiency in health care (Van Montfort, 2012)

Funding level	Efficiency	Incentives	Explanation
Citizens/ society	Health benefit (outcome)	Prevention incentives	Adherence funding
Individual patient	Medical efficiency	Incentives for alternative treatment and medical activity	Integral rates per DBC/ care product
Medical activities	Technical efficiency	Incentive production structure, use production factors per action	Action funding, intermediary production
Inputs/ production factors	Input efficiency	Incentive for lowest input prices/ production factors	Input standards/ fire brigade model

The comparisons can be divided into three efficiency categories: medical efficiency, input efficiency, and technical efficiency.
Each efficiency reflects a different aspect of health care and costs. They also work at different funding levels within the organisation. These three efficiency forms also lead to different incentives for improvement.

Medical efficiency shows which and how many actions are taken to care for or cure the patient. The physician, as director of the treatment plan, can influence or make the choices. He/ she may choose a different medication, hip prosthetic or entire different treatment. By looking for different, perhaps cheaper or more efficient options, or an option with less follow-up risks, the physician can steer the costs. Especially with the DRG structure provided by the Dutch government (one price for an entire treatment) physicians are challenged to think of different options to reduces costs (Van Montfort, 2012).

Technical efficiency is calculated by looking at the staff and substitute options. When days of care or staff numbers can be reduced by working differently, the input is organised more efficiently and this leads to cost reduction. Sometimes substitute options are possible. For instance, a follow-up consult can be performed by the physician but a nurse practitioner could do the same, with a lower hour rate than the physician.

Input efficiency deals with changes in prices. For instance wages of personnel can change and prices of products can change. For prices of implants, the orthopaedic department could look at other suppliers as some products can be very similar, although the brands differ.
Technical efficiency is concerned with the input, what is provided, not what the output will be. In hospital care this is often relevant for departments such as the emergency department. Production can never be fully predicted and a minimum number of staff and means are needed for emergencies. This department can best be steered on input standards. Incentives to work more efficiently can be found in searching for the lowest input prices and/or production factors.

With our results, we fill in this model for the orthopaedic department of Gelre Apeldoorn. And as mentioned further along in Chapter 5, we will also be using a benchmark provided by the company Tragpi to compare Gelre Apeldoorn with Gelre Zutphen, and the MMC in Eindhoven/ Veldhoven. Comparing these three hospitals can give insight into the differences between hospital generally and these three hospitals specifically, since some steps in the care path can differ. Where aspects differ, it is interesting to see what causes these differences and whether the hospitals can learn from each other. Gelre hospital Apeldoorn has some improvement projects running, amongst others the aforementioned care hospital route. Elements like these can change the total cost price of a treatment and can lead to quality and cost improvements when applied correctly and in the right environment.

Chapter 5. Research design

To answer the research questions, a research design is necessary in order to identify researchable variables and to determine which parts are connected and researchable. From the literature review, we conclude that the departments with the largest cost expenditures are the orthopaedic department (paying for the hip prosthetic), the operating room complex, and the nursing department. In order to keep a clear overview, the research design description is divided into four parts, each discussing one of the four large cost centres. Each of the four cost centres will be described with a mentioning of the case sampling, explaining why certain variables are chosen, which data we collected, and how this is analyzed. We try to connect each aspect to the efficiency model, thus being able to draw conclusions and give recommendations to the orthopaedic department.

General remarks on data

Expert interviews with employees of orthopaedics, OR, pharmacy, physical therapy, and employees of the purchasing department increase insight into some non-quantifiable variables.

We have looked into the Electronic Patient Record (EPR) system. Data from this system can confirm other findings and give more detailed insight. Hip prosthetics used in 2011 and length of stay can be checked with the data from this system.

For some parts of this study we have chosen to use patient data from the year 2011, as we wish to work with the most recent, complete data. This will be noted per cost centre.

To be able to compare patients from different time periods or populations on the characteristics of age, gender and ASA (American Society of Anaesthesiologists) status.
The ASA status is a classification of patients, and is relevant for the needed type of care and especially the intensity of care for each individual patient. This ASA classification is estimated during the pre-operative consults with anaesthesiology or the nurse practitioner. A patient can receive from I to V score in ASA, depending on his/her previous condition. ASA I is for a reasonably healthy person, II for patients with a mild condition, with or without medication and not restricted in daily activities. III is when patients have serious conditions, need medication and are limited in their daily activities, also for instance when the BMI is above 30. ASA IV stands for patients with severe chronic conditions that form a threat to their life. And V defines a severely ill patient who will not survive 24 hours, with or without medical interference.
This manner of classification can not only effect the operation but also the care following the operation at the in-house department and the medication needed to treat the patient. This is a better indication of categories of patients than for instance age. It gives a better objective presentation of the health status of a patient.

Orthopaedic department; The hip prosthetic

To gather information about the hip prosthetic, we spoke with three experts within and outside Gelre hospitals and we also talked with the buyer for the orthopaedic department of Gelre hospitals.

Prices for the different hip prosthetics are given by the purchasing department. Prices of 2011 are preferred to keep a homogenous view on the information given by other departments.
Combining this information with data from the EPR on the frequency of use of the different hip prosthetics gives a weighted average for the costs of a hip prosthetic. In the Tragpi model this is part of the material costs for the orthopaedic department.
The costs of a specific prosthetic with negotiated discount prices is part of the input efficiency. When the purchasing department uses their negotiating power, together with purchasing departments of other hospitals in an alliance, they can try to reduce the costs of a hip prosthetic by asking for a higher discount. To increase their negotiating power a purchasing department can also look into similar prosthetics offered by other suppliers. Choosing a prosthetic supplier is a process performed by the orthopaedic department and the purchasing department together. The purchasing department can

oversee whether there are more ongoing contracts with the same supplier and try to negotiate a (bigger) discount.
As one can see, the input efficiency can be influenced here by the purchasing department, together with the orthopaedic department.

The operation room complex
Several aspects contribute to the total prices of the OR, namely: personnel, materials, and equipment, as stated in the Tragpi model. For a THR operation, the Gelre hospitals have protocols available. In these protocols, material lists state what instruments are needed. The electronic DKS protocol system of the hospital will help in gathering a part of this information, and combined with price information of the Purchasing department we can calculate the costs of materials used during a THR operation.

Personnel costs are determined by calculating the minimally needed staff in the OR during a THR operation for the orthopaedic department.

The materials are mostly disposables and the hip prosthetic itself, but the latter is accounted for separately, because it is not part of the expenses of the Operation Room Complex.
For this research, the OR has registered, during the entire month of September 2012, what extra materials have been used during an operation for a THR, beside the lists stated in Appendix 5 which are the lists for all the basic equipment for a THR operation.

Equipment is among others the trays provided by the Operation Room complex.
The instrument trays are prepared with a fixed number of specific instruments which are sterilised beforehand or supplied sterile. When the orthopaedic department decides to change the protocols for the trays, this can be considered as technical efficiency. The department for instance might discover that some instruments are never used or some instruments can be substituted.

The nursing department
The costs of the nursing department were analysed with a time study. We determined the amount of time spent by nursing staff on THR patients in the nursing days following the operation and compared this to other patients on the same ward. We did this to determined the direct personnel costs for a THR.

To research the nursing staff, we performed a time study. In this prospective study we followed one nurse at a time with a stopwatch to track all activities performed during a shift.
For the time study of the nursing staff in the orthopaedics nursing department, the selected nurses were ‘average’ health care workers. They represent the entire orthopaedics nursing staff, and do not excel in specific activities or emphasize certain activities. Some staff members might take extra time for patient care or hygiene or have just graduated and have not yet mastered the routine of caring as more experienced nurses have.

The selection of nurses was made in consultation with the head of the in-house orthopaedics department. She knows the nurses best and could estimate which employees best fit the description of a good representation of the nursing staff.
The nursing department of orthopaedics, where patients stay for several days following their operation, is A7. A7 is shared by orthopaedics and ENT (Ear, Nose, Throat) department. Thus the nursing staff takes care of both orthopaedic and ENT patients together. In Appendix 6 more information on the department is given. In the software system “Data warehouse” we found more specifics about salary and fte (full time equivalents) of a department and present these in the result section.

When following and timing the nursing staff, their activities are divided into several categories:
- Movement (from A to B)

- Administration
- Transfer (of information)
- Medicine management
- Consults
- Personal hygiene
- Patient flow
- Direct care
- Different

Within these categories subdivisions are made. The complete form can be found in Appendix 9. Some categories and activities are based on information given by department A7 about their daily routine. And part of this research design is also freely translated from the NHS project "Productive Ward" (author unknown, 2012).

Each minute on the 30th second of the minute, the observer checks what the nurse is doing at that exact moment. Timing every activity is namely too complex because some activities are interwoven and activities can't be measured exactly on the second. This way of observing each minute on the same second, results in a sample study where observations will result in averages of activities.

Important in this research is that the observer does not interfere in the activities of the nurse (research subject) and does not lead to distractions. The nurse needs to perform her task as naturally as possible. This also means that being aware of the observation could create a bias, as the nursing staff could be performing their tasks slower or quicker, depending on their concerns what will happen with the results and whether the results will reflect on their job review.

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Prior to the observation it was not communicated to the nursing staff that we make a comparison between THR patients and other patients. They were told that the research concerns the amount of time spent on several categories of activities. This was to prevent a risk of testing bias, that nursing staff would not spend more or less time on THR patients.

We process the results of the time study in excel to create a pie chart showing the average activities of the nursing staff.
With this time study we wished to determine the average time spent on several activities and the amount of direct care given to patients. Furthermore, we wanted to see whether there is a difference between THR patients and other orthopaedic patients in the amount of time/ care they receive. If intensity of care differs between patients, the nursing staff needs to distribute their time between patients, and care of certain patients will be more time consuming and expensive than for other patients.

Knowing the amount of time spent on care, specifically for THR patients, helps us calculate a costprice for the nursing department. Because of differences in nursing staff and differences between shifts, this is a complex process. But when succeeding, this can be put in the efficiency model to see where the orthopaedic nursing department stands. Since we don't have an exact number available for the MMC or Gelre Zutphen, we can not compare the costs, but we can look into care differences between THR patients and other patients. In a previous research performed for the nursing departments in Gelre hospitals about intensity of care for patients, we know that THR patients will need more care the first two days of their stay, after these days they are "regular" patients.

We did not only research the time needed per patient, but also looked at the total number of days and what happens during those days using the EPR system to check given data.

Medication
Medication is part of the materials used on the nursing department to treat patients. But these are prepared separately by the pharmacy department.

Patients from 2011 were selected, as mentioned earlier. We chose for a retrospective study of medication use because the pharmacy software system should be able to give a complete image of medication use. The pharmacy software system is "Ross health pharma". Since researching all 393 THR patients of 2011 is too time consuming, compared to the results it will produce, we selected 156 of the THR patients at random.

In the pharmacy system "Ross health" a sample size of THR patients of 2011 is looked at for a representative view on medication use of THR patients during their stay at the hospital. Registration of time of stay, all types of medication, dosage and number of times during the day taken with prices for a total cost profile. This results in a total price per patient. Their ASA status is added from the EPR system.
Analysis of drug use in the Gelre hospital for THR patients of 2011, the second half of the year. All drugs used in the time the DBC of THR was open, are registered in excel and with a net price list provided by the pharmacy, the average cost price of drug use for THR patients is calculated.

Costs of personnel of the pharmacy is not taken into consideration in this research because of the desire to focus mainly on direct and influenceable costs for the orthopaedic department.

Indirect costs
Within a hospital, many departments are needed to facilitate the care giving process but are not directly related to a specific care process. These result in indirect costs for the health care process. Through allocation methods these indirect costs are credit to direct care departments. The MIC department of Gelre hospitals is responsible for these allocations and are asked for specifics on this aspect.
Efficiency of these costs is difficult to determine, especially in this time-limited research. Of many non-direct-care-related process, the cost prices are difficult to establish and gains from these processes are even more difficult to determine. Therefore in this research, we will only identify the general indirect cost.

Benchmark with other hospitals
To compare the costs of different options of prosthetics and treatment plans we have chosen to perform a small benchmark with Gelre hospital Zutphen and Maxima Medical Centre (MMC) in Eindhoven & Veldhoven. The choice for these two hospitals is due to easy access to information and the small differences between the Zutphen and Apeldoorn locations, and their desire for more cooperation in the future. The MMC has a different financial structure and its care path differs from the care path in Gelre hospitals.

The benchmark between hospitals on the same treatment can give insight into different treatment protocols for the same disease with the same endresult in mind. Perhaps one hospital needs less consults or more physical therapy. And hip prosthetic choices can differ between hospitals as well, causing the total costs of treatment in either Gelre hospitals or MMC to be different. These differences in number of activities and total price can give insight into medical efficiency of the THR treatment.

Specialist costs

The specialist costs are also a relevant part of health care expenditure in the Netherlands with a lot of media attention over the past years.

To conclude, we researched several aspects of the process in different manners, important is to be able to compare the populations of the different research parts. Due to the registration of ASA status, we can compare patients' data more accurately.

We will fill in the results in the efficiency model to see what conclusions can be drawn and what recommendations can be given.

Chapter 6. Results

The first subquestion what a total hip replacement treatment contains, is partly shown in Appendices 4 and 5, and will generally be answered below, in addition to subquestion two, concerning the costs accompanying the large cost centres of a total hip prosthetic treatment.

The 2011 THR cost price profile provided by the MIC department gives an overall picture of costs made, including indirect costs within the hospital. This is relevant to show the overall ratios of the large cost expenditures.

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1. Results of the orthopaedic department; The hip prosthetic

The orthopaedic department in Apeldoorn has several hip prosthetics. As explained previously, the choice made for a certain prosthetic depends on the patient characteristics and the preferences of the specialist.
The hip prosthetics used are listed in the table below. An example of an hip prosthetic is shown in Appendix 8.

Table 2. Prices hip prosthetics orthopaedic department Apeldoorn, with in the second column gross prices and in the third column net prices with all discounts. (Purchasing department, 2012)

Type of hip	Gross prices	Net prices

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Location Apeldoorn has a large number of hip prosthetic choices, because of the wish of the orthopaedic department to offer their patients the best fit possible. All the prosthetics used, have a clinically proven 90% 10-year survival rate. This has been a condition of the orthopaedic surgeons in Apeldoorn for quite some time, and now health care insurance companies tend to set the same standard for other hospitals when operating their insured clients *(Source: Interview with Eric Raven, 2012).* The gross price is the price found in the catalogue of the supplier. Due to the fact that Gelre hospitals negotiate prices with suppliers and for quantities of a certain number of prosthetics per year, the supplier gives a discount. As Gelre hospitals choose to negotiate together with other hospitals, they increase their purchasing power and the discounts are applicable to all hospitals within the alliance.

The choice made for a specific prosthetic for a specific patient, is a process between patient and specialist. The specialist has a preference and the patient can indicate what he/ she wishes to be able to do. But patient characteristics are the main determinant since age, ASA status, and anatomy help

determine for instance the differences between normal and high offset stem of the prosthetic implant (depending on the distance between femur and acetabulum).

2. Results of the Operation Room Complex

The costs of the operation consist of:
- The personnel costs
- The required materials
- The equipment

a. Personnel costs of the OR
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b. Material costs of OR
In Appendix 5 the materials lists for one of the THR operations are given. These can differ, depending on the chosen hip prosthetic. The operations where cemented hip prosthetics are put in, need a cement system and ingredients for making the special cement. Some instruments used to put in the prosthetic differ from the instruments used to put in an uncemented prosthetic. The example given in the appendix concerns a cemented hip prosthetic.
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Sterilisation costs are included in the total OR price in not-time related costs.
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c. Equipment
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3. Results nursing department orthopaedics

a. Personnel costs
As explained in the research design we followed several nurses during their shifts to have an image of their daily activities and determine direct personnel costs.
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Table 3. Nursing staff department A7 specifics (Data warehouse system Gelre hospitals, 2012).

Function	Number of fte	Salary

In Appendix 6 a specific overview of all personnel employed at A7 with their specifics, is given. There are different kinds of nursing staff to provide regular care. Diners and drinks are served by an diet assistant, separate from the nursing staff.

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b. Material costs of the nursing department
Of all the selected patients, we determined the number of used pills, times the price and we calculated a total costprice per patient.
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Table 4. Medication costs.

Medicine	General application	Gross price	Net price	Prescription

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These actual costs are higher because of several reasons, such as longer stay, revision or luxation in the early days after operation, and because of other illnesses. These also add to the hospital bill, because they fall in the regular care period.
When a patient has airway problems or diabetes, the costs of medication increase strongly due to the high costs of insulin and inhalers. The hospital chooses to provide patients with new medication at the point of their hospitalization in view of hygiene protocols, in stead of using the patients' medication administered at home. The hospital is responsible for purchasing and payment for these medications, and chooses to follow this medicationprotocol to minimize possible contamination in the hospital of patients' medication brought from home.
Another reason of higher medication costs is a longer length of stay or a readmission within the DBC/ DOT time because of a hip joint dislocation after surgery, or infection.

When determining whether the medication is efficient, one could first of all look at the prices negotiated for the products. The negotiations of Gelre hospital take place in November each year, done by Gerrit de Weerd, head of the department. He does this not only on behalf of the pharmacy of Gelre hospitals, but also on behalf of regular local pharmacies. By forming this alliance, pharmacies try to increase their discounts with large pharmaceutical companies.
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Some medications have the same function, such as reducing thrombosis risk or as pain killer. The physician prescribes a medication of his/ her choosing, based on current knowledge, protocols, and patient characteristics. The hospital pharmacy department will always try to find a generic brand with a lower price but with the same results to control costs. In the total medication prices calculated for the nursing department, the pharmacy also incorporates their facility and personnel costs.

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Besides the personnel, also cleaning, linen, and, meals are incorporated in the price of the nursing days. Therefore we also look into the prices of these aspects, but have not performed research ourselves.

Meals and drinks are also part of the nursing day. This service is offered by the Hotel Service of the hospital. Dinners are created in the kitchen, breakfast and lunch are provided from the foodcarts at the request of patients. The diet assistant is responsible for breakfast and lunch, diners in Apeldoorn are distributed by the nurses.

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c. Equipment

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5. Results from the electronic patient record.

In the electronic patient record we found different kinds of information, such as the time needed in each operation from first cut to wrapping the leg in bandages.

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Furthermore according to the time path provided by the orthopaedic department, patients will have one appointment with the orthopaedic surgeon prior to their operation. The record shows one appointment with a summary of what was talked about, but in the system of appointment dates, more consults are shown.
In the follow-up, the consults with the orthopaedic surgeon and the nurse practitioner are recorded, this does not apply to the x-rays taken to check whether the prosthetic is still in place.

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Results regarding overhead costs/ indirect costs

Besides the direct costs, a hospital also has indirect costs. Many activities within the hospital are not direct primary care, but help facilitate care. This is not part of the initial research question, but is important for a complete image of cost places and drivers which contribute to the total price of a treatment.
There are different options of assigning indirect costs to cost centres such as the hip replacement. Some parts of the indirect costs are calculated on the basis of square metres on which the care takes place.

Maintenance and facility management is assigned based on square metres within the given cost profile.

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Specialist costs

The honorarium of orthopaedic specialist is not calculated in this research.
This is a separate agreement between hospitals, specialist and insurers, the prices are set nation wide by the NZA.
In 2015 this will probably change and negotiations will start on these parts of treatment.
For now, the prices are set and paid from a different budget than what the hospital and insurers negotiate. Therefore this part of expenses is not integrated in the model, but mentioned separately.
The orthopaedic specialists in the Gelre hospitals are united in a venture. This construction results in being able to have more influence on work time and reduction of waiting list.
From the pricelist given by the Gelre hospitals (for both Apeldoorn and Zutphen), the specialistprice is set at 575.29.

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Below a figure is given with all found results from interviews and research.

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Figure 5. Total overview found results

Benchmark with other hospitals

We compared the specific hip prosthetics and the Tragpi benchmark of Gelre Apeldoorn, Gelre Zutphen and Maxima Medical Centre to analyse possible efficiency differences between the hospitals.

The processes of Apeldoorn and Zutphen differ slightly. Zutphen has a joint care program in which a few patients receive a THR operation on the same day and rehabilitate together and support each other. They are received on Sunday and undergo the operation on Monday. Discharge is planned on Friday.

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The process in the MMC differs from the process in Gelre hospitals.
In the MMC, patients are selected separately into a fast track treatment group and a slow track treatment group, based on their ASA status and comorbidity problems. The fast track treatment group is placed on a special ward together with total knee replacement (TKR) patients with the same low ASA status.
They are operated on either Monday or Tuesday and will start rehabilitation the same day. The aim is to have the patients rehabilitated sufficiently to be ready on Friday to leave for home. When the last patients has left, the complete ward is closed until it is opened again on Monday for the next group of patients. During their stay, patients receive an intensive treatment with physical therapy, together with other patients in a joint care program. They have received information together beforehand and will also have a follow-up meeting together, also called group consult. In this manner, more patients can be seen for the follow-up meetings and patient satisfaction improves. Closing the ward over the weekend and creating a homogenous group of patients to streamline the treatment and increase results and quality of treatment according to Marc van Tuyn, the manager of the orthopaedic department of the MMC (Personal communication, 2nd of October 2012).

Below the different chosen hip prosthetics are listed for Zutphen and the MMC.

Table 6. Hip prosthetics of Gelre orthopaedics Zutphen (Source: Purchasing department, 2012)

Type of hip	Gross prices	Net prices

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Table 7. Hip prosthetics of Maxima Medical Centre (Source: expert interview J. van Mourik, 2012)

Type of hip	Gross prices	Net prices

The net prices of hip prosthetics of MMC are not available due to confidentially agreements between the MMC and its suppliers.

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Table 8. Tragpi benchmark comparison for the THR (source: MIC department & MMC, 2012).

	Apeldoorn	Zutphen	MMC	General benchmark
Total				
Hip				
OR personnel € total				
OR time				
OR occupied costs				
OR activities				
OR session				
OR specialist time				
Days				
€ per nursing day				
Physical therapy				
Pre Op Screening				
Consult nurse				
Consults policlinic				
Imaging ultrasound				
Laboratory				

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Below a table is given which compares the results of the benchmark with the results found in this research.

Table 9. Comparison of benchmark with found results

	Apeldoorn	Found results
Total		
Hip		
OR personnel € total		
OR time		
OR occupied costs		
OR activities		
OR session		
OR specialist time		
Days		
€ per nursing day		
Physical therapy		

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Chapter 7. Discussion

In this section we discuss the main findings in relation to the efficiency model. After that, we discuss the limitations per topic.

Findings

The Tragpi benchmark for the Total Hip Replacement shows some significant differences between the hospitals.

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Limitations

General comments

The time path used in this research has resulted in some measurements taking place during the summer, which not always gives a representative image of the reality of every day hospital care. During the summer less patients are helped, less treatments take place and also less hospital personnel is present.

Another limitation is the period on which research has been performed, because some information systems have changed over the period of research. For the pharmacy this led to an incomplete image of drug use in 2011.

Comparing populations on the basis of ASA status was not possible because ASA statistics were not available for the MMC and Gelre hospitals Zutphen.

Operation room

Measuring costs of the operation room proofed rather difficult. Some materials are disposables and some are used on a regular basis with sterilisation in between. The costs of OR personnel were determined together with a department head of the OR and the personnel department. Since personnel rotated shifts and specialties, the group of possible OR assistants for orthopaedics was quite large and calculating personnel costs took longer than expected.

The nursing department

The time study performed was limited due to the summer schedule starting, which meant a change in set up of the nursing department and its staff. For a more accurate resemblance a time study should be performed over a longer period of time. Now it is more a cross section of two weeks, while the differences between seasons can influence the outcomes of a time study like this.

Physical therapy

Physical therapy seems to be well structured with protocols for treatment of THR patients. Unfortunately not everything is registered in the electronic patient record, but is in SAP. But this system is less accessible for personnel to increase their own insight into production.

Medication

When researching the information system, we encountered several irregularities:

- Double entries of medication in the system; This can lead to an overestimation in the system of drug use.
- Use of medication in the weekends when patients will be discharged, are not entered in to the system at all. During the weekends, the registration of medication is postponed until Monday. Because patients no longer stay in the hospital when they are discharged on Saturday or Sunday, the pharmacy feels there is no need for further administration of the used medication. Whether this underestimation cancels out the overestimation is of no doubt, because wrongful entries reasonably occur less often than discharges in the weekend.
- Because the pharmacy switched between systems half through 2011, this has resulted in a change in what information we researched. We selected only THR patients of the second half of 2011, starting around the 1st of June.
- Some medication is given, calculated with a schedule present on the in-house departments or based on diabetic levels of patients. Exact use of this can not be traced. Some medication given in different options (anal, oral etc) so the nurses can choose an option most suitable for the patient. The leftover medication returns to the pharmacy but is not registered.

Chapter 8. Conclusions & recommendations

In this thesis, the costs of a THR treatment at the orthopaedic department of Apeldoorn were researched. Several departments were examined more closely because of the relevance of larger cost centres; Operation Room, nursing department, pharmacy and the hip prosthetic itself. This in order to answer the subquestions and the research question:

How can insight into the costs of a total hip prosthetic treatment by the orthopaedic department of Gelre hospital Apeldoorn be increased and what lessons can be learned from this increased insight about cost improvement?

Subquestions:

1. What does a total hip replacement consist of? (Activities, means and people in Gelre hospital Apeldoorn)
2. What are the main expenses of a total hip replacement in the Gelre hospital?
3. Can certain cost improvement possibilities be identified?

Firstly for the setting of the questions a description of the general Dutch health care market is given, noting the changes of both government ruling and increasing commercialization of health care to reduce costs. Due to demographic changes in Dutch population, an increase in demand of hip prosthetics is to be expected. The total hip prosthetic treatment has proven to be an adequate and profitable solution to certain hip problems such as arthritis.
A care path is lined out, describing the steps for treatment of a THR patient. Main events are the activities of the orthopaedic department, the operation, and the nursing days. The large cost centres determined in the literature were the hip prosthetic itself, the operation, and the nursing days. In a figure

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Recommendations

Orthopaedic department

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A cost-benefit analysis of different possibilities for care after operation (hospital vs. care hotel) with an extended financial report concerning the money flow constructions could help determining whether alternatives for the nursing days are realistic and cost efficient.

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As the orthopaedic department has the wish to transition to a RVE, clear agreements on standards are needed, mostly concerning the financial part of the RVE structure.

Operation Room Complex

For the operation room complex several recommendations are possible.
Since it appeared difficult to gather results of the usage of products on the OR, a scanning option for all products, including the hip prosthetic, could help specify the usage per operation and department, and make physicians aware of usage and costs, and reduces the administrative activities for the OR who are obliged to have a track and trace system for all implants.

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Nursing department

Focussing on the patient care is already a good part of the activities for the nursing staff, but trying to increase direct care time will heighten the quality of care and patients´ satisfaction. Reducing the administrative load and reducing the moving around looking for equipment, will also increase the job satisfaction of nursing staff. Overall, a project such as the "productive ward" program can help improve nurses jobs and job satisfaction.
Lowering the length-of-stay by increasing care and guidance, and physical therapy will be

Physical therapy

- Better registration of consults in EPR, to be able to compare it with the SAP system.
- More time per patient
  These two are difficult to combine, unless registration is simplified/ digitalised with scanners or time-clock with touch screen for quicker activity registration.

Pharmacy department

- Solid system for pharmacy with possibilities to look in the past for all drug use, pharmacy has linked its system to the hospital information system to increase information quality and control.
- Better registration of medication use during the weekends
- Anaesthetic costs/ drugs not yet registered in general pharmacy program

General remarks concerning the hospital

- More cooperation between Apeldoorn and Zutphen for better negotiating position, already a general purchasing cooperation of several hospitals, but with use of same product, larger amounts and larger discount.
- One can only keep the cost prices of everything in mind when negotiating. But when overhead costs, necessary to pay personnel, are ignored/ neglected, the price an insurer will pay, will perhaps not cover all expenses important for an hospital to make.
- For qualitatively better comparisons between hospitals, more statistics about patient demographics is needed. This makes comparisons more justified, if data can be adjusted for differing patient populations.
- Many old versions of software programs and Windows, compatibility problems with external info sources, and with upgrading problems internally between programs.
- For implementing a complete RVE structure it is important to have all the main stakeholders on board with the change within the organisation. Changing one department often leads to changes in other departments and successful implantation of a RVE structure requires cooperation of many different departments.

Further research possibilities

- A project for the nursing staff with an example of the National Health Service (NHS) of the UK or the research done by Zutphen neurology department concerning minutes for patients vs. time spent otherwise. This can increase insight in activities and improvement opportunities. The NHS has several projects to improve nursing activities.
- Cost benefit analysis of project team vs. own in-house OR staff specialised in orthopaedics.
- Cost benefit analysis in-house physical therapy vs. physical therapy in care hotel or at home.
- Knee arthroplasty is in many ways similar to hip arthroplasty, and can be used in research concerning cost calculation for orthopaedics as well.
- Re evaluate the orthopaedic trays of the OR. For now we assumed that trays were effectively planned and arranged, but for further research it would be interesting to look further into this. When it appears that some tools are never used, or to much disposables are unpacked, a change in the tray can lead to cost and activity reduction.

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Appendices

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11. Recovery
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Appendix 1.
List of Abbreviations:

CBO	Centraal Begeleidings Orgaan (institute of quality in care)
DOT	DTG On the road to Transparency
DTG (DBC)	Diagnosis Treatment Group
EPR	Electronic Patient Records
MMC	Maxima Medical Centre (Eindhoven & Veldhoven)
NOV	Nederlandse Orthopedie Vereniging (Dutch Orthopaedic Association)
Nza	Nederlandse Zorg autoriteit (Dutch Healthcare authority)
OR	Operating Room
THR	Total Hip Replacement
ZiZo	Zichtbare Zorg

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Appendix 2. Dutch health care market

The current situation on the Dutch health care market is one of transition. The three market model of van Montfort (1997) is a good starting point to explain the complexity of the Dutch health care market. In the figure the three squares represent the different players in the health care market, namely the hospital/ physician, the financer (health care insurer) and the patient/ customer. Between these three players different relationships can be distinguished. The patient, when needing treatment, will seek treatment with a physician on the so called care supply market, an individual market. The patient is also the customer of the health care insurer on the insurance market, this is mainly a collective market in the Netherlands. And the same insurer is the financer on the health care purchasing market, paying the managing staff of a health care institution for care for their customers. Insurers negotiate prices with health care institutions for total budgets and not individual treatments.

In this model the government has a regulating role, protecting citizens (patients/ customers) by regulating certain treatments and prices and guarantying a minimum amount of health care paid through social solidarity.

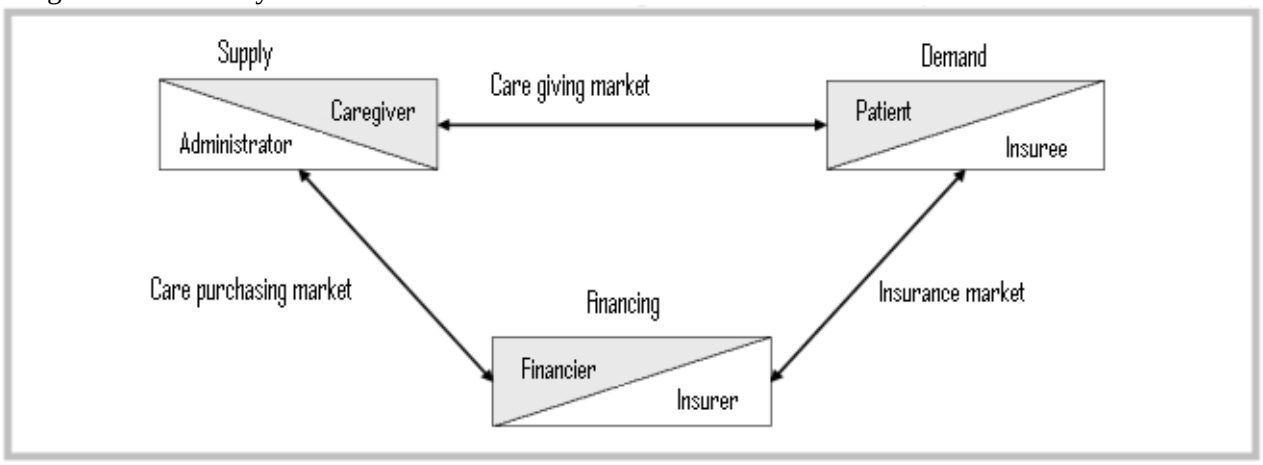

Figure 5. Three-marketmodel (Van Montfort, 1997)

In the last few decades health care expenses in the Netherlands, and other Western countries, have risen excessively. In the Netherlands the costs of health care have risen 66 % between 2001 and 2010. Costs in hospitals have risen even more, with 78 %. (Centraal Bureau voor de Statistiek [CBS], 2011) Partly this is due to volume growth and partly because of *rising prices*. The volume increases due to better health care extending citizen's life expectancy with several years, but not all of these years are of good quality of life since co morbidity is on the up rise.

The aging population is often mentioned when talking about rising costs. The Dutch public is aging and it is to be expected that in the coming years the number of elderly civilians will rise rapidly. This is because of the so called baby boom after World War II and also the improving methods of treatment which have turned many fatal diseases into chronic diseases.

The aging population and rising prices are only part of the problem. Improving levels of technology have created more treatment possibilities but also caused expansion of treatment duration, increased complexity of treatment and higher expenses. And with all the new possibilities, more specialities are needed and specialists need to be trained on more specific, lengthy procedures.

Because of the rising expenditure in health care, and expenditure becoming a larger part of total collective expenses, the Dutch government is forced to look at possible cutbacks in health care.

Part of the solution is believed to lie in liberalisation of the health care market. In the past other government organisations have been privatized to hopefully increase competition and decrease prices, with varying results. With more free market commerce, the prices of treatments and total budgets need to be negotiated more on the edge between health care institutions and health care insurers. By

negotiating prices and decreasing rules and regulations, hopefully more transparency will be created and costs will decrease and cost effectiveness improvement is encouraged.
For the negotiations between health care institutions and insurers, the DBC system is created in the Netherlands. DBC stands for "Diagnose Behandel Combinatie" or diagnosis treatment group. It is a tool made by the Dutch government for both health insurers and health care institutions to use in their effort to increase transparency and facilitating negotiation options in the ever increasing 'free market' of health care. The thought behind this concept is that for every patient with the same diagnosis, a specific insurer pays a specific hospital the same amount of money. The DBC's are calculated on averages with a little risk percentage for unexpected problems.

All DBC's are divided into two categories; A-segment and B-segment. A-segment prices are determined by the NZa (Dutch Healthcare Authority) and include for example emergency care, trauma surgery, and transplant costs. For the B-segment the prices are free negotiable between health care institutions and health care insurers.
In the general Dutch DBC registration, the total hip prosthetic (non acute) treatment is indicated with the code 5.11.1701.223. The 5 stands for orthopaedics, 11 for regular care (as opposed to revisions), 1701 is the diagnosis, being hip arthritis, and 223 stands for the treatment (operation with clinical episodes).

Since the first of January of 2012 the system has been changed slightly, and DBC's are now called "DBC op weg naar transparantie" (DTG's on the road to transparency, DOT) because the system needed to be simplified and less codes should be used and treatments are now called "care products". (NzA, 2012)

Appendix 3. Gelre hospitals

For a complete description in which this research is set, a description of the concerning hospitals can offer a better picture.

"A hospital can be described as a medical centre, consisting of facilities for research, cure, and care, health care workers and supportive staff." (Boot, 2005) Hospitals have come into existence out of a need in the Middle Ages to house the poor, mentally ill and homeless. And over the years they have evolved from houses for the poor and sick into sophisticated, high-tech institution focussed on curing and caring for the ill.

Gelre hospitals have come into existence after uniting 2 hospitals (Lukas and Juliana) in Apeldoorn and later on merging with the "Spittaal" hospital in Zutphen (founded in the Middle Ages). The Lukas hospital was created when the catholic Saint Liduina hospital (1928) and the foundation protestant Christian hospital merged in 1974. The Juliana hospital originates from a merger between the "hospital at the Sprengenweg" (1886) and the Childrens hospital Mary (1887). In 1986 the Lukas hospital merged with the Juliana hospital into hospitalcentre Apeldoorn with two locations.
In 2007 a start is made with pushing off the Juliana location after renovating the Lukas location and is now nearly finished and called the Apeldoorn location.

Gelre Apeldoorn and Gelre Zutphen share a board of directors and several supportive services. Both locations have their own managing director and medical staff. (Gelre Hospitals website, 2012)

Together the locations Apeldoorn and Zutphen have 925 beds, 188.602 first policlinic visits, 190 medical specialists and 2466 fte for employees. Besides this, there are several clinics in surrounding villages, to bring care to the patient. The mission statement expresses their desire to help people by providing care to cure or alleviate symptoms and strive for improvement and innovation. (Gelre hospitals website, 2012)

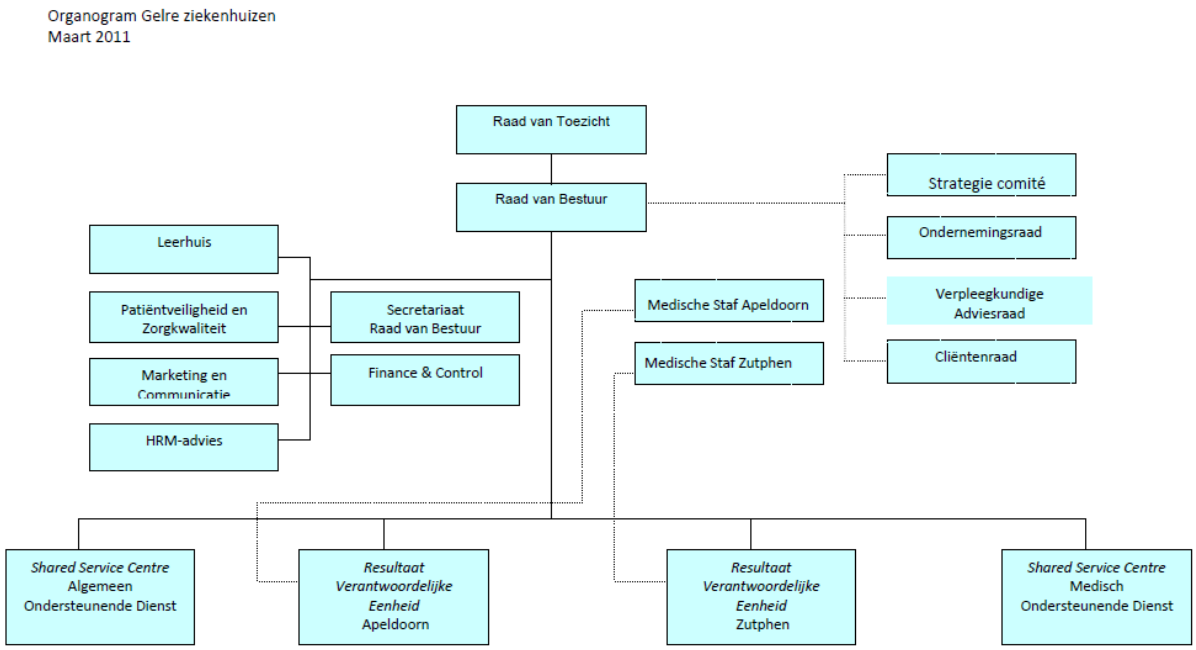

Figure 6. Chart structure Gelre Hospital (Gelre Hospitals website, 2012)

Some departments fully cooperate or are centralised in one location. For now, orthopaedics of Apeldoorn and Zutphen operate separately. There is a separate department for both locations and so far few collaborations have been formed between the two, but this is on the up rise, with a possible

further extension to Deventer hospital for more purchasing and medical benefits. For now, the focus of this research will be on orthopaedics Apeldoorn, but in the future this department might change.

Table 10. Indicators Gelre hospitals Apeldoorn and Zutphen. (Author unknown, Gelre website, 2012)

Indicator	End of 2010	End of 2011
Beds (according to government acknowledgement)	925	925
First polyclinic visit (excl. PAAZ)	182,45	188,602
Dagopnamen (excl.PAAZ)	32,540	35,914
Hospitalization (excl. PAAZ)	36,974	38,557
In-house days (excl. PAAZ)	174,292	170,928
Adherence area of coverage clinical	269,168	270,408
Adherence area of coverage polyclinical	283,198	282,103
Specialist places	123	128
Medical specialists	190	190
Employees in fte's	2,437	2,466
Employees fulltime & part-time	± 3500	± 3500
Medical extended education	18	19
Nursing education studies	3	3
Specialist extended education	9	9
Paramedical education programmes	12	12

Appendix 4.

Figure 7. THR flow chart (Source: Eric Raven, 2012)

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Appendix 5.
Lists with tools OR
As example a list of everything that is prepared at the OR for a THR operation. There are 4 possibilities for a THR for the OR.

Figure 8. A hip tray for Gelre Apeldoorn orthopaedics (Purchasing department Gelre hospitals, 2012)

Appendix 6.
Data time study in-house ward Orthopaedics Apeldoorn

Table 11. Data on employees nursing department A7, anonymous. (Source: Kim Buisman, Gelre Hospitals, 2012)

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The shifts of the nursing staff are 8 hours each: 7:30 tot 15:30, 15:30 to 23:30 and 23:30 to 7:30. Before the shifts start, handover takes place between the two shifts, with starting staff reading the files and listing important information on care, medicine and resuscitation code.

Some activities of the department are performed by specifically trained nurses or other health care workers. Food distribution is done by the nutrition assistant, with meals planned by the dietician. Intake is done during the Nursing consultation of Orthopaedics (VSO, verpleegkundig spreekuur Orthopedie) outside of the regular in-house shifts, in the polyclinic (mentioned in the care path diagram). Medication is sent from the in-house pharmacy and is always sorted by the night shift into the trolley carts of the department. For scans, patients will be transported to radiology.
There are 33 beds spread over 16 rooms, some being for four patients, some for two and some for one patient.
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Figure 9. Activity categories time spent during study.

Appendix 7.

Table 12. List of DBC codes for orthopaedics (05) ; hip operations for arthritis. *(Source: Hasekamp, 2007)*

DBC code	Description diagnosis	Description treatment	Forecast nr of patients 2008	ZN care profile
05 11 1701 211	Arthritis: pelvis/hip/upper leg	Operation outpatient care	96	no
05 11 1701 212	Arthritis: pelvis/hip/upper leg	Operation, day	140	No
05 11 1701 213	Arthritis: pelvis/hip/upper leg	Operation, clinical episodes	346	*Operation without prosthetics
05 11 1701 216	Arthritis: pelvis/hip/upper leg	KZD. Operation clinical episodes		No
05 11 1701 223	Arthritis: pelvis/hip/upper leg	Operation clinical, prosthetics	17401	*Operation with prosthetics
05 11 1701 226	Arthritis: pelvis/hip/upper leg	KZD. Operation, clinical, prosthetics.		No
05 21 1701 216	Arthritis: pelvis/hip/upper leg	KZD, operational, clinical episodes, revision.		No
05 21 1701 226	Arthritis: pelvis/hip/upper leg	KZD. Operation clinical prosthetics, revision.		No

* Two ZN profiles are made: One for the total hip prosthetic (operation with joint prosthetic), one for the rare hip operation because of arthritis without joint prosthetic.

Appendix 8. Examples of hip prosthetics

Figure 10. Spectron steel (hip implant)

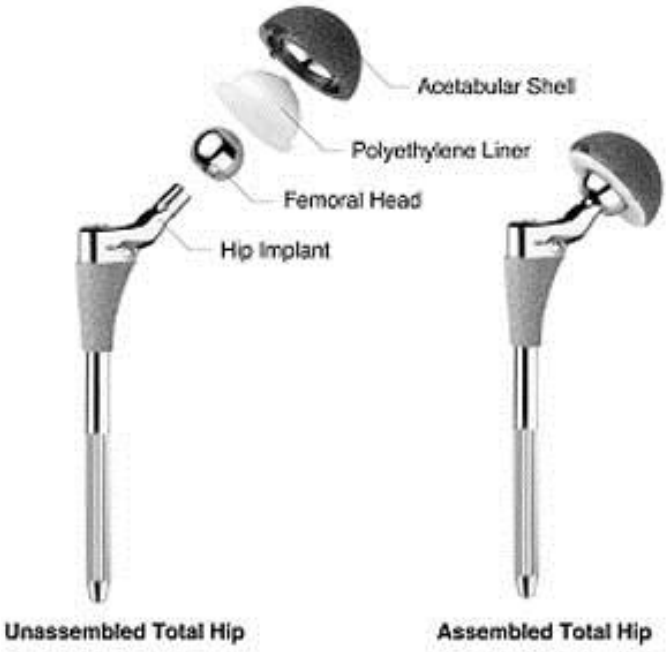

Figure 11. Example of a Zimmer hip prosthetic

Appendix 9. Form time study

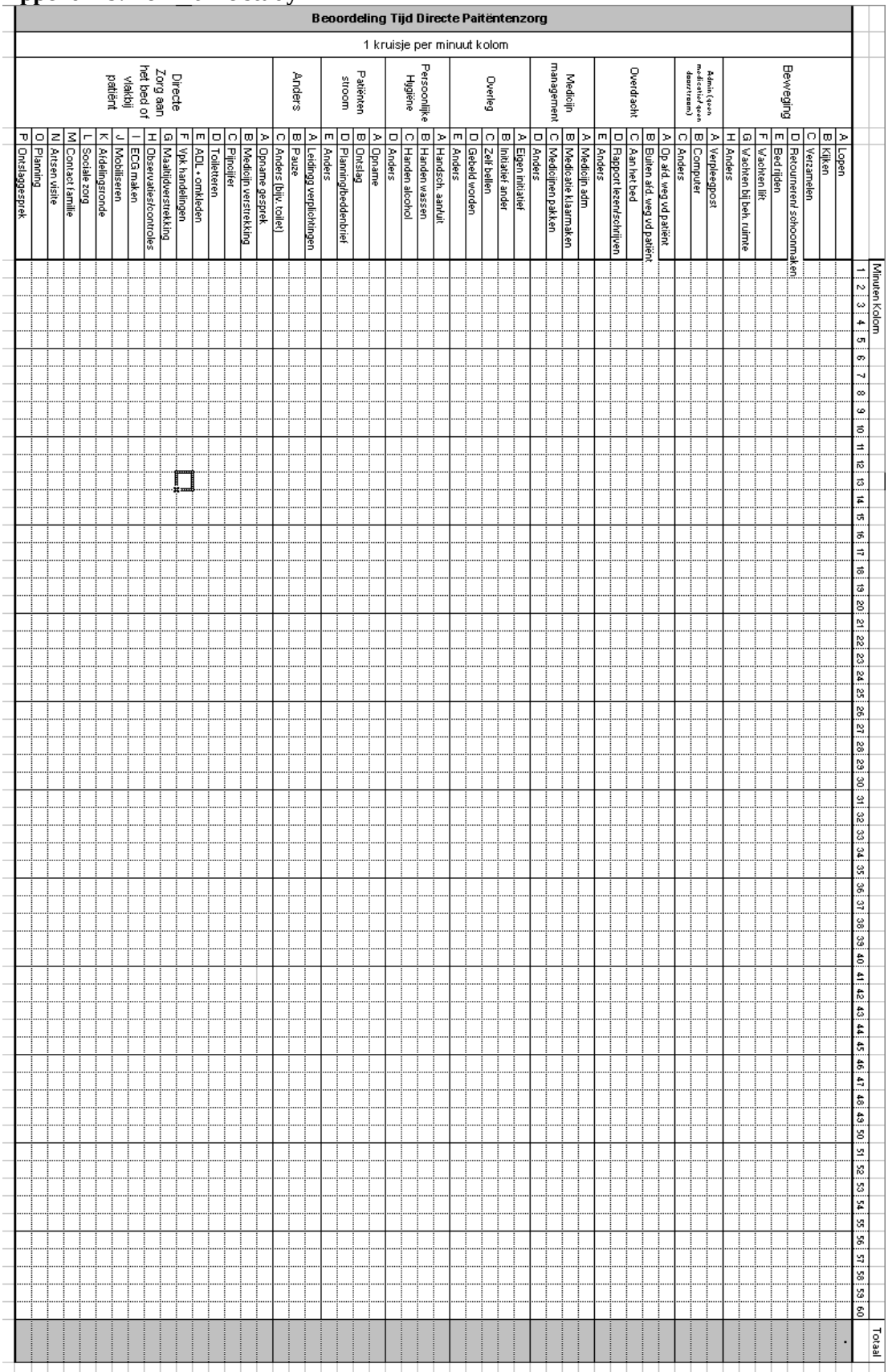

Figure 12. Example of a form for time study. With the 13th minute selected in the category of direct care, medical activity.

Appendix 10. Anaesthetics

Table 13. Anaesthetic info for THR patients (Source: OR department Gelre hospitals, 2012)

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Appendix 11. Recovery

Table 14. Material used during recovery of THR patients (Recovery, OR department Gelre hospitals, 2012)

Product	Product no.	Amount	Gross price p.p.	Total price

Material used at recovery for 23 patients. This was registered by employees of recovery in the month September 2012. Gross prices are rounded but the unrounded prices are used to calculate total costs.

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Appendix 12. MMC data

At the MMC the orthopaedic department is one entity, operating at both locations. Data is therefore presented for the two locations combined. Information for 2011 is not (yet) available.

Table 15. Production data for the orthopaedic department of the MMC. (Source: MMC Orthopaedic department annual report 2010)

	2007	**2008**	**2009**	**2010**
Total new patients orthopaedics				
Intakes (including trauma'				
Outpatient treatment (including trauma)				
Surgery patients orthopaedics Total				
Activities OR (total incl. outpatient treatments and trauma)				
Nursing days (excluding trauma)				

The MMC orthopaedic department has nine orthopaedic specialists, one chef de clinique, six residents and one anios.

Appendix 13. NOV guidelines (in Dutch), summary of recommendations
(Source: "Richtlijn totale heupprothese" 2010, Nederlandse Orthopaedische Vereniging)

Samenvatting van de aanbevelingen voor totale heupprothese
Onderstaande is een samenvatting van de aanbevelingen uit de multidisciplinaire klinische richtlijn „Totale heupprothese". Deze richtlijn is tot stand gekomen met de evidence-based richtlijnontwikkeling (EBRO) methodiek. In deze samenvatting ontbreken het wetenschappelijk bewijs en de overwegingen die tot de aanbevelingen geleid hebben. Lezers van deze samenvatting worden voor deze informatie en de overige aanbevelingen verwezen naar de volledige richtlijn.

Indicatiestelling
Wat zijn de indicaties en contra-indicaties voor het plaatsen van een heupprothese?
De werkgroep adviseert de indicatie voor totale heupvervanging te stellen op basis van pijn, functieverlies en radiologische afwijkingen na het falen van conservatieve therapie. Jonge leeftijd en overgewicht vormen hierbij relatieve contra-indicaties. Op hoge leeftijd is langdurig uitstel van de operatie te ontraden vanwege dalend postoperatief functieherstel en stijgende mortaliteit. Ook wanneer progressief functieverlies (met contracturen) meer op de voorgrond staat dan pijn, is uitstel van de operatie te ontraden vanwege steeds beperkter postoperatief functieherstel.

Operatietechnische aspecten
Welk type prothese geniet de voorkeur?
Lagering
De werkgroep adviseert als eerste keuze een metalen of keramische kop en een conventionele polyethyleen kom. Op basis van de verminderde slijtage op middellange termijn kan ook een crosslinked polyethyleen kom worden gekozen. Voor het gebruik van andere lageringen bestaat onvoldoende bewijs en deze worden dan ook bij voorkeur alleen in studieverband toegepast.

Kopdiameter
Bij plaatsing van een totale heupprothese kan het gebruik van een heupkop met een diameter van meer dan 32 mm doorsnede worden overwogen. Het ontbreekt echter aan lange termijn data en daarom lijkt het beter deze ingreep te reserveren voor patiënten met een hoge kans op een vroege postoperatieve luxatie. Verdere toepassing van deze koppen met grotere diameters moet bij voorkeur in studieverband worden verricht.

Gecementeerd versus ongecementeerd
De werkgroep adviseert om de keuze voor een heupprothese (zowel gecementeerd als ongecementeerd) te laten bepalen door de goed gedocumenteerde langere termijneffectiviteit en de (directe en indirecte) kosten. Onder "goed gedocumenteerde langere termijneffectiviteit" wordt verstaan: in een peer reviewed tijdschrift gepubliceerde klinische follow-up met tien-jaarsoverleving.

Voor de introductie van nieuwe, niet "goed gedocumenteerde" of gewijzigde prothesen wordt het volgende 4-stappen plan geadviseerd:
1. preklinisch onderzoek (laboratoriumtests);
2. een kleine serie operaties geëvalueerd middels radiostereometrie;
3. een gerandomiseerd klinisch onderzoek met vergelijking met een goed gedocumenteerde prothese (N > 100), en tenslotte
4. bewaking van de klinische resultaten middels een implantatenregistratie

Wat is de waarde van resurfacing?
De werkgroep is van mening dat de waarde van resurfacing waarschijnlijk beperkt is. Deze behandeling wordt bij voorkeur slechts in studieverband verricht en gereserveerd voor jonge patiënten (max. 60-65 jaar) met een heup kop diameter boven de 50 mm en een goede botkwaliteit. De

beschikbare implantaat registers dienen leidend te zijn in de implantaatkeuze en de chirurg dient ruime ervaring te hebben met de operatietechniek.

Welke benadering geniet de voorkeur en wat is de waarde van minimaal invasieve chirurgie?
De werkgroep kan geen voorkeur voor één van de vier benaderingswijzen aangeven.
Zij adviseert wel om bij de posterolaterale benadering van de heup het kapsel te reconstrueren.

De werkgroep adviseert grote terughoudendheid met de toepassing van de minimale invasieve technieken bij het plaatsen van een totale heupprothese en deze alleen toe te passen in gecontroleerde omstandigheden met een goede follow-up. Waarschijnlijk bestaan er alleen voordelen in de direct postoperatieve fase en het is niet duidelijk of deze opwegen tegen mogelijke nadelen op langere termijn.

Wat is het beleid met betrekking tot preventie van postoperatieve wondinfectie?
De werkgroep beveelt aan altijd systemisch antibiotica te geven, en te kiezen voor eerste of tweede generatie cefalosporines gedurende maximaal 24 uur.
Antibiotica moeten zijn toegediend in de periode van 15 -60 minuten voordat de incisie wordt gemaakt.

De werkgroep adviseert bij plaatsing van primaire gecementeerde prothesen altijd een antibioticumhoudend cement te gebruiken in combinatie met systemische antibioticaprofylaxe.

Alle prothesechirurgie dient in OK-lucht met een kiemgehalte van < 10 KVE/m3 tijdens de ingreep te geschieden. Orthopedische operatiekamers dienen te zijn voorzien van een laminaire downflow luchtbehandeling met een plenum van voldoende oppervlak. Ziekenhuizen dienen een beheersplan voor de luchtbehandeling op operatiekamers te implementeren. Een goede luchtbehandeling kan niet los worden gezien van strikte handhaving van hygiënische discipline van alle aanwezigen op de operatiekamer en andere profylactische maatregelen in dit hoofdstuk beschreven (systemische antibiotica, antibioticumhoudend cement).

Bij bekende MRSA dragers en hoog risico patiënten dient wel een preoperatieve controle en eventueel een eradicatie kuur te worden uitgevoerd, en moet Vancomycine als profylactisch antibioticum worden gebruikt.

Wat is de beste vorm van preventie van diep veneuze trombose na een totale heupvervanging?
Voor tromboseprofylaxe na een totale heupvervanging vormen laag moleculair gewicht heparines, fondaparinux, coumarinederivaten, rivaroxaban en dabigatran een goede keuze. Hier kan postoperatief mee worden gestart. De behandeling wordt gedurende 4-5 weken na de operatie voortgezet.
De werkgroep beveelt aan om met name bij de nieuwe orale middelen (rivaroxaban, dabigatran) de bijwerkingen goed te registreren.

Welke anesthesietechniek heeft de voorkeur bij de totale heupvervanging?
Op basis van onder andere betere postoperatieve pijnbestrijding is er voorkeur voor regionale anesthesie. De definitieve keuze dient gemaakt te worden op basis van overleg tussen de anesthesioloog en de patiënt.

Indien gebruik gemaakt wordt van een neuraxiale blokkade dient er een lokaal protocol te zijn voor het voorkómen van urineretentie. Het gebruik van een urinecatheter gedurende 24 uur wordt aanbevolen.

Wat is de waarde van fysiotherapie voor en na de operatie?

In het algemeen is er onvoldoende bewijs voor het aanbevelen van pre-operatieve fysiotherapie voor een totale heupprothese, maar in individuele gevallen kan bij een (oudere) patiënt met veel stoornissen in functies en beperkingen in activiteiten en met veel comorbiditeit pre-operatieve fysiotherapie (inclusief voorlichting en oefenen met krukken) overwogen worden. Postoperatieve extramurale fysiotherapie c.q. een (thuis)oefenprogramma na een totale heupprothese is aan te bevelen om aanwezige stoornissen in functies (spierkracht, mobiliteit, stabiliteit en gangpatroon) en beperkingen in activiteiten (bijvoorbeeld uitvoeren van transfers en lopen) te verbeteren.

De werkgroep beveelt aan om, zo mogelijk, de zorg bij patiënten gepland voor een totale heupprothese aan te bieden in de vorm van een klinisch pad, met vooraf educatie over de „versnelde zorg", op maat gericht advies en begeleiding en postoperatieve revalidatie in het ziekenhuis.

Nazorg

Wat is het beleid om hematogene besmetting van heupprothesen te voorkomen?

De werkgroep adviseert bij het ondergaan van de volgende invasieve ingrepen kortdurende antibiotische profylaxe:

- alle invasieve procedures als de patiënt een verminderde weerstand heeft.
- tandheelkundige ingrepen in geïnfecteerd gebied;
- cystoscopie als de urinekweek positief is bij een symptomatische infectie;
- endoscopie(sche ingreep) in geïnfecteerd gebied;
- oesofagoscopische ingrepen.

De keuze van het middel zou kunnen zijn een eenmalige gift van amoxicilline en clavulaanzuur (Augmentin, twee tabletten van 500/125mg per os één uur vóór de ingreep.

Wat is de waarde van routinematige follow-up?

De werkgroep is van mening dat routinematige follow-up van patiënten na een totale heupvervanging in ieder geval dient te gebeuren gedurende het eerste jaar, en na het vijfde jaar, of eerder als daar aanleiding voor wordt gezien door de operateur op grond van de ervaringen met de gebruikte prothese.