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Matching capacity and demand

An analysis of the planning issues at the gynecology clinic at Medisch Spectrum Twente

Master thesis for completion of the master Health Science at the University of Twente

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Samenvatting

Dit onderzoek is gestart naar aanleiding van het niet behalen van het afgesproken productievolume binnen de afdeling gynaecologie van het ziekenhuis "Medisch Spectrum Twente" in Nederland. Na een eerste analyse van dit probleem, werd het doel van dit onderzoek het vinden van een oplossing om een betere afstemming tussen de capaciteit en de vraag naar zorg te bewerkstelligen en daarmee de tactische planning van middelen te verbeteren. Het idee was om met informatie over de doorstroming van patiënten in zorgpaden de verwachte vraag voor de toekomst te bepalen.

In MST worden verschillende spreekuren gehouden per subspecialisatie. De planning van de capaciteit van de artsen wordt uitgevoerd door één werknemer die verantwoordelijk is voor de planning. De planner verdeeld de artsen over de taken zonder dit te baseren op historische gegevens. Historische gegevens over de vraag naar ongecompliceerde zwangerschap zorg leren dat de vraag fluctueert over de maanden van het jaar. Een model voor de prognose van de vraag moet daarom rekening houden met deze fluctuaties. Het beschreven zorgpad dient als basis voor het onderzoek met informatie over de capaciteit die nodig is per fase en de stroom van patiënten door middel van het zorgproces.

In dit onderzoek is het model gebaseerd op het zorgpad voor ongecompliceerde zwangerschappen. Het model moet het aantal benodigde ‘slots’ voor controlepatiënten en nieuwe patiënten voor een bepaalde week kunnen voorspellen. Het aantal ‘CP slots’ in een week is gebaseerd op het aantal ‘slots’ in de week voor. Het aantal ‘NP slots’ in een week is ofwel gebaseerd op een voorspelling van nieuwe patiënten of op het werkelijke aantal patiënten. Het model is gebouwd in Excel wat resulteerde in een planningstool met als uitkomst de benodigde NP en CP ‘slots’ voor de komende periode. Uit verificatie van de tool blijkt dat die goed functioneert. De uitkomsten van de planningstool werden gevalideerd door het vergelijken van de uitkomsten van het model met het werkelijke aantal ‘slots’ die nodig zijn in twee gecontroleerde weken. De uitkomsten van het model zijn niet zo goed als gehoopt. Maar die uitkomst kan nauwkeuriger worden omdat het mogelijk is om werkelijke data in te voeren in de planningstool. Met het invoeren van die data als randvoorwaarde voor gebruik, verwachten we dat de planningstool zeker nuttig is voor een betere match tussen capaciteit en vraag.

Een aanbeveling voor de afdeling gynaecologie is het doen van een pilot met de planning tool. Na de pilot zullen zij in staat zijn om aanpassingen te doen aan de planningstool of het proces om het model zo goed mogelijk te kunnen toepassen. Het ontwikkelde model maakt een voorspelling van de vraag mogelijk. Meer inzicht in de vraag naar slechts een subspecialisme maakt het mogelijk voor de planner om ook te beslissen over de toewijzing van capaciteit aan andere sub specialismen. Daarmee is zijn de planner en artsen in staat om beslissingen te nemen over het leveren van zorg in de nabije toekomst. Dit kan een manier zijn om het volume van EPB’s te beheren en de haalbaarheid van het overeengekomen productievolume te bepalen.

Summary

This research started in response to the problem of not reaching the agreed production volume within the gynecology department of the hospital 'Medisch Spectrum Twente' in the Netherlands. After analysis of this problem, the aim of the research became to find a solution on a better match between capacity and demand to improve the tactical planning of resources. The idea was to use information on the patient flow in clinical pathways to determine the expected demand for the future.

In MST there are different consultation hours per subspecialty. The planning of the capacity of physicians is performed by one employee in charge of the planning. The planner allocates the physicians to several tasks without basing decisions on historical data. Historical data on demand for uncomplicated pregnancy care learns that demand fluctuates over the months of the year. A model for the forecast of demand should account for these fluctuations. The clinical pathway serves as the basis for the research giving information on the capacity needed per phase and the flow from patients through the care process.

In this research a model is designed based on the clinical pathway for uncomplicated pregnancies. The model needs to forecast the number of needed control patient slots and new patient slots for a certain week. The number of CP slots is based on the number of slots in the week before. The number of NP slots is either based on a forecast or on the actual number of new patients. The model is built in Excel which resulted in a planning tool giving the needed NP and CP slots for the coming period. Verification of the tool shows that the tool is functioning properly. The outcomes of the model were validated by comparing the output of the tool to the actual number of CP slots and NP slots needed in two weeks. The outcomes of the model are not as good as desired. The outcomes can become more accurate since it is possible to enter actual data from former weeks in the planning tool. With entering that data as a precondition we expect the planning tool to be very useful to obtain a better match between capacity and demand.

The gynecology department is recommended to do a pilot with the planning tool. After the pilot they will be able to make adjustments to either the tool or the process to optimize use of the model. The developed model makes a forecast on demand possible. More insight in demand for just one sub specialism makes it possible for the planner to decide on the allocation of capacity to other sub specialism's. Therewith the planner and physicians are able to make decisions on the delivering of care in the near future. This can be an instrument to manage the volume of EPB's and therewith reaching the agreed production will be easier.

Preface

Before you lies my master thesis which marks the end to my master study Health Science at the University of Twente. It contains the outcomes of a study on the tactical planning process in an outpatient department for gynecology. During the research a model is developed to forecast the future demand with the aim to improve the match between demand and capacity while planning capacity.

At the start of this project I was very eager to find an interesting assignment preferably at an hospital. I was happy to find this at the Medisch Spectrum Twente hospital in Enschede. Very soon it became clear that there was no clear problem description. At least not one I was able to solve. I thereafter sort of created my own problem analysis with help of my supervisor. This has resulted in the thesis your are about to read. The process to the final report has been long and challenging but it has also been an instructive period. I am now looking forward to the future starting with my working career.

I would like to thank my first supervisor Ingrid Vliegen for the support and patience during my graduating project and for all the help to come to a structured report. I also would like to thank Wineke van Lent for being second supervisor and providing the needed critical view on the project. Furthermore I want to thank Josephine oude Lohuis for giving me the possibility for a master thesis at the Medisch Spectrum Twente and for the interesting conversations about the department. And last but not least I want to thank my dear family and friends for all the support during my study.

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Lieske Kobes

Content

Abbreviations

CP: follow-up patient (In Dutch: controle patient)

DTC: diagnosis treatment combination (In Dutch: diagnose behandel combinatie (DBC))

EPB: first outpatient visit (In Dutch: eerste polikliniekbezoek)

MST: Medisch Spectrum Twente

NP: new patient (In Dutch: nieuwe patient)

OBS: observation room

OR: operating room (In Dutch: operatiekamer (OK))

POR: policlinic operating room (In Dutch: poliklinische operatiekamer (POK))

RVE: result responsible unit (In Dutch: resultaat verantwoordelijke eenheid)

VKC: woman child centre (In Dutch: vrouw kind centrum)

1 Introduction

In this first chapter, the research will be introduced by some background information in Section 1.1, followed by an analysis of the possible related problems in Section 1.2. This is an extensive analysis because the primary problem is related to a lot of issues. Finally, in Section 1.3, we define the main goal and the research questions for this research.

1.1 Background

Today's political agenda focuses heavily on controlling health care costs. One of the latest developments from politics is an administrative agreement on cost trends for hospital care, in which the expenditure growth for hospital care is set to a limit. The aim is to have a maximum expenditure growth of 2,5% each year (Ministerie VWS, 2011). This has impact on hospitals and the organization within the hospitals. In the agreement (Ministerie VWS, 2011) it is also mentioned that redundant capacity in hospitals needs to be reduced. It is clear that organizing processes in an efficient way is getting more and more important for hospital organizations.

This research was performed at the outpatient department of gynecology in the hospital Medisch Spectrum Twente (MST) in Enschede, the Netherlands. This outpatient department, also called gynecology department, provides ambulatory care. Ambulatory care can be defined as care for which patients come for diagnosis and treatment without staying overnight. The gynecology department is part of the so-called "Woman Child Centre", which besides the gynecology department consists of the urology and the pediatrics department. At the outpatient department of gynecology, opportunities for improvement on organizing processes efficiently are expected. The department is located in the hospital MST in the centre of Enschede. Furthermore there are locations in Oldenzaal, Haaksbergen en Losser where patients come on consults.

1.2 Problem analysis

The starting point for this research is that the production volume agreements are not met for the outpatient department of gynecology. Each year agreements are made regarding the number of so-called "first outpatient visits" (In Dutch: eerste polikliniekbezoeken (EPB's)). An EPB is registered when it is either the first visit to the particular outpatient department or when it is the first visit more than twelve months after the last EPB (Nederlandse Zorgautoriteit, 2008). EPB's generate revenue for the outpatient department, repeat consults do not. Reaching the production volume on EPB's is therefore very important for the department.

For 2011 the production volume was set on 11000 EPB's. Table 1 shows the actual results for year 2009 to 2011. The number of registered EPB's for 2011 are 10460, which means that the actual

production volume is too low. The budgeted volume does not look unrealistic given the realized volumes of the former years. In 2010 there was an agreement on 10340 EPB's for that year, while 10519 EPB's were achieved. From 2009 till 2010 the production had increased from 9241 till 10519.

Table 1 Number of EPB's per sub specialism

Consultation hours	2009	Percentage	2010	Percentage	2011	Percentage
Endocrinology	46	0.5 %	80	0,8%	56	0,5%
Infertility	1.264	13.7 %	1.476	14,0%	1.236	11,8%
Gynecology	5.332	57.7 %	6.268	59,6%	6.548	62,2%
Oncology	300	3.2 %	306	2,9%	317	3,0%
Obstetrics	2.139	23.1 %	2.361	22,4%	2.254	21,4%
Osteoporosis	160	1.7 %	28	0,3%	49	0,5%
Total # of EPB	**9241**	**100 %**	**10519**	**100 %**	**10460**	**100 %**
Agreed # of EPB	**unknown**		**10340**	**100 %**	**11000**	**100 %**
Difference	**unknown**		**179**	**1.73 %**	**-540**	**-4.9%**

A first step towards analyzing the problem made clear that there are many problems related to the production volume targets. Therefore we drew a mind map to organize the related problems in a clear figure. This mind map can be found in Appendix A. From the core problem, production volume agreements are not met, arise a lot of underlying problems which can be subcategorized in two groups. The first subgroup is about production agreements not being feasible, which will be further discussed in Subsection 1.2.1. The second group of underlying problems is about the capacity not used efficiently, which will be further discussed in Subsection 1.2.2.

1.2.1 Production agreements are not feasible

A reason for not meeting the production agreements can be that the production agreements cannot be achieved. If the agreements are based on incorrect information about the possible production volume they might not be feasible. The possible production volume depends on the demand for care and the capacity to produce. For the gynecology department the agreed production has raised with almost 1% from 2010 till 2011. It is not clear whether correct or incorrect information is used for determining this volume. In Subsection 1.2.1.1 will be analyzed whether insufficient demand can be the cause of the

production volume not being reached. The possibility of insufficient capacity is discussed in Subsection 1.2.1.2.

1.2.1.1 Insufficient demand for care

When aiming to reach a certain production volume, sufficient demand is needed for the care in that area. The demand for gynecological care has been measured by averaging patient contacts at several outpatient departments in the Netherlands. With that information and expectations on prevalence and incidence for gynecological care the demand for gynecological care for woman has been forecasted, for both hospitalization and outpatient care (van Greuningen, Batenburg, & Hansen, 2010). For outpatient care in the category woman from in the age 14-44 demand is expected to decrease with 2.97 percent and for woman in the age of 45-64 and 65-74 the demand is expected to slightly increase with respectively 0.52 and 0.57 percent. Based on this information the overall demand for the outpatient care in 2014 is expected to decline with 2 percent.

Another indicator for the future demand is the number of referrals from general practitioners to the gynecological care. The number of referrals has increased over the past years. From the year 2001 till 2007 the number of referrals increased on average with 1.6 percent per year (van Greuningen, Batenburg, & Hansen, 2010). This trend is expected to continue in the future.

Based on these indicators the report concludes a growing demand for care (van Greuningen, Batenburg, & Hansen, 2010). Therefore it is not likely to assume that the demand for the gynecologic department is insufficient.

1.2.1.2 Insufficient capacity

Insufficient capacity may cause a gap between agreements and performance and is therefore part of the problem analysis. Circa 2400 EPB's are expected to be derived from visits on the observation rooms and the delivery rooms, where emergency patients are helped. To know whether a volume of the remainder of 8600 EPBs is feasible we should determine the capacity on consultation hours. Although an EPB either can be an new patients visit (NP), taking 20 minutes, or an follow-up patient (CP), taking 10 minutes, we do our calculations with 20 minutes slots as if an EPB always is a NP. Each consultation hour lasts on average 3 hours. Which means there is 9 NP slots in one consultation hour. Therefore we need 8600 divided by 9 is rounded 956 consultation hours to be able to reach the agreed production. Besides that we need capacity for the CP slots. The average repeat factor 2.68 (see Appendix B table 5). We need 8600 times 2.68 is 23048 CP slots. There is 18 CP slots in one consultation hour. Therefore we need 1280 consultation hours for CP slots. Together 2236 consultation hours are needed to be able to reach the agreed production volume. The planning software gives totals on the number of scheduled consultation hours. The data is not entirely correct but it gives an approximation of the capacity with a total of 2722 consultation hours planned throughout the year

2011. Based on this data the capacity on consultation hours should be more than sufficient to reach the agreed production.

For each consultation hour one professional, a consultation room and in most cases ultrasound equipment are necessary resources. There are 8 consultation rooms at the gynecology department at location Enschede. The physicians do not have their own room but are assigned to one of the rooms when doing consultations. Till now the number of consultation rooms has not been a bottleneck, because there are not more than 8 consultation hours on the same moment. Given the number of scheduled consultation hours and presuming 42 full working weeks per year, there is an average of 13 consultation hours per day. These are spread over the mornings and afternoons. The department has 6 echo devices. This means that it happens that one of the physicians has to work without an ultrasound device. The physicians experience this as insufficient capacity. However, because ultrasound examination is not always needed, this should not affect the production.

Waiting lists

Although capacity is assumed to be sufficient to reach the production volume, capacity does not always match the demand. Due to variability in demand and supply waiting lists can occur. We can define waiting lists as: "*a queue of patients waiting for access to a service*" (Vissers, van der Bij, & Kusters, 2001). We summarized the waiting lists for consultation hours at the main location Enschede in the Figures 1 and 2. Appendix B, Figure 14 and 15, shows the waiting lists for the location Oldenzaal.

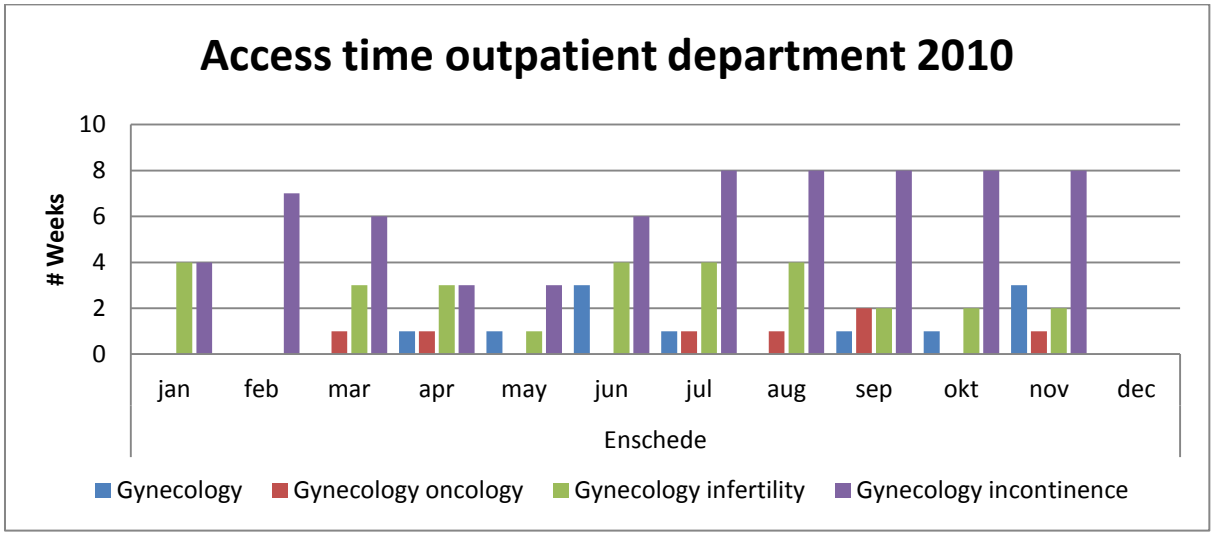


Figure 1 Access time outpatient department Enschede 2010

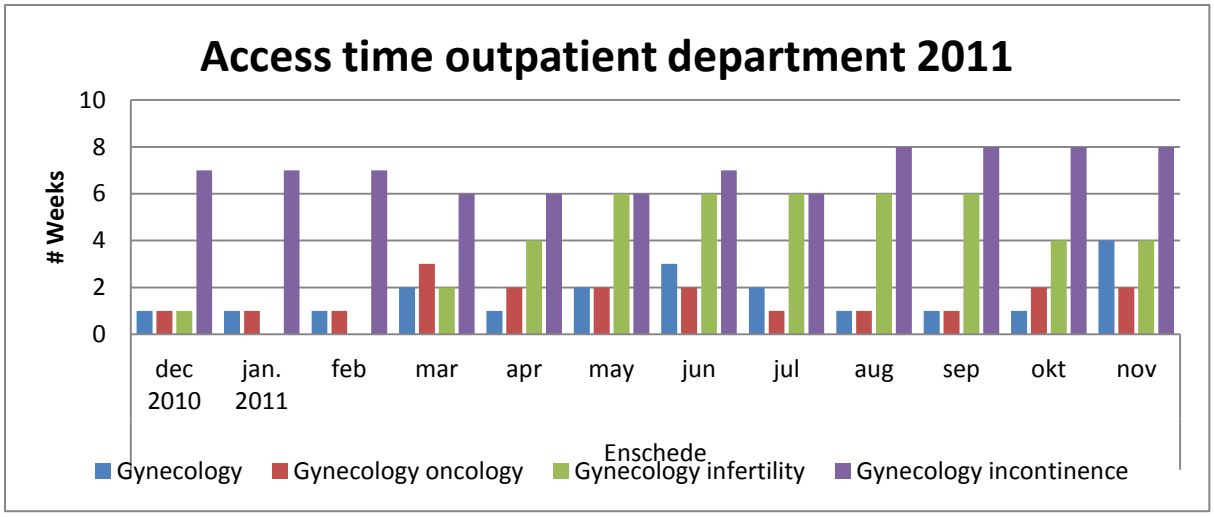


Figure 2 Access time outpatient department Enschede 2011

We see that the access time for both infertility and incontinence is much higher than the access time for gynecology and gynecology oncology. Waiting lists for infertility became larger in 2011 compared with 2010 but in future years this part of the gynecology will not be done in the hospital; therefore it is not relevant for this research. For the remainder of the specialism's the figures do not show a trend of growing waiting lists, but there are fluctuations for the length of the waiting lists through the time. Waiting lists that remain constant do not imply that the capacity is too little, because this can be solved by a one-time catch up reducing the waiting list onto a certain level, but growing waiting lists are often caused by insufficient capacity. Because waiting lists are not really growing we do not recognize insufficient capacity on consultation hours based on this information. But we see fluctuations over time which means that capacity is sometimes sufficient and sometimes insufficient.

1.2.2 Capacity is not used efficiently

Based on the analysis of a sufficient demand and capacity on the department we can conclude that the production volume agreements seem feasible. Another possible cause for not reaching the agreed production volume is found in the possibility that the capacity might not been used efficiently. The use of capacity is efficient if the resource is used with a minimum of waste. We calculated 2236 needed consultation hours and circa 2722 scheduled consultation hours. This may indicate an inefficient use of consultation hours. As shown in the mind map in Appendix A, there are different problems that might cause an inefficient use of capacity. Which we will discuss in the Subsections 1.2.2.1, 1.2.2.2, 1.2.2.3 and 1.2.2.4.

1.2.2.1 Visits too long

One of the related problems is that of visits being too long. When a consultation takes longer than necessary, it will be at expense of the production. The time needed per patient per consult depends on the kind of consultation. Normally, for a new patient an appointment duration of 20 minutes is planned

and for a repeat consultation 10 minutes is booked. In a study on the future labor market for gynecologists, gynecologists are questioned on the time they use per patient. On average the study shows 19,4 minutes needed for a new patient and 11.1 minutes for a follow-up patient (van Greuningen, Batenburg, & Hansen, 2010). The time per appointment in MST is just slightly different from the average needed time in the study. Therefore it seems unlikely that the time per consultation is too long or too short.

1.2.2.2 Too many repeat visits

The more time needed for CP visits for follow-up patients, the less time is available for the production of EPB's. Follow-up consults are included in the diagnosis treatment combination (DTC) for the EPB and do therefore not generate any revenue. In Table 5 (in appendix B) the repeat factor of the different patient groups is shown. Most of the factors are around 1 and 2, only the factor for obstetrics is much higher. Although there is a striking repeating factor of more than 6 for the obstetric consultation hours, judgments cannot yet be made because of insufficient knowledge of the standard in repeat visits for this specialism. From the perspective of using available capacity efficiently, repeat consultations should be restricted. No more repeat consultations should be performed than recommended in clinical pathway descriptions. The released capacity can then be used for other patients.

1.2.2.3 Not all capacity used

The right use of capacity depends also on the use of each planned slot. An issue is the occurrence of no shows. That means that people who are planned on a certain day do not come to the outpatient department. There can be personal reasons for not showing, but it is also possible that an employee made a mistake in the planning of the patient. In 2011 there were 1880 no shows, see also Figure 16 (in Appendix B). This is a lot of unused capacity. According to the trend this number is increasing over time. Currently, a study is going on in which the medical secretary calls the patients to ask for the reason of staying away, to gain insight in the problem, and to reduce the number of no-shows in the future.

Another issue is related to unused slots. The planning starts with scheduling the number of consultation hours. The consultation hours are assigned to a certain sub specialism with the right professional. After that, patients are planned at the slots within the consultation hours. We assumed that demand would be sufficient. However, the demand for care for the different sub specialism's within gynecology varies. Although we do not depose of precise numbers, it happens regularly that the staff finds out that there are still some unused slots for a certain sub specialism. To prevent empty slots the head of the unit tries to regularly check the patient planning. More insight in demand on forehand could make tackling this problem much easier. Given the above analysis improvements related to unused capacity are expected to be possible.

1.2.2.4 Planning is not optimal

In the last part of the previous paragraph is mentioned that although there is sufficient demand and capacity, demand does not always match with the capacity. On the department there is one employee in charge of the planning. She tries to plan the right number of consultation hours per week. The process of planning the production has to be done on several levels: strategically, tactical and operational. These levels will be further specified in Chapter 2. The planning described here is at the tactical level. The tactical level is facing the challenge of matching the demand with the capacity. Optimal planning arises when demand and capacity are balanced with a positive effect on the production volume. However, at the department there is a lot of uncertainty about the demand and the capacity related to this level. Therefore it is not possible to judge the performance properly. Uncertainty on the demand for care per sub specialism on the intermediate term makes matching the capacity with the demand difficult. Especially when the absence of the physicians for congresses, vacations or research is not aligned with developments in the demand of care neither with the absence of colleague physicians.

In the planning process the department tries to take into account some expectations on the demand for care but after all the planning is highly supply driven. Because of the different specialties of the physicians and physician assistants, the supply or capacity on a certain moment influences the schedule. To be able to reach the production agreements the aim should be to adapt the capacity to the demand. At this level, there is much improvement to be made which will make the use of capacity more efficient.

1.3 Problem definition

The performed problem analysis made aware of the extensiveness of the subject of not reaching the agreed production. A lot of problems seem to contributed to this main problem. To solve the main problem we want to tackle one of the sub problems. The problem analysis reveals that insufficient capacity or demand is not the issue. The most relevant problems were found within the subgroup: capacity is not used efficiently. Although the problems within this subgroup can be interrelated we focus on one problem. A very relevant and interesting part is that of the planning not being optimal. This will be the focus of this research. Finding a solution on making a planning with a better match between capacity and demand will help to use the capacity more efficient.

A match between capacity and demand is needed when planning consultation hours per sub specialism. The problem analysis shows that there is no insight in the performance on this match. There is uncertainty on the demand for the different specialism's. Insight in this demand can make a better match between capacity and demand, which will reduce the chance that capacity is not used efficiently because the capacity is actually needed within another sub specialism for a certain week.

To develop a model that makes this match possible this research makes use of so-called clinical pathways. A clinical pathway describes the path a patient goes through after a first visit. It describes when a patient should be seeing a certain caregiver. Clinical pathways will be discussed in more detail in Chapter 2.2. The idea that future demand is partly based on the demand of patients already in the system and following a certain path, is very important in this research.

1.3.1 Main goal

The aim of this study is to analyze the current tactical planning process and to develop a model that provides information on the expected demand of care and needed capacity to support the planning on the outpatient department with the goal to improve the match between capacity and demand.

This in turn can make the use of capacity more efficient to ensure that inefficiency is not the problem that limits the department form reaching the agreed production volume.

1.3.2 Research questions

To reach the research goal, we need to answer the following research questions:

1. What relevant information can be found in literature on tactical planning of capacity and demand?
2. How is the current planning process organized?
3. How can we develop a model to provide insight in the expected demand and the needed capacity to improve the match between capacity and demand for ambulatory care?
4. Is the planning tool, based on the model, useful in improving the match between capacity and demand?
5. What are the conclusions and discussion points of this research?
6. Which recommendations can be done to the gynecology department?
7. How can we implement the planning tool into the planning process?

The next paragraph will explain the methods used to answer the research questions.

1.3.3 Research methods

This research can be called applied research. Babbie (2007) distinguishes between pure and applied research. Pure research is meant to derive knowledge and theories about a certain topic whereas applied research aims to apply a solution in a certain case. We try to find an intervention that will work in practice for this specific organization. Therefore this is an design-oriented case-study. To be able to design a model this research contents two of the purposes described by Babbie (2007). These purposes are exploration, description and explanation. This research has both descriptive and explanatory elements. Descriptive by questioning the performance of the current situation and the current process. And explanatory by identifying possible reasons and possibilities for improvement. Both qualitative and quantitative methods are used to get the needed information. Designing a model to improve the current planning process is the ultimate goal.

To answer the first research question we will search for literature on planning methods and former research on improvement of planning processes. The search engines Scopus and Google scholar are the main sources for literature search. The results on the literature study are provided in Chapter 2.

Answering question 2 is done by analyzing the planning process by observing the process and by questioning the head of the unit and the employee in charge of the planning. We use open interviewing. This means that there are some questions prepared on forehand, the rest of the questions depend on the conversation. Furthermore, we analyze some work descriptions and protocols. An employee in charge of the data warehouse provides data on the number of EPB's per month per diagnose, repeat factors, access times and no shows. The results of the analysis can be found in Chapter 3.

To answer the third question we identify the variables needed to determine the future demand. Then we develop a model in which we link future demand and capacity. We use Excel to make a planning tool. With verification and validation on the model we give an answer on the fourth question. Chapter 4 describes and validates the model and the planning tool.

The answer on the fifth question will follow from the results in Chapter 4. We gather the suggestions that are found during research. With reference to the developed model and the planning process we list the conclusions and discussion points in Chapter 5.

To answer question 6 we gather the recommendations based on the conclusions of the research. The recommendations are discussed together with members of the department. This is described in Chapter 6. This chapter will also answer question 7, outlining ways for implementation. We will also develop a manual for the planning tool in collaboration with the head of the department.

Table 2 gives an overview on the research questions and the linked chapters in this thesis.

1.3.4 Scope of the research

As written before the research provides a model to match capacity and demand. This match is needed for the whole production in the department. However, in this research the focus will be on the consultation hours for pregnant women. This is mainly because clinical pathways form the basis for this research and till now these are not developed for the other patients groups of the department. Besides that, there is a lot of uncertainty on the demand for care for pregnant women and the department is interested in reducing this uncertainty and improving the match between capacity and demand.

Table 2 Chapter outline

Research Question	**Chapter**	**Chapter title**
1. What relevant information can be found in literature on tactical planning of capacity and demand?	2	Theoretical framework
2. How is the current planning process organized?	3	Analyzing the current situation
3. How can we develop a model to provide insight in the expected demand and the needed capacity to improve the match between capacity and demand for ambulatory care?	4	Model and planning tool
4. Is a planning tool, based on the model, useful in improving the match between capacity and demand?	4	Model and planning tool
5. What are the conclusions and discussion points of this research?	5	Recommendations
6. Which recommendations can be done to the gynecology department?	6	Recommendations and implementation
7. How can we implement the planning tool into the planning process?	6	Recommendations and implementation

2 Context analysis and literature overview

This chapter provides a brief analysis of the context of the research and contains an overview of the relevant literature regarding the research questions. Context information on the obstetric system and clinical pathways is discussed in Section 2.1 and 2.2. Section 2.3 and 2.4 give an answer to the first research question: What relevant information can be found in literature on tactical planning of capacity and demand? In Section 2.3, the theory on planning on a tactical level is described. Section 2.4 provides literature on matching capacity and demand. And Section 2.5 gives the implications of this information for the research.

2.1 Gynecology and obstetrics

The specialisms gynecology and obstetrics deal with all kind of woman diseases. Originally a gynecologist was dealing with all the diseases in his department. In 1972, however, the American Board of Obstetrics and Gynecology formed some subspecialties within the discipline of gynecology and obstetrics (American Board of Obstetrics and Gynecology, 2009). This lead to the creation of the sub specialism's: gynecologic oncology, maternal-fetal medicine, reproductive endocrinology and infertility. In the Netherlands accepted sub specialism's are:

- gynecologic oncology: for cancer in the female genital;
- obstetric perinatology: for high risk pregnancies;
- urogynecology: for pelvic floor problems and incontinence;
- reproductive medicine: for man and woman with fertility problems.

2.1.1 The obstetric system

The obstetric care in the Netherlands is delivered by obstetricians, gynecologists and physician assistants. There is a distinction between first line and second line care. First line care is delivered close to home with obstetricians counseling the pregnancy as long as the progress is normal. The first line obstetrician is able to detect a possible increased risk. The patient is then referred to second line care. This care is delivered at a hospital by gynecologists and obstetricians working under supervision of a gynecologists. Risk selection is very important in choosing for first line or second line care and is an continuing process during the pregnancy (Bais & Pel, 2007). The supply of patients in the obstetric system is via the first line. The first line refers to the second line. Lako & Rosenau (2009) show that the choice for the hospital is often made by the referring obstetrician or general practitioner, namely in 58% of the cases. For 18% of the patients the choice was based on the reputation and 24 % chose for another reason e.g. location.

2.2 Usefulness of clinical pathways

Clinical pathways or integrated care pathways are very important in this thesis. The model for the forecast of future demand is based on the patient flow outlined by the clinical pathway for uncomplicated pregnancies. Vanhaecht, De Witte, & Sermeus (2007) give the following definition for a clinical pathway, also known as care pathway:

"*A care pathway is a complex intervention for the mutual decision making and organization of care processes for a well-defined group of patients during a well-defined period.*

Defining characteristics of care pathways include:

i. *An explicit statement of the goals and key elements of care based on evidence, best practice, and patients' expectations and their characteristics;*
ii. *the facilitation of the communication among the team members and with patients and families;*
iii. *the coordination of the care process by coordinating the roles and sequencing the activities of the multidisciplinary care team, patients and their relatives;*
iv. *the documentation, monitoring, and evaluation of variances and outcomes; and*
v. *the identification of the appropriate resources."*

The origin of this phenomenon is to be found in the industrial quality management. Standard operating procedures (SOP) where developed to use the resources in a more efficient way and to use a standard amount of time to finish a certain task . Clinical pathways were first used in the New England Medical Center in the USA. Originally clinical pathways were used to design care processes to deliver qualitative good care. Today the clinical pathways are also used to improve the efficiency in processes (Vanhaecht, Panella, van Zelm, & Sermeus, 2010). Literature and guidelines need to be input for the pathways. To guarantee the validity of clinical pathways and the quality of the care process itself, there should be continuous improvement (Vanhaecht, Panella, van Zelm, & Sermeus, 2010).

When starting to use clinical pathways the design of the pathway makes care givers think about the current care processes. Changing certain elements of the process in the creation of the pathway causes the first improvements. In a survey with questions on the ways in which clinical pathways can be used, most respondents agreed that pathways can be used for allocating resources and workforce and service planning. The actual use in the questioned applications was much lower (Hindle, Dowdeswell, & Yasbeck, 2004).

2.3 Literature on scheduling in hospitals

The literature search on matching capacity and demand learned that there are a lot of topics regarding scheduling in different parts of health care at different levels. A lot of research is performed to find ways to improve the capacity utilization in hospitals. The simulation model PROMT is an example of

software that can be used to simulate different scenarios the resources beds, operating theatres and nurses (Harper, 2002). This example is totally based on hospitals as a place where patients stay overnight. There is also literature on appointment systems in outpatient departments, especially on the operational level. Simulation is often used to reduce waiting times for patients and to avoid idle time of physicians. Cayirli & Veral (2003) reviewed the literature for outpatient scheduling appointments, concluding that a lot of studies are too case-specific to use in other cases and that a lot of possible appointments schedules are found but there is a lack of knowledge on variation in patient flow. Moreover appointment rules were not successfully implemented in practice.

Appointment systems assume a certain amount of capacity in the system. Often this capacity is fixed, when filling up with appointments. However, capacity in a department working with physicians with different subspecialties is partly variable. This means that a decision needs to be made on how much time or capacity, is used on a certain sub specialism. In some literature importance of these decisions is stated but not included in the research (Gupta & Denton, 2008). They describe that in case of several medical specialties access rules are used to determine the needed time for a certain type of appointment. Literature on appointment systems is often on the operational level, while this research focuses on decisions on a tactical level, which will be explained in the next paragraph.

2.3.1 Tactical planning

In this research the focus is on the processes around tactical planning in the outpatient clinic. To be able to look at the different levels of planning in a good way a framework for planning is used, shown in Figure 3, (Hans, Houdenhoven, & Hulshof (2011)).

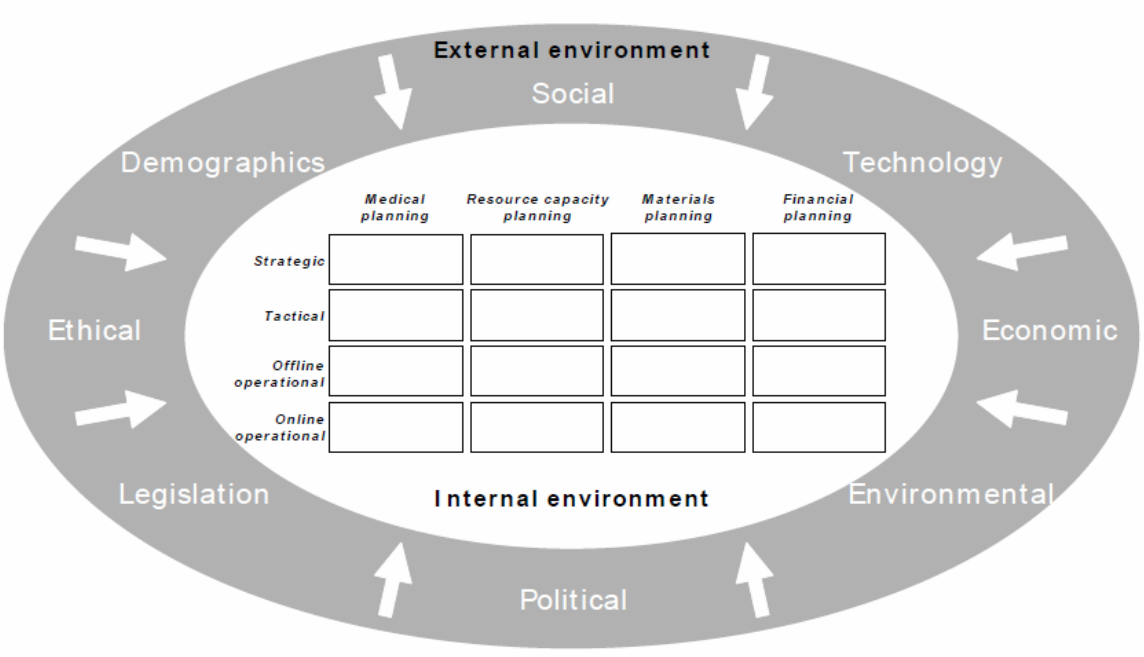


Figure 3 Planning framework with internal and external environment (Hans, Houdenhoven, & Hulshof, 2011)

This framework enables the user to place each planning function and activity in the right context. There is a lot of interaction between the boxes. For instance strategic decisions have impact on tactical planning and the performance on the tactical level can influence the strategic decisions in a next period. In addition, the different planning areas, medical planning, material planning and financial planning, do influence the decisions and choices for the tactical resource capacity planning. The financial planning provides constraints or possibilities for decisions in the other planning areas. Besides the internal environment the framework includes the external environment of a health organization. As written in the introduction there is a major role of the politics influencing the decisions in a hospital regarding cost efficiency. Another issue already mentioned in Chapter 1 is that of demographics, because it determines the expected demand in a certain area.

In the figure four types of planning are shown: medical planning, resource capacity planning, materials planning and financial planning. This research focuses on the resource capacity planning. Figure 4 shows the hierarchical levels from the framework for the resource capacity planning. It is filled with the planning functions for our situation on the gynecology outpatient department in MST. Seen from the tactical planning point of view, interaction with both the strategic and the operational planning levels is needed to get a good tactical performance. For this research it means that while focusing on the tactical planning, strategic and operational issues will be taken into account to get a clear vision on how decisions on these areas influence the other areas. Decisions in the whole matrix will create limitations or create possibilities for the tactical planning for the department.

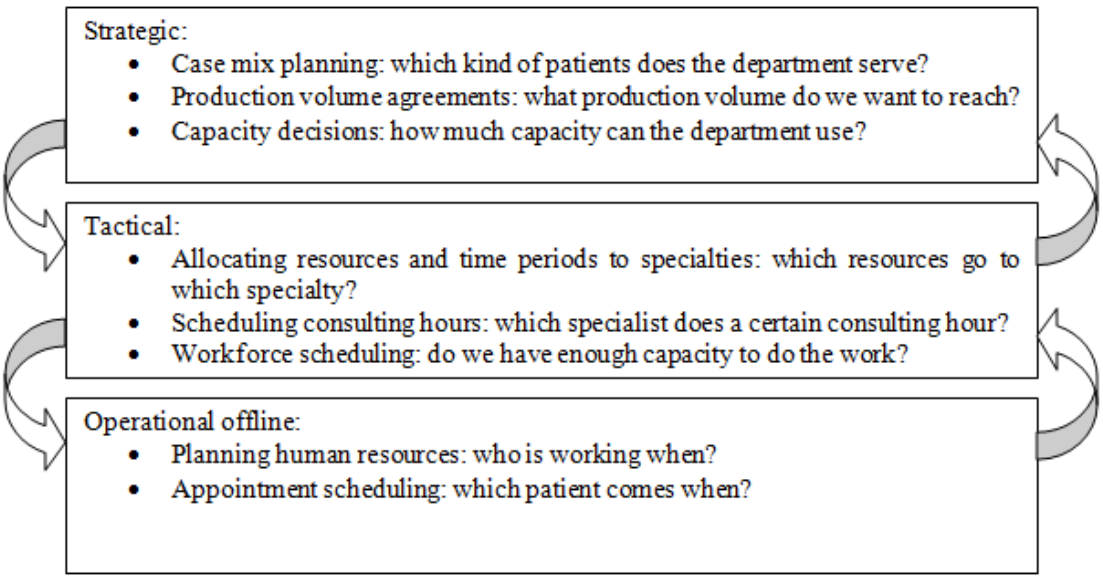


Figure 4 Planning functions from the department gynecology on different hierarchical levels

2.4 Former research on matching capacity and demand

In an outpatient department different resources are used. Resources are for example: specialist time, consultation rooms, secretaries and materials. The problem analysis in Chapter 1 showed that the number of consultation hours are not always matching demand, while consultation rooms and

equipment were sufficient. Therefore the specialist time is assumed to be the bottleneck resource. Specialist time is a shared resource which has to be divided among different patient care activities, such as operating theatres, clinic sessions and consultation hours per sub specialism (Vissers J. , 2005).

2.4.1 Forecasting demand

To obtain a match between capacity and demand information on the expected future demand is essential for planning on the different planning levels. Forecasting can be used to determine the expected demand for a future time frame. Although a forecast is never exact it can be used to decide on the planning of resources.

Forecasting can be done by a judgmental method in which experts give their opinion on future demand. But forecasting in hospital care can also be based on historical data when valid data is available. Within these main types there are a lot of methods for forecasting as shown in Figure 5. The use of graphs helps to identifty trends, seasonal effects or cylical effects. Whereafter the right method can be applied to forecast demand (Voudouris, Owusu, Dorne, & Lesaint, 2008).

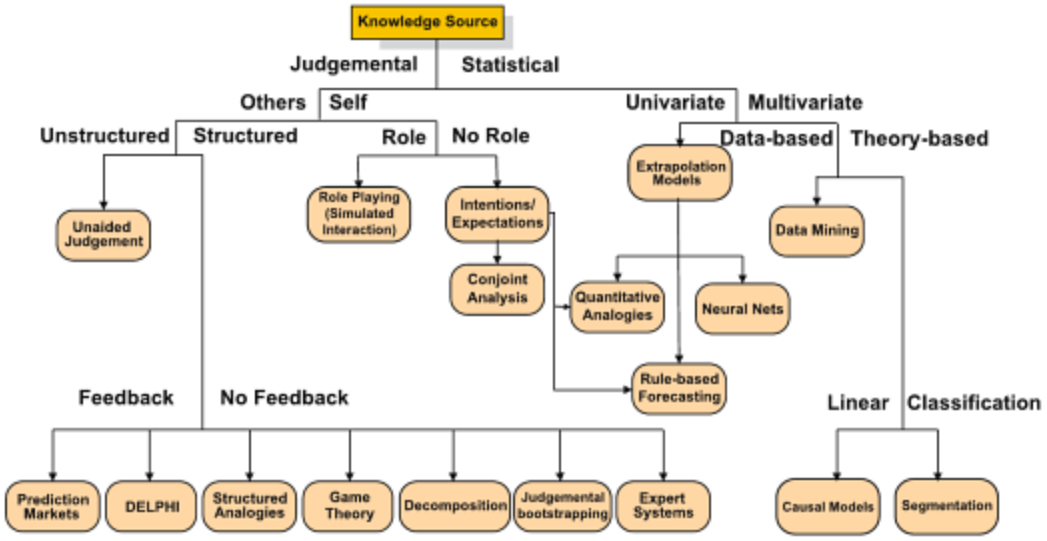


Fig. 4.4 Methodology tree for selecting forecasting approach (Forecasting Principles 2007)

Figure 5 Methodology tree for selecting forecasting approach (Forecasting Principles, 2007)

Côté and Tucker (2001) describe four commonly used forecasting methods in healthcare. These are the so-called percent-adjustment forecasting method, the 12-month moving average, the trendline and the seasonalized forecast. The method that will give the most precise forecast compared to actual demand should be used. The choice also depends on the availability of historical data.

The percent-adjustment method uses data of the past 24 months. It compares the total demand from a year 1 with that of year 2. The third year gets the percentage increase or decrease as found from year 1

to year 2. From that total expected demand for year 3 the average expected demand per month is taken. So it doesn't take into account the fluctuations between months.

The 12-month moving average calculates a forecast per month. The forecast for each month is the average of the 12 months before that month. This is more accurate compared to the percent-adjustment method, because the forecast changes per month. However, the forecast becomes less accurate when for example a steep decline occurs over the last three months because the method smoothes this trend.

The trend line method does account for trends. In this method the slope of the trend line is measured. With that slope the future demand is forecasted. So this method is more precise than the aforementioned, but it does not account for seasonality.

The last method is called seasonalized forecast. This method involves adjustments for trend and seasonality. The average over two former years is adjusted by an seasonal index per month and by the slope of the trend. This will be a more advanced calculation when implementing in the department, but it gives a more accurate forecast. It depends the existence of a trend or seasonal effect whether it is needed to use this last method or not.

2.4.2 Panel sizing

The forecast in Subsection 2.4.1 is about the expected new patients based on historical data. Besides new patients an outpatients provides care to patients already in a clinical pathway. Therefore a forecast on demand should also be able to determine the expected demand for control patients. Methods developed to determine this number of patients are found in literature. For family practices a panel size can be calculated which assumes that there is a maximum number of patients that can be helped by one health care provider (Murray, Davies, & Boushon, 2007).

Vanberkel (2011) studied panel sizing in oncology. In this panel sizing the panel size, the maximum number of new patients a physician should follow, taking into account new patients will come back for repeat visits, are determined. In oncology there are also patients that after discharge relapse into the care system. So a patient can either be a new patient, an active patient or an inactive patient. After a period the inactive patient returns to be an active patient again or else exits the care. The study is based on the statement that the number of patients treated today are indicator for future demand. Probabilities are used to determine the state of the patients. And a distribution is used to determine the length of time in a certain state.

In this research the number of new patients today are also indicator for future demand. We assume that each patient follows a clinical pathway. In the clinical pathway each of the consecutive steps are defined and also the period of time between the steps is determined. Therefore we can take into account the demand for control patients.

2.5 Conclusions

Background information on the obstetric field learns that the specialty contains different subspecialties. The care in hospitals is called second line care and their patients come from the first line care provided by general practitioners and obstetricians. According to literature clinical pathways are developed to organize the care to perceive good quality of care. In this research we want to use the pathway for improvements on the planning process. Literature endorses that clinical pathways can be used to improve the quality of the processes. Planning is done on different levels. The focus of this research is on the tactical level. The planning functions in MST are placed in the planning framework. In this research specialist time will also be assumed to be the bottleneck resource which is reflected in the fact that we focus on the planning of specialists for consultation hours. To match the capacity with demand we need to know the expected future demand on uncomplicated pregnancies. Literature shows that demand can be forecasted with different forecasting methods. For this research we use historical data to forecast demand. In Chapter 3 the historical data on new patients for uncomplicated pregnancies is analyzed. It shows that at least seasonality should be taken into account. To take into account also the patients already in the clinical pathway we use the idea as in panel sizing. The principle, number of patients treated today are indicator for future demand, will be used in the model developed in this research.

3 Analyzing the current situation

Chapter 3 is about the current situation on the department providing an answer on the research question: How is the current planning process organized? Section 3.1 explains the context situation for the gynecology department. In Section 3.2, the planning process is described. Section 3.3 gives some facts on the uncomplicated pregnancies and Section 3.4 explains the clinical pathway for this target group. Section 3.5 will draw a conclusion from the analysis in this chapter.

3.1 The gynecology department

Outpatient departments are the departments in a hospital were patients come to visit a physician and then go home afterwards. An outpatient department in MST operates as a so-called "result responsible unit" (In Dutch: resultaat verantwoordelijke eenheid (RVE)). Each RVE has its own budget, needs to reach previously set targets and has to justify its results in front of the board of the hospital (MST, 2008). Each year the production volume is determined by the board of the hospital and the physicians, working in a partnership (In Dutch: de maatschap). The negations of the board with the insurance companies influence these decisions.

The gynecology department of this hospital is serving the specialisms gynecology and obstetrics. Care is delivered by gynecologists, obstetricians, echoscopists and physician assistants. The physician capacity planning is in this paper covering different tasks for the specialists. For example the tasks to do a ward round, doing an operating theatre session or a clinic session with consultation hours in an outpatient department. On the VKC building a policlinic operating room (POR) is available for physicians doing minor surgeries after which the patient can go home. Also a so-called observation room (OBS) is available to receive emergency patients; a physician is needed on the observation room as well. The planning on consultation hours is often a closing item. Some of the tasks can also be done by physician assistants. They do consultation hours independently, with the help of a supervising physician when needed.

The outpatient department for gynecology serves different sub specialism's. In this research we focus on the consultation hours. Different consultation hours are held for each sub specialism. This means that the following consultation hours can be distinguished:

- Consultation gynecology
- Consultation pregnant
- Consultation high risk/ perinatology
- Consultation urogyn (two specialism's: urology and gynecology)
- Consultation oncology
- Consultation sexology
- Consultation osteoporosis

3.2 The planning process

In this research the planning processes on the tactical level of the planning framework are covered. The focus is on the consultation hour schedule. To come to such a schedule the planner allocates resources to the different tasks of physicians as doing ward rounds and operating theatres. After that the planner decides on the number of consultation hours per sub specialism. As written before a consultation hour is on average a 3 hour shift.

At the time of this study there is one employee in charge of the capacity planning for the physicians. This employee has the knowledge for the planning in the specific situations within this department. Three months in advance the planner aims to have finished the schedule. The planning for the physician assistants is done by one the physicians in charge of the education of the physician assistants, because he or she is informed of the current knowledge of the physician assistants. This planning comes often one month in advance. The employee in charge of the planning tries to optimize the match between the two schedules and finishes the total consulting hour schedule.

In Figure 6 the current planning process is shown. First step is to determine the available physicians. Then ward shifts need to be filled in. Then the holidays and congresses of physicians need to be blocked. Furthermore physicians need to be allocated to both the general OR and the policlinic OR. After that physicians can be scheduled for consultation hours spread over different sub specialism's. The schedule of the physicians then needs to be combined with the schedule of physician assistants which might result in adjustments. After that the final schedule is ready.

There are some constraints concerning the preferences of physicians regarding working hours, consulting hours, days off, days in congress etcetera. The listed preferences beneath are taken into account when making the consulting hour schedule:

- After a shift of clinic service there needs to be a scheduled day off.
- For part-timers this should be on an already free day because of the part-time working.
- Working hours are from 8.00-16.30.
- A physician needs to do two OR's per month
- A weekend shift is spread over two weeks. This means working on Friday and Sunday the first week and working on Saturday the next week.

The software used to make the planning is called Medspace. This is an internet application which is kept by the employee in charge of the planning. Figure 7 shows a screenshot of the schedule in Medspace. The white areas on the left normally contain the names of the resources, either physicians or assistants. The planner uses abbreviations to fill in the schedule, which is done manually. The system is therefore quite error-prone and needs revisions before making public.

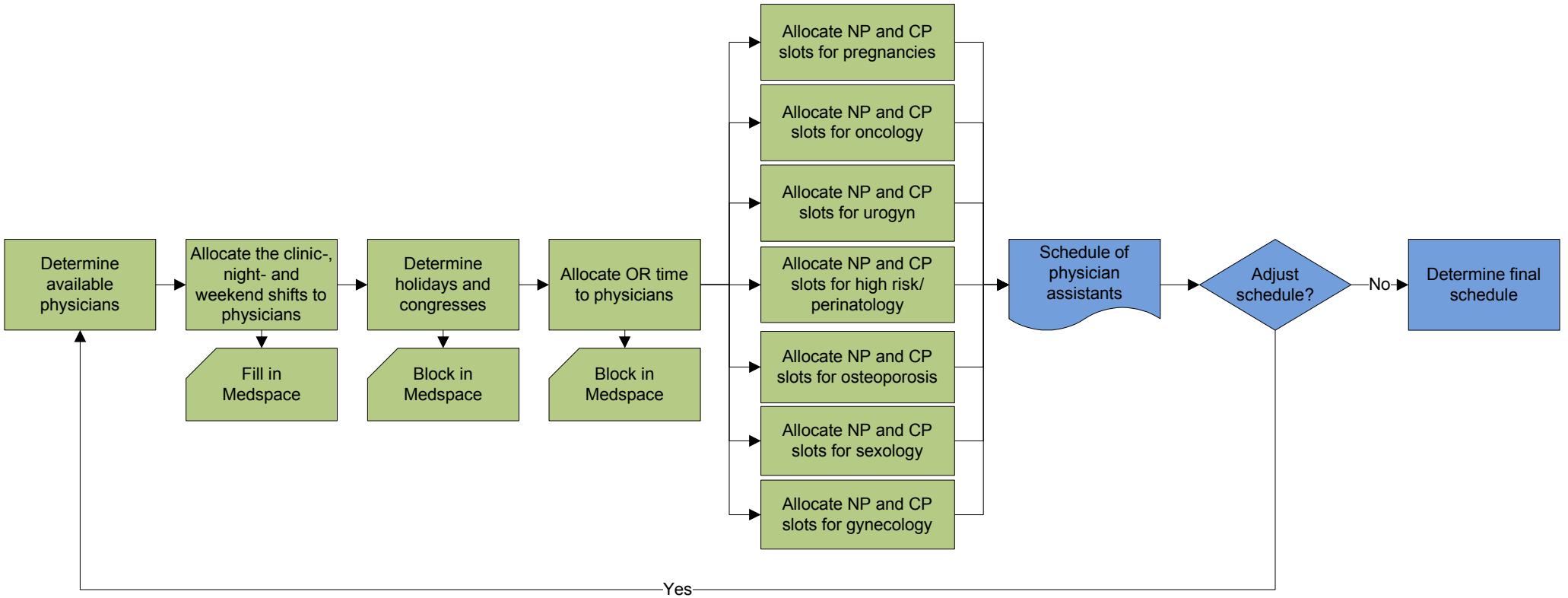


Figure 6 Planning process

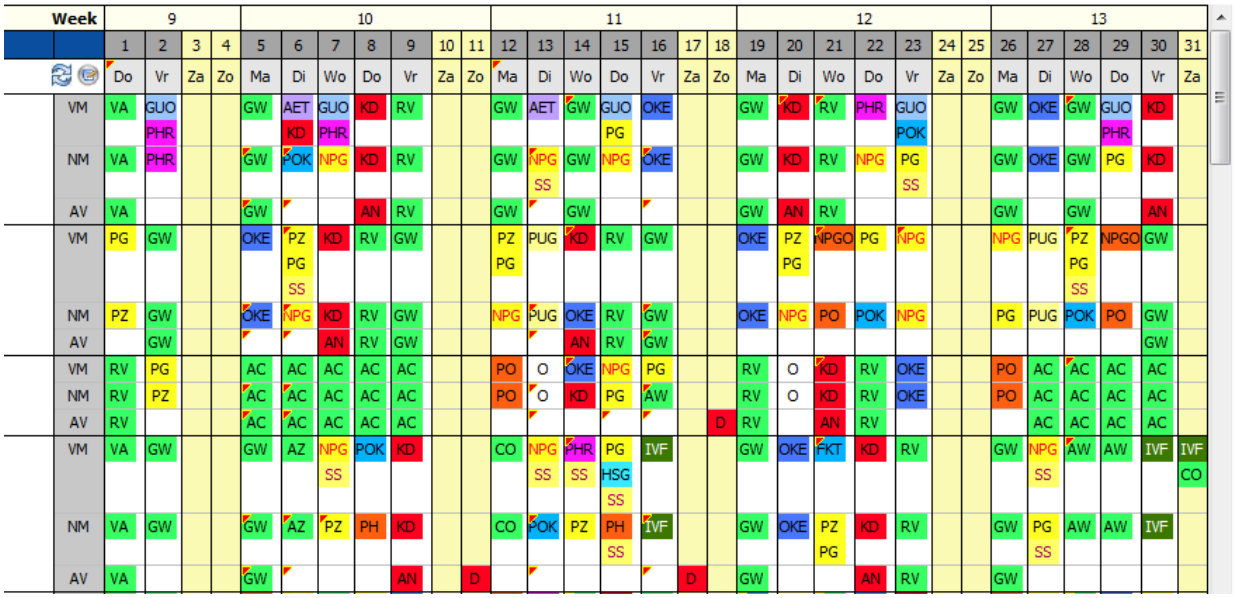


Figure 7 Medspace screenshot

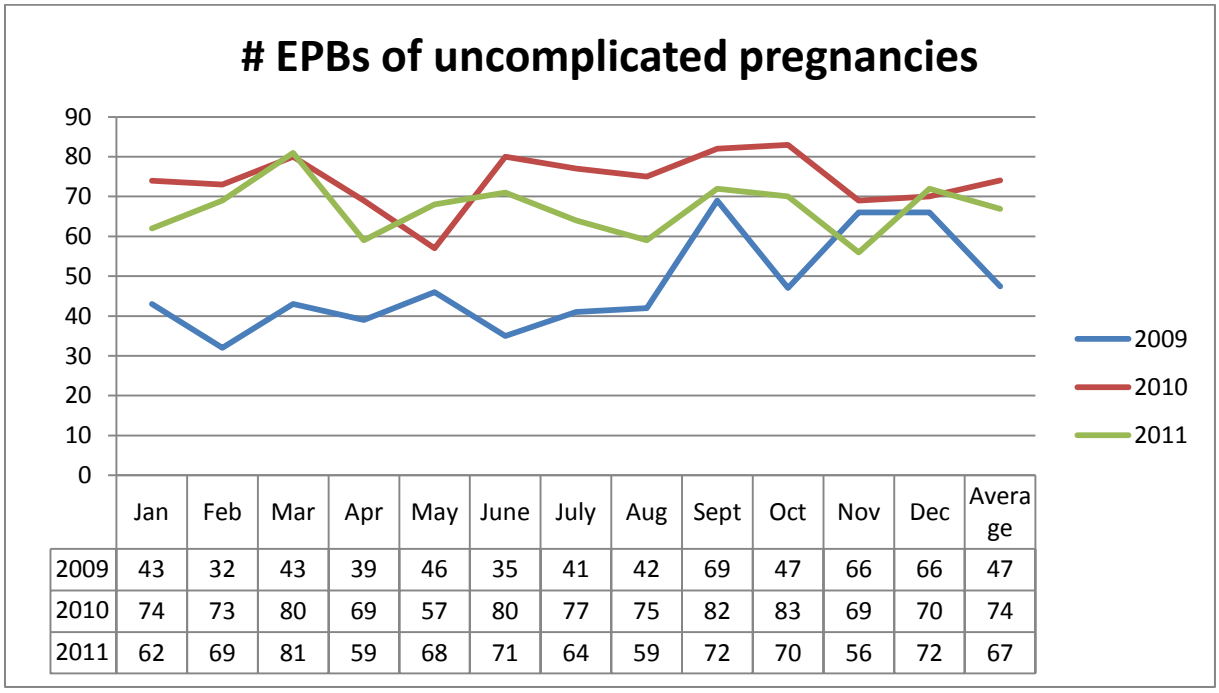
The current input for the decision on allocating resources depends on the knowledge of the planner on the average needed capacity per sub specialism per week and knowledge of the current number of consultation hours per sub specialism being sufficient or not. Currently the planner does not dispose of a certain demand forecast. Therefore matching demand and capacity on consultation hours is not an easy job. Additionally, there is no information on the performance of the match between the former planned capacity and the actual demand for that period.

3.3 Uncomplicated pregnancies

The scope of this research is on the consultation of pregnant woman following a clinical pathway for uncomplicated pregnancies. The department has developed clinical pathways for complicated pregnancies such as: pregnant with diabetes, multiple pregnancy, pregnant with a body mass index higher than 30 and pregnant with maladaptation. A pregnancy with maladaption has an increased risk of complications or miscarriage. Uncomplicated pregnancies are the pregnancies who do need the care from a hospital but do not belong in any of the complicated care pathways.

From the hospital information system we derived information on the number of EPB's for the uncomplicated pregnancies in 2011. Theoretically, EPB's can besides new patients also contain patients that have been receiving care for more than 12 months, resulting in a registered EPB. Since a pregnancy lasts shorter than a year we expect that the number of EPB's is the same as the number of patients in treatment. In 2011 there was a total of 2254 EPB's for pregnancies which is 22 percent of the total number of EPB's. From the total pregnancies 803 EPB's were from uncomplicated pregnancies being 7.7 percent of the total EPB's of the department.

In Figure 8 we see the number of EPB's plotted against the time from the years 2009, 2010 and 2011. For 2010 and 2011 we see that the rise and fall in the curve is almost the same. Because this information is based on data for 3 years we have not much evidence that there indeed is a seasonal effect. However, the effect is recognized by the staff of the department. It means that for the match of capacity with demand we take into account that the expected demand differs per month.



	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Average
2009	43	32	43	39	46	35	41	42	69	47	66	66	47
2010	74	73	80	69	57	80	77	75	82	83	69	70	74
2011	62	69	81	59	68	71	64	59	72	70	56	72	67

Figure 8 Number of EPB's over time

3.4 Clinical pathway uncomplicated pregnancy

Clinical pathways in MST are developed to standardize the care for patient groups. The documents describe how often and in which time period a patient should return to the outpatient department after an EPB or (P)OK. In Appendix C the clinical pathway for uncomplicated pregnancies is shown. The pathway is divided into different phases. Each phase corresponds with a certain 'week of the pregnancy'. For example in the first phase, the patient is in the ninth week of the pregnancy and has to come to have an ultrasound scan made by a sonographer. In the second phase, the patient is in the tenth week of the pregnancy and has to be seen by the gynecologist.

In some phases of the pathway only the gynecologist has a task, in some phase only the sonographer and in some phases the gynecologist and sonographer both have tasks. For the capacity it means that for some phases we need more than just one visit at the consulting hours from the gynecologist. For this research we match the demand and the capacity to schedule the consulting hours. Therefore the model will base the capacity just on the phases in which the gynecologist is needed.

3.5 Conclusions

An important task of the department of gynecology is to held consultation hours. This part of the care has the focus of the model. The planning of the capacity of physicians is performed by one employee in charge of the planning. The planner allocates the physicians to several tasks and blocks their agenda's for congresses and vacations. After that the planner decides on the distribution of the remaining capacity of physicians to the different consultation hours. Till now this is not structurally based on historical data. A model to forecast the future care will be an improvement on the current planning process. Historical data on demand for uncomplicated pregnancy care learns that demand fluctuates over the months of the year. A model for the forecast of demand should account for these fluctuations. The way in which this is done is covered in Chapter 4. Analysis of the clinical pathway of uncomplicated pregnancies has different phases with a different capacity needed per phase. The phases of the pathway and the needed capacity will be input for the model in the next chapter.

4 Model and planning tool

In this chapter, the developed model for insight in the expected demand and the needed capacity is described in Section 4.1. Section 4.2 is about the planning tool that is developed to make the match between capacity and demand for ambulatory care possible. Combined with the knowledge from the former chapters Section 4.1 and 4.2 will answer the third research question: How can we develop a model to provide insight in the expected demand and the needed capacity to improve the match between capacity and demand for ambulatory care? The verification and validation of the model is also described in Section 4.2 answering the fourth research question: Is the planning tool, based on the model, useful in improving the match between capacity and demand. Section 4.3 summarizes the conclusions on the developed model.

4.1 Model description

The model developed provides insight in the demand and the needed capacity for the coming periods. The purpose is that the scheme will provide knowledge for the tactical planning on how much space and/or time is needed for consulting hours for a certain sub specialism. More concrete this means that the model gives the expected number of required new patient (NP) slots and follow-up patient (CP) slots per week.

As mentioned in the introduction the tool will be applied on the care pathway for pregnant women. In Figure 9 we see a simplified representation of the clinical pathway, with in the middle the different phases. A new patient enters the pathway in one of those phases. Then the patient follows the remainder of the pathway. In most cases the patient will exit the pathway when the child is born. In some cases, however, the patient will drop out earlier. The patient might be discharged because specialized care is no longer needed or the patient might be referred to an obstetrician, a general practitioner or another hospital. Besides that the uncomplicated pregnancy can become complicated and the patient can end up in another clinical pathway.

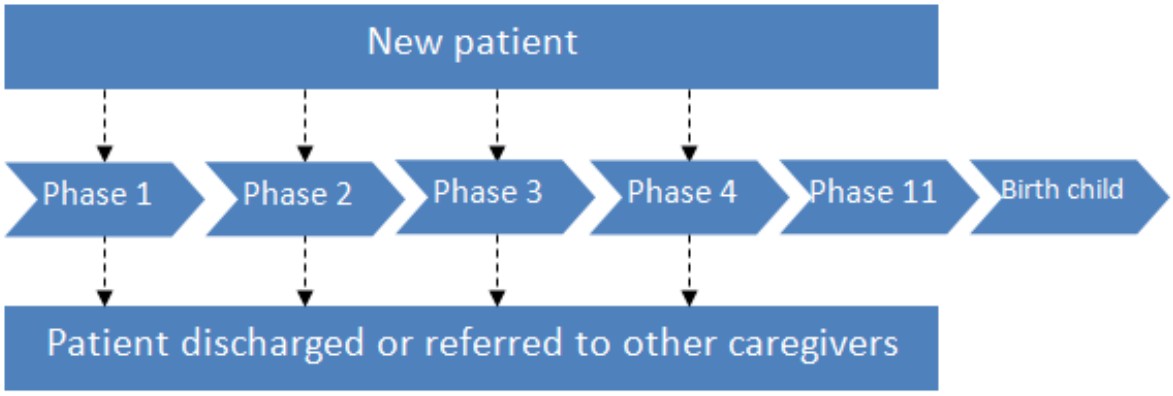


Figure 9 Model of the clinical pathway

The model is based on the following assumptions:

1. Every patient entering the system is always following the clinical pathway.
    a. This means that we expect a patient in a certain phase to come for the next phase in the exact week given in the clinical pathway.
    b. This means that a patient never skips a phase.
    c. It also means that a patient is not coming between two phases.
    d. In principle, the model assumes that every patient is finishing the whole pathway, unless the user of the tool specifies otherwise.
2. The model doesn't account for the availability of the gynecologist who has seen the patient before.
3. Demand is determined by the patients visiting the department and not by the number of referrals.
4. The specialist time used per NP or CP slot is independent of the fact whether a gynecologist or a physician assistant is doing the consultation hour.

4.1.1 Demand

The input for demand in the model consists of two components. One component of the demand is based on the expected repeat visits of patients already in the system. Clinical pathways provide a standard on the frequency of repeat visits and the interval between those visits. With information about the current number of patients in a certain phase of the pathway, it is possible to calculate the expected number of patients in a certain phase on a later time. To be able to do the calculations, we need to use data on the week of the pregnancy instead of the phases of the clinical pathways. In the final outcome of the model we will convert the variable 'week of pregnancy' into 'phase of clinical pathway'. Let w = 1,2,3,…, *41* be the different weeks of pregnancy in which the patient can be. Suppose we determine the demand for care on time t based on the number of patients in the system at the previous week and naturally also the previous week of the pregnancy. Then $N_w(t)$ is the expected number of patients in the week of the pregnancy w at time t based on $N_{w-1}(t-1)$ with the number of patients in the system at the previous week.

The other component is either the forecasted number of new patients per phase coming into the process or the actual number of new patients per phase as soon as available. New patients do not necessarily enter the clinical pathway in phase 1. Therefore we need to distinguish between the forecasted number of new patients per phase. Lets denote $F_w(t)$ as the total forecasted number of new patients in week w at time t. As soon as there is information on the actual number of new patients per phase in a certain week the forecasted demand will be replaced with the actual number of new patients expressed as $A_w(t)$.

For the total expected number of patients in a week w of the pregnancy on time t, represented as $N_w(t)$, we add up the two components. Assuming that information on the actual number of new patients for a certain week is available when that week was in the past makes the model calculate with either the forecasted or the actual numbers. Let T denote the current week and t the week for which the number of patients is calculated.

$$N_w(t) = \begin{cases} N_{w-1}(t-1) + F_w(t) \; if \; t \geq T \\ N_{w-1}(t-1) + A_w(t) \; if \; t < T \end{cases}$$

Table 3 Phases versus weeks of pregnancy

Phases	Weeks of pregnancy	Interval till next visit (phase)
1	9	1
2	10	2
3	12	9
4	21	4
5	25	5
6	30	3
7	33	3
8	36	2
9	38	2
10	40	1
11	41	

To convert the number of patients in a certain 'week of pregnancy' into 'phase of clinical pathway' we use the information in Table 3. The number of patients in N_{phase} is the same as the number of patients in the corresponding week of pregnancy for that phase.

4.1.2 Capacity

With the information on how many patients are expected in a certain phase in a certain week it is possible to calculate the needed capacity. To get this right we need to differentiate NP and CP slots, respectively slots for new patients and follow-up patients. This because new patients take a slot of 20 minutes and follow-up patients need a slot of 10 minutes. In Table 4 the needed employees per phase according to the clinical pathway are shown. In all phases a gynecologist is needed for either a NP or a CP slot except from phase 1. The number of NP slots needed is the number of forecasted new patients for that *phase* when *t* is in the future or the number of actual new patients when *t* is in the past.

$$NP_w(t) = \begin{cases} F_w(t) \; if \; t \geq T \\ A_w(t) \; if \; t < T \end{cases}$$

The number of CP slots needed is the number of patients in the pathway the week before.

$$CP_w(t) = N_{w-1}(t-1)$$

Table 4 Needed employees per phase

Phase	1	2	3	4	5	6	7	8	9	10	11
Gynecologist		X	X	X	X	X	X	X	X	X	X
Sonographer	X		X	X		X					

The normally scheduled consultancy hours for uncomplicated pregnancies are 24 NP slots and 100 CP slots per week. The expected number of needed slots is compared with this fact.

4.2 Planning tool

To be able to use the model described in Section 4.1 in practice, we designed a planning tool. The tool is build in Excel. With correct input data the tool will be able to give the expected demand for the coming period. The outcomes can be used by the employee in charge of the planning to take into account the expected demand.

4.2.1 Input model

For the forecast we took the following input. In Section 3.4 the number of new patients is described in the number of EPB's per month. We saw that the numbers of new patients differ for 2009, 2010 and 2011. The numbers of 2010 are higher than in 2009. However, from the numbers of 2011the majority is less than the numbers of 2010. Because there is no indication for a growing or shrinking demand for specifically the uncomplicated pregnancies we assume that the most recent data will be the best forecast for the future number of patients. Therefore we take the average number of new patients per week for just 2011 as input for the weeks in 2012. There seemed to be seasonality effects, because of a different average per month ranging from 11 to 18 new patients per month. Therefore we calculate an average of new patients per week for each month.

For the forecast we do not only need the total number of new patients, but also distribution of new patients per phase. In Table 4 is shown that the gynecologist is first needed in phase 2. This means that a NP slot is first needed in phase 2. The distribution of new patients per phase is derived from another research performed at the gynecology department at MST. Beltman & Klever (2012) studied the flow of patients through the clinical pathway. The research consulted in a distribution with 62% of the NP slots needed in phase 2, 3 % in phase 3, 6% in phase 4 and 29% in phase 6.

Beltman & Klever (2012) determined the number of patients leaving the pathway in a certain phase. The number of patients leaving the pathway is translated to a percentage of the people still in the system. They found that 5% of the patients left in phase 1, 20% in phase 3, 4% in phase 4 and 9% in phase 6. The number of patients in the system is adjusted for these percentages.

Another part of the input for the model is the number of people already in the system in the 'start week'. This 'start week' is the week from which the model is filled with data. From the hospital information system X-care we derived the patients in the system with week 14 as the start week. The hospital information system does not provide data on the phases of the pregnancy or the phase of the clinical pathway a patient is in. This information is available in DSV and can just be obtained manually. For now the current week of the pregnancy of the patient is found by counting the weeks from the 20 week echo till now. The 20 week is assumed to be the most accurate to measure with. However, not every patient has got a 20 week echo yet. On the patients without a 20 week echo the distribution of the weeks on which the patients with a 20 week echo come in, is used. We assume this to be the best way to fill the model.

Data from the actual number of patients is available when the weekly meeting on pregnancies is held. This is a meeting where every new patient is discussed. For now we got data for two of those meetings, held in week 12 and 13 of the year 2012. For the patients discussed in the meeting it was possible to derive data on the arrival week and the corresponding phase of the pregnancy manually from the patients record.

4.2.2 Verification planning tool

The model gives as output the expected number of needed NP and CP slots per week. It also shows whether overcapacity or undercapacity is expected compared to the number of slots scheduled normally. An impression of the outcomes is shown in Figure 10.

Week	27	28	29	30	31	32	33	34	35	36	37	38
Needed NP slots	17	17	17	17	14	14	14	14	14	21	21	21
Needed CP slots	152	116	111	126	105	125	107	109	117	99	97	98
Scheduled NP slots	24	24	24	24	24	24	24	24	24	24	24	24
Scheduled CP slots	100	100	100	100	100	100	100	100	100	100	100	100
Overcapacity/undercapacity NP	7	7	7	7	10	10	10	10	10	3	3	3
Overcapacity/undercapacity CP	-52	-16	-11	-26	-5	-25	-7	-9	-17	1	3	2

Figure 10 Output planning tool

Some checks are done to verify that the model works appropriately:

- We see that the forecasted number of NP slots stays equal for several weeks, this is correct because the forecast is calculated per month.
- The forecasted number of CP slots differs per week, we see fluctuations with a quit large range from 97 to 152 CP slots needed. It is correct that the outcomes differ per week because the input also differs per week.
- A change in the number of patients in the first week of a phase from the start week is reflected in the needed CP slots in the weeks after that.

- Filling in “0” patients entering the pathway, at ‘the input for actual new patients’, gives indeed an outcome of 0 needed NP slots for that week.
- Filling in “10” people leaving the pathway, at ‘the input for actual new patients’, gives 10 slots less needed for that week.
- Furthermore by watching the “model” sheet we see the pattern which shows that the number of patients in the system is calculated through the model.

The planning tool is successfully based on the designed model. The formulas work and the outcomes of the model are clear. Filling in the actual numbers of new patients or leaving patients will adjust the forecast and make it more accurate.

4.2.3 Validation outputs

The calculations of the model show an overall expected overcapacity on NP slots ranging from 3 to 7 NP slots. The outcome on the match between capacity and demand for CP slots is an expected undercapacity for most of the forecasted weeks ranging from -52 CP slot overcapacity to 3 CP slots undercapacity. This outcome is given by comparing the expected demand with the average number of slots scheduled per week.

To validate whether the planning tool is accurate or not we need to compare the forecasts with the real number of visits. The hospital information system does not easily provide this real data and we needed to find the information manually in X-care. We searched the system for the number of CP slots and NP slots for week 27 till week 38. The results are shown in Figure11.

Week	27	28	29	30	31	32	33	34	35	36	37	38
Expected # NP slots	17	17	17	17	14	14	14	14	14	21	21	21
Actual NP visits	21	26	26	23	15	18	13	26	17	22	12	23
Difference	-4	-9	-9	-6	-1	-4	1	-12	-3	-1	9	-2
Exected # CP slots	152	116	111	126	105	125	107	109	117	99	97	98
Actual CP visits	82	99	91	90	102	84	85	154	105	95	82	67
Difference	70	17	20	36	3	41	22	-45	12	4	15	31

Figure 11 The actual NP and CP visits for week 27 to 38

We see that there is a pretty large deviation between the expected number of NP slots and the actual number of NP visits. And the number of actual NP visits fluctuates more in reality than forecasted in the planning tool. But on average the real number of NPs in week 27 - 30 is higher than the actual number of NPs given in week 31 - 35 which corresponds with a higher expected number of new patients in the weeks 27 - 30 compared to the weeks 31 - 35. For CP slots Figure 11 shows that the number of used CP visits is lower than the expected number of CP slots. Some of the weeks actual number of CP visits are very different and others are very similar to the expectation.

Interesting is week 34 which forms an exception with a very high number of CP visits. The heat wave taking place in the Netherlands could be responsible for this outlier. Therefore the high number of CP visits is occasional. Besides that also the number of actual NP visits is very high. This shows that filling in the actual number of patients is important for the forecast.

We can check for accuracy by using the formulas for MAD mean absolute deviation and MAPE mean absolute percent error. These are also used when a choice has to be made for the forecasting method (Ozcan, 2009). The MAD gives a deviation for the forecasted number patients and the MAPE gives the error as a percentage of the actual number of patients. For the forecasted number of new patients this results in the following rates:

$$MAD = \frac{\sum|Actual-Forecast|}{n} = \frac{41}{12} = 3.42 \text{ and } MAPE = \frac{\sum|Actual-Forecast|}{\sum Actual} = \frac{41}{242} = 0.17.$$

For the control patients the calculations are as follows:

$$MAD = \frac{316}{12} = 26.33 \text{ and } MAPE = \frac{316}{1136} = 0.28.$$

The lower the MAD rate, the better the forecast. We see that the forecast on NP slots is more accurate with an error of 3.42 than the forecast on CP slots with an error of 26.33. The MAPE rate is taking into account the size of the actual values. The difference of the accuracy of NP slots and CP slots is softened using the MAPE rate with an error of 17 percent for NP slots and an error of 28 percent for CP slots.

The outcomes of the model and reality are not as good as desired but we denote that validation is done with the planning tool even though the possibility of entering actual data is not used. Because this data is not yet available, it is not been possible to adjust the planning tool for that information. More about the needed data is described in the implementation part in Chapter 6. We expect a reduction of the size of the differences when real data is entered.

4.3 Conclusions

The designed model is based on the clinical pathway for uncomplicated pathways to forecast the number of needed CP slots and NP slots for a certain week. In which the number of CP slots is based on the number of slots in the week before. The number of NP slots is either based on a forecast or on the actual number of new patients. The model is built in Excel which resulted in a planning tool. The tool is validated and seems to function good. The outcomes of the model were compared to the actual number of CP slots and NP slots actually used over 12 weeks. The outcomes of the model are not as good as desired. The outcomes can become more accurate since it is possible to enter actual data from former weeks in the planning tool. With entering that data as a precondition we expect the planning tool to be very useful to obtain a better match between capacity and demand.

5 Conclusions

This chapter will draw conclusions on the research performed. In Section 5.1 the answers to the research questions 1-4 will be summarized. Section 5.1 and 5.2 together give an answer on research question 5: What are the conclusions and discussion points of this research?

5.1 Answer research questions

Not reaching the agreed production volume has been the reason behind this research. After a thorough problem analysis the subject of the research became the mismatch between capacity and demand for outpatient care. In the introduction we stated the following research goal:

"The aim of this study is to analyze the current tactical planning process and to develop a model that provides information on the expected demand of care and needed capacity to support the planning on the outpatient department with the goal to improve the match between capacity and demand."

The focus has been on consultation hours and the capacity of physicians within the outpatient department. Furthermore the research was funneled to just uncomplicated pregnancy care.

What relevant information can be found in literature on planning capacity and demand?

Searching literature learns that clinical pathways can be used to analyze care processes. Besides the quality of care also the quality of the processes can be improved. Planning capacity and demand is done on different levels. The tactical level is introduced as the planning level in focus of this research. Specialist time is identified as a possible bottleneck resource. A better match of the specialist time capacity with demand will help to use capacity more efficient. Demand can be forecasted with different forecasting methods. For this research we used historical data to forecast demand. Seasonal effects are taken into account during the development of the model. Literature on panel sizing shows that we can also do calculations on the number of people coming for control visits. Besides forecasting the number of new patients, the number of patients already in the clinical pathway can be input for the forecast on control patients.

How is the current planning process organized?

The current planning process of the department is analyzed by interviewing staff and by analyzing documents and protocols. Currently there is, on the department of Gynecology, there is one employee in charge of the planning. The planner allocates the physicians to several tasks and blocks their time in case of absence. The planner decides on the distribution of the remaining capacity of physicians to the different consultation hours. This is often communicated with the head of the department. Historical data on demand for uncomplicated pregnancy care learns that demand fluctuates over the months of

the year. Currently such data is not systematically used in the decision making. The clinical pathway of uncomplicated pregnancies is introduced consisting of different phases of the care process. The needed capacity differs per phase, while the caregivers differ per phase. This information is used in the development of the model.

How can we use a model to provide insight in the expected demand and the needed capacity to improve the match between capacity and demand for ambulatory care?

Based on the problem analysis and the analysis of the current situation the model is developed calculate the expected demand and the needed specialist time capacity. The model is based on the clinical pathway for uncomplicated pathways to forecast the number of needed CP slots and NP slots for a certain week. In which the number of CP slots is based on the number of slots in the week before. The number of NP slots is either based on a forecast or on the actual number of new patients. The model is built in Excel which resulted in a planning tool.

Is the planning tool, based on the model, useful in improving the match between capacity and demand?

The planning tool will be supportive in the decision making for the tactical planning process. The planning tool is validated and seems to function good. The outcomes of the model were compared to the actual number of CP slots and NP slots actually used over 12 weeks. The outcomes of the model and reality are not as good as desired. The outcomes can become more accurate since it is possible to enter actual data from former weeks in the planning tool. With entering that data as a precondition we expect the planning tool to be very useful to obtain a better match between capacity and demand.

5.2 Discussing the research

As written in Chapter 4 the model some assumptions were made to be able to develop the model. One of the assumptions is that every patient entering the clinical pathway is following that pathways as it is defined. However, in practice some patients might not follow the pathway at all. This uncertainty influences the planning and might give a less precise prediction. Further research was recommended to analyze how often the path of the patient deviates from the clinical pathway and more exactly what the deviation from that standard entails. During this research Beltman & Klever (2012) performed a study on the patient flow within the clinical pathway of uncomplicated pregnancies. We did account for the number of patients leaving the pathway per phase according to outcomes of this research. With that information the model could be optimized by correcting for some deviations.

Another assumption made implies that a patient can be helped by different gynecologists. In practice the patient often prefers to be seen by only one gynecologist. This might have influence on the outcomes because the capacity might be more fluctuating.

In this research the time needed for an NP or CP slot for gynecologists or physician assistants is assumed to be equal. However, because a physician assistant operates with supervision of a gynecologist the time needed for the physician might differ from the time needed for an gynecologist.

The forecasted demand as input for the model is derived from the averages of patients visiting the department. A better indicator for the demand would have been the number of received referrals. For now we assumed that the physicians of the department see all the patients that have been referred. If possible it would be better to keep track of all the referrals.

In the problem analysis a total of 2236 consultation hours is found to be needed to be able to reach the agreed production volume. An approximation of the available capacity gave a total of 2722 consultation hours planned throughout the year. During the research the duration was said that a consultation hour normally lasts for 4 hours. Analyzing the consultation hour schedules however showed that consultation hours on mornings are often scheduled for 3,5 hours and consultations on the afternoons are often scheduled for 2,75 hours. For the calculations the average duration of consultation hours is used. But for the department it might be interesting to check whether this duration is a deliberated choice or not.

6 Recommendations and implementation

In this chapter, Section 6.1 describes the recommendations towards the gynecology department and Section 6.2 discusses the implementation of the planning tool. This provides an answer on research question 6: Which recommendations can be done to the gynecology department? And answers research question 7: How can we implement the planning tool into the planning process? The last section, Section 6.3, gives a final conclusion on the research.

6.1 Recommendations

After this study we recommend to use the model to improve the planning process and therewith the match between capacity and demand. The expectation is that the outcomes in terms of the accuracy of the forecast is not optimal yet. With better registration the data as input for the model will be more accurate, which in turn will make the forecast more accurate.

6.1.1 Pilot planning tool

Based on the conclusions of Chapter 4 we recommend the department to do a pilot on the use of the planning tool. After half a year the outcomes of the model should be evaluated. The evaluation will show whether the forecast gets more accurate as the actual data is entered in the tool. The department can then make an informed decision on whether they find it worthwhile to make the effort to obtain the right data and use it as input for the tool. Adjustments to the tool or the planning process can then be made before implementing the use of the tool. The implementation in the planning process is described in the next chapter.

To make the use of the planning tool easier we recommend to keep track of the phase of the clinical pathway a patient is in. The department might want to add a function in DSV or X-care for that purpose. The department may want to explore the possibilities of their information systems to make data collection easier.

Determine the demand by counting the number of referrals to the department. Demand will then be more accurate because patients moving to another caregiver before visiting the department can then be taken into account. Weiner et al. (2009) developed a web-based system for handling referrals. Such an application gives all the information on referrals and therewith on demand. Besides that failure by using fax or email is avoided because all requests are handled in that application.

6.1.2 Planning process

As described in this study the physician schedule contains also the schedule of physician assistants. The schedule of physicians is ready 3 months in advance. Therefore it should be recommended to

finish the schedule of physician assistants also 3 months in advance. This would make revisions and the step in the process, see Figure 6, in the planning process unnecessary. This will need the willingness of the physician in charge of the planning assistants.

For the planning process the use of the planning tool will make the planning process for the schedule on care for uncomplicated pregnancies easier. We can recommend to schedule based on the demand instead of scheduling based on the available capacity. Adjusting capacity for the expected demand will need some flexibility of physicians. The number of consultation hours for a certain type of care might differ per week.

6.1.3 Further research

It would be very interesting to know whether this model can be used for more clinical pathways. Research could be performed to find a more general model, which can be used on all kind of clinical pathways. The model could be introduced to other departments with good clinical pathways to benefit from the knowledge on future demand.

In Section 5.2 the duration of consultation hours is mentioned because there does not seem to be a clear vision on the length of one consultation hour. This question should be asked at the department. A duration of 3 hours or 4 hours is a large difference in terms of the provided capacity. Sharpening the standard length of a consultation hour might result in a major improvement in the efficient use of specialist time.

6.2 Implementing the planning tool

In Subsection 6.1.1 is recommended to start using the planning tool at the gynecology department. The implementation of the tool in the current process and the needed inputs of data are discussed in the Subsections 6.2.1 and 6.2.2.

6.2.1 Implementation in the current process

The developed model and planning tool aim to help the planner by scheduling consultation hours and allocating physicians to those consultation hours. In figure 12 a part of the planning process is shown. After determining the capacity, the number of physicians available for consultation hours, the expected demand can be found by using the planning tool. Based on the expected demand, the planner can allocate capacity for NP and CP slots for uncomplicated pregnancies. The next step is to allocate the left capacity to the other sub specialism's. This results in a schedule for physicians with the scheduled specialist time based on expected demand.

To make sure that the forecast is as close as possible to the actual number of slots needed, the actual numbers of visits can be entered in the planning tool as soon as information is available. It means that

the employee in charge of the planning should enter real data once in a week. This is an activity parallel to the planning process.

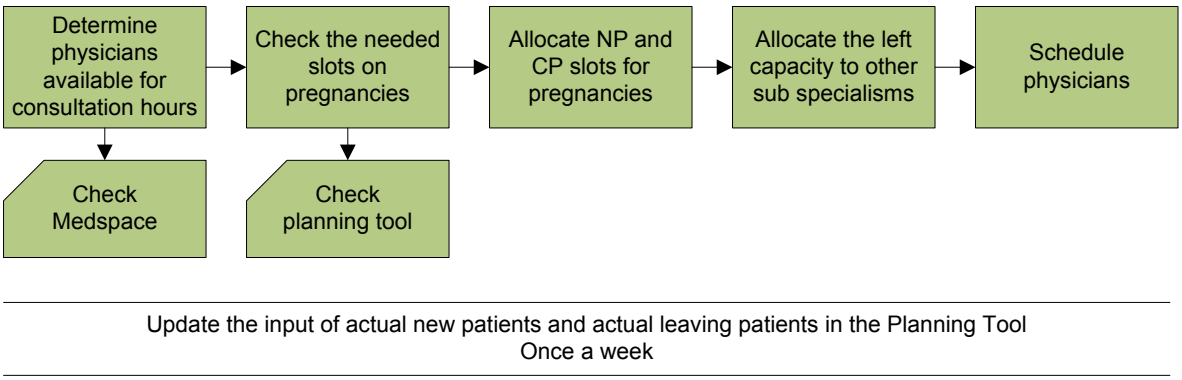


Figure 12 The new process

6.2.2 Data inputs

Entering actual data means entering the actual number of new patients per phase for a certain week and the actual number of patients leaving the clinical pathway. For every week physicians have a meeting to discuss the new patients for pregnancy. At that time the phase of the patient entering the system is known. This data then needs to be entered in the planning tool. The meeting in which the new patients for pregnancies are discussed will give important input data for the planning tool. How to enter this data is described in the manual for the planning tool available in Appendix D.

6.3 Final conclusion

The developed model makes a forecast on demand possible. This results in an improved match for capacity and demand when the forecast is accurate enough. More insight in demand for just one sub specialism makes it possible for the planner to decide on the allocation of capacity to other sub specialism's. Therewith the planner and physicians are able to make decisions on the delivering of care in the near future. This can be an instrument to manage the volume of EPB's and therewith reaching the agreed production will be easier.

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Appendix A Mind map

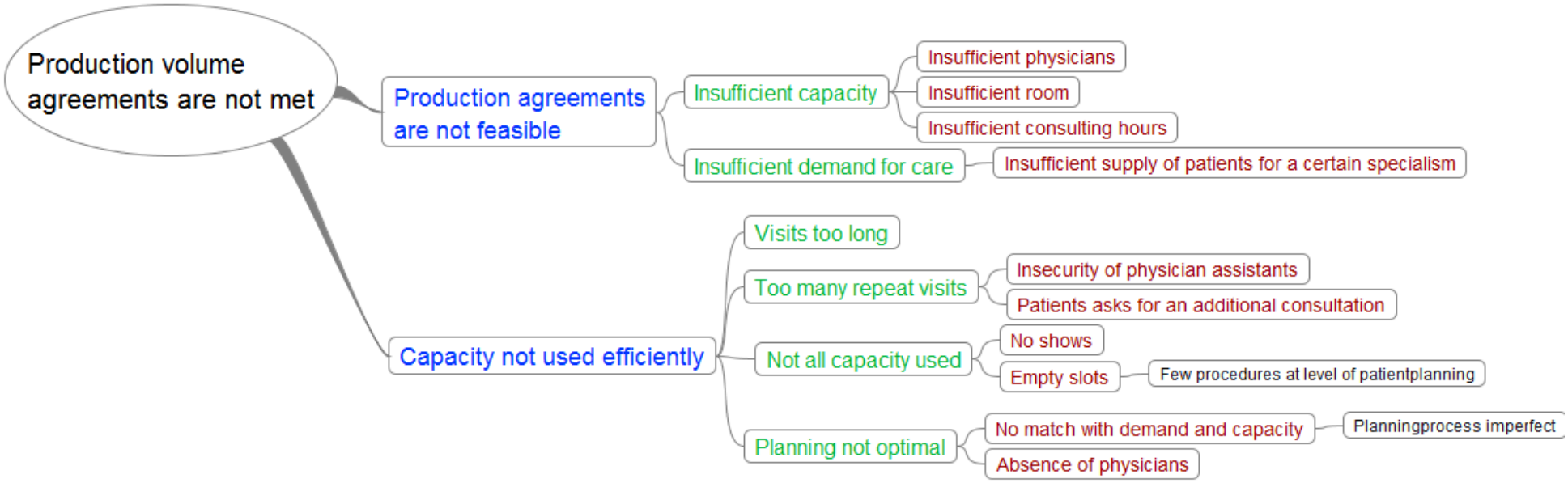

Figure 13 Mind map

Appendix B Descriptive facts

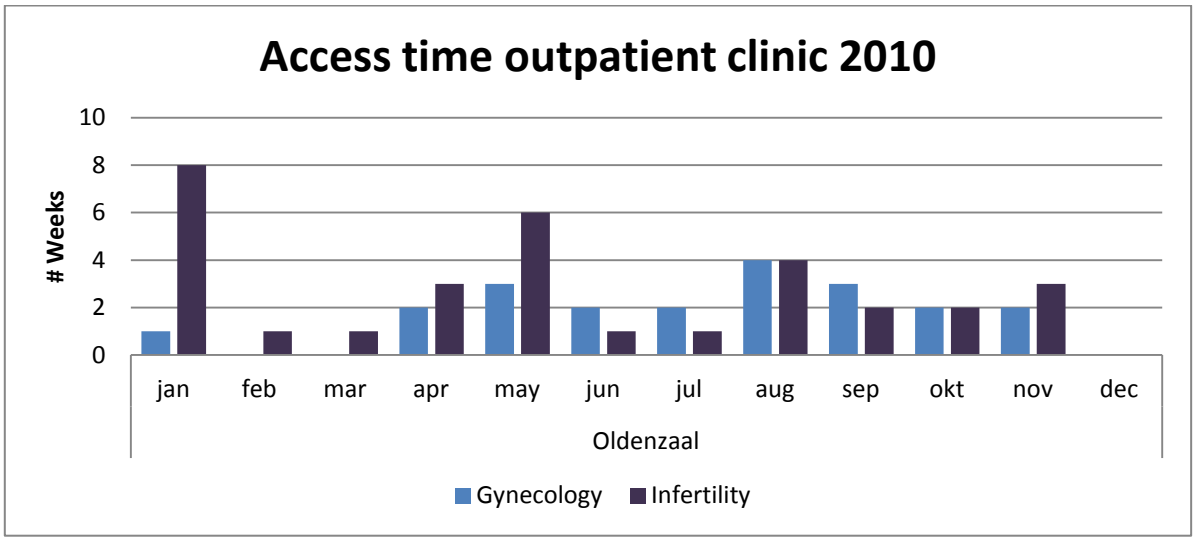

Figure 14 Access time outpatient department Oldenzaal 2010

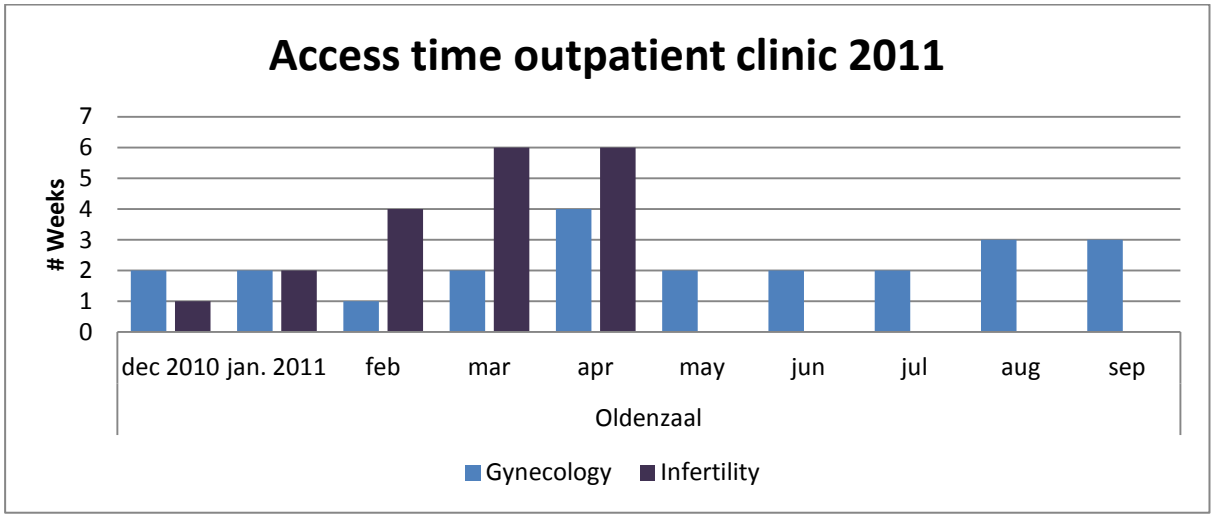

Figure 15 Access time outpatient department Oldenzaal 2011

Table 5 Repeat factors at gynecology

Consulting hours	2009	2010	2011
Endocrinology	1.57	1.29	1.46
Infertility	2.29	2.39	2.19
Gynecology	1.29	1.35	1.36
Oncology	1.62	1.82	2.09
Obstetrics	6.11	6.01	6.32
Climacteric problems	0.92	0.84	-

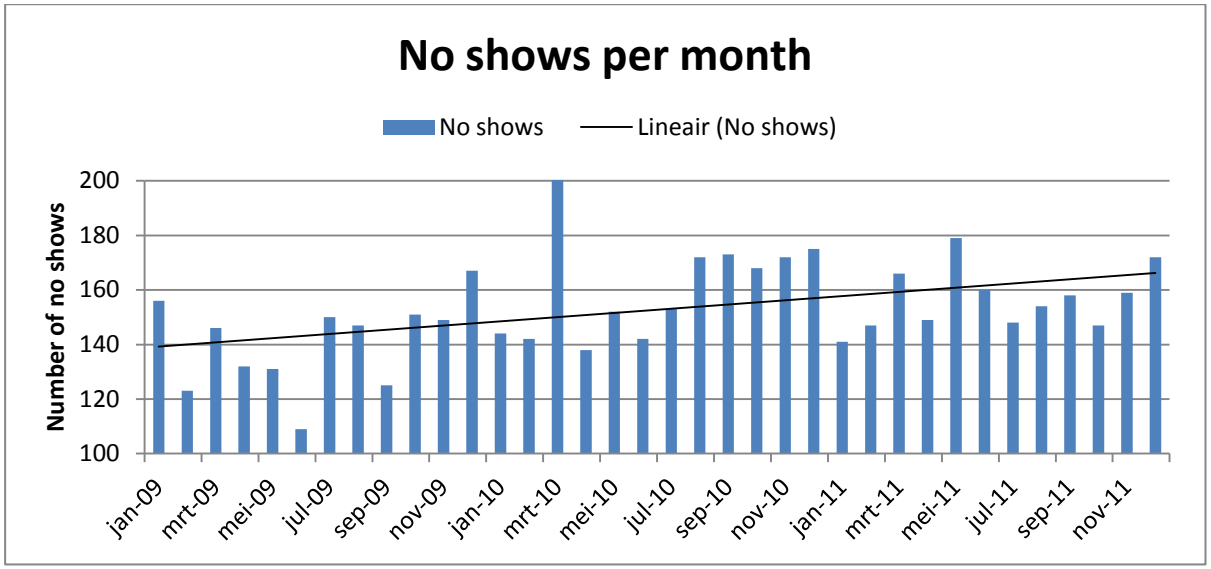

Figure 16 Number of no shows at gynecology department 2009-2011

Appendix C The clinical pathway for uncomplicated pregnancies (in Dutch)

Medisch Spectrum Twente VKC

Fase 0:
- Afspraak voor termijnecho en counseling
- Zorgpad invoegen
- Afspraak spreekuur

Patiëntgegevens /ponsplaatje

Fase 1: 9 weken zwanger
9wk termijnecho is verricht en counseling is gegeven
Patiënt heeft een vervolg afspraak bij de gynaecoloog voor week 10

Fase 2: 10 weken zwanger
Termijnecho is besproken, patiënt heeft besluit genomen wel/geen combitest. Wel: Afspraak is gemaakt voor combitest en aanvraag laboratoriumonderzoek is geplaatst. Niet: afspraak is gemaakt voor 12 weken echo en aanvraag laboratoriumonderzoek is geplaatst. Patiënt heeft een vervolg afspraak bij gynaecoloog na de combitest/ 12 weken echo.

Fase 3: 12 weken zwanger
Resultaten van combitest en overige onderzoeken zijn besproken. Patiënt is voorbereid op volgend controlemoment (20 -22 weken): SEO/GUO is gepland,

Fase 4: 20 weken zwanger
Resultaten onderzoeken zijn besproken. Patiënt is voorbereid op volgende controlemoment (25/40)

Fase 5: 25 weken zwanger
Resultaten van onderzoeken zijn besproken. Patiënt is voorbereid op volgende controlemoment (30/40) Voor Rh-D negatieve patiënt/ Rh-c negatieve patiënt is lab order geplaatst voor 27e week. (niet eerder dan 27 weken)
30 weken-echo is gepland.

Fase 6: 30 weken zwanger
Resultaten onderzoeken zijn besproken en patiënt is voorbereid op volgende controlemoment (33/40)
Rhesus D-negatieve patiënt met foetaal Rhesus positieve uitslag : anti- D spuiten Resultaten onderzoeken zijn besproken en patiënt is voorbereid op volgende controlemoment (33/40)

Fase 7: 33 weken zwanger
Resultaten onderzoeken zijn besproken, bovenvermelde informatie is gegeven en patiënt is voorbereid op het volgende controlemoment (36/40)

Fase 8: 36 weken zwanger
Resultaten onderzoeken zijn besproken en patiënt is voorbereid op volgende controlemoment (38/40)
Wijze van bevallen is afgestemd.

Fase 9: 38 weken zwanger
Resultaten onderzoeken zijn besproken en patiënt is voorbereid op het volgende controlemoment (40/40)

Fase 10: 40 weken zwanger
Resultaten onderzoeken zijn besproken en patiënt is voorbereid op het volgende controlemoment (41/40)

Fase 11: 41 weken zwanger
Resultaten onderzoeken zijn besproken en patiënt is voorbereid op de bevalling, inleiding is gepland.

Fase 1: 9 weken zwanger

Onderwerp	Code	Uitvoerder	Activiteit	Nvt	Resultaat
Anamnese / observatie		Financieel secretaresse	**DBC-V41 openen**		0
		Echoscopist	Counseling t.a.v. testen: nekplooimeting en serumscreening (combitest risicobepaling syndroom van Down) en SEO		0
Onderzoek / metingen		Echoscopist	Termijn echo		0
Voorlichting (mondeling en schriftelijk)		Echoscopist	Folders meegeven: • Zwanger! Algemene informatie • Informatie over screening op Downsyndroom • Informatie over Structureel Echoscopisch Onderzoek		0
Randvoorwaarden		Echoscopist	Registratie van counseling en echo in Astraia		0
Extra activiteit			Echo Lab		0 0
Variantierapportage					

Resultaat	9wk termijnecho is verricht en counseling is gegeven Patiënt heeft een vervolg afspraak bij de gynaecoloog voor week 10

Dienst	Functie	Naam verantwoordelijke	Paraaf

Fase 2: 10 weken zwanger

Onderwerp	Code	Uitvoerder	Activiteit	Nvt	Resultaat
Anamnese / observatie		Gynaecoloog Anios Aios Verloskundige	Anamnese, resultaten termijnecho bespreken, checken of patiënt informatie heeft begrepen van de counseling, besluit patiënt bespreken Combitest SEO Risico analyse Indicatie echo……	 0 0	0 0 0 0 0
Onderzoek / metingen		Gynaecoloog Anios Aios Verloskundige	RR lengte en gewicht (BMI >30) ja/nee Lab: 12e week , Combitest Ja/Nee : CRL vermelden !! op formulier 1 order plaatsen! • Order 12e week screening (inclusief Rh-c –antigeen)(Hb HT, glucose, kreat, Rubella) zonodig ook Combitest	 0 0	0 0 0 0
Randvoorwaarden		Gynaecoloog Anios Aios Verloskundige Secretaresse	Verslaggeving huisarts maken Registratie van counseling in Astraia Check labaanvraag: 12e week / combitest Aanvraag: echo combitest Aanvraag : 12 weken echo Inplannen op zwangeren bespreking Controle moment 12e week plannen		0 0 0 0 0 0 0
Extra activiteit			Echo Lab		0 0
Variantierapportage					

Resultaat	Termijnecho is besproken, patiënt heeft besluit genomen wel/geen combitest. Wel: Afspraak is gemaakt voor combitest en aanvraag laboratoriumonderzoek is geplaatst. Niet: afspraak is gemaakt voor 12 weken echo en aanvraag laboratoriumonderzoek is geplaatst Patiënt heeft een vervolg afspraak bij gynaecoloog na de combitest/ 12 weken echo.

Dienst	Functie	Naam verantwoordelijke	Paraaf

Fase 3: 12 weken

Onderwerp	Code	Uitvoerder	Activiteit	Nvt	Resultaat
Anamnese / observatie		Gynaecoloog Anios Aios Verloskundige	Combitest/12 weken echo en laboratoriumonderzoeken worden besproken. Checken of patiënt informatie heeft begrepen Invasieve diagnostiek	 0	0 0 0
Onderzoek / metingen		Echoscopist Gynaecoloog Anios Aios Verloskundige	Combitest/12 weken echo RR Afspreken SEO Afspreken GUO	 0 0	0 0 0 0
Randvoorwaarden		Echoscopist Gynaecoloog Anios Aios Verloskundige Secretaresse	Registratie van echo in Astraia Zwangerschapsverklaring Aanvraag SEO/GUO regelen Controle moment 20e week plannen	 0 	0 0 0 0
Extra activiteit			Echo Lab		0 0
Variantierapportage					

Resultaat	Resultaten van combitest en overige onderzoeken zijn besproken. Patiënt is voorbereid op volgend controlemoment (20 -22 weken): SEO/GUO is gepland.

Dienst	Functie	Naam verantwoordelijke	Paraaf

Fase 4: 20-22 weken

Onderwerp	Code	Uitvoerder	Activiteit	Nvt	Resultaat
Anamnese / observatie		Gynaecoloog Anios Aios Verloskundige	Resultaten onderzoeken bespreken Checken of patiënt informatie heeft begrepen Checken of kraamzorg is aangevraagd Checken of verloskundige is geregeld voor kraambed		0 0 0
Onderzoek / metingen		Echoscopist/ Perinatoloog Gynaecoloog Anios Aios Verloskundige	SEO/GUO Fundus hoogte Cortonen RR Glucose Hb	 0	0 0 0
Randvoorwaarden		Echoscopist Secretaresse	Registratie echo in Astraia Controle moment 25e week plannen		0 0
Extra activiteit			Echo Lab		0 0
Variantierapportage					

Resultaat	Resultaten onderzoeken zijn besproken. Patiënt is voorbereid op volgende controlemoment (25/40)

Dienst	Functie	Naam verantwoordelijke	Paraaf

Fase 5: 25 weken

Onderwerp	Code	Uitvoerder	Activiteit	Nvt	Resultaat
Anamnese / observatie		Gynaecoloog Anios Aios Verloskundige	Resultaten onderzoeken bespreken Checken of patiënt informatie heeft begrepen		0
Onderzoek / metingen		Gynaecoloog Anios Aios Verloskundige	Fundus hoogte Cortonen RR Echo 30 weken aanvragen Lab aanvraag plaatsen indien: • screening 27e week voor Rh-D-negatieve patiënt: foetale RhD typering en IEA Form. 27 Sanquin: **E940** • screening 27e week voor Rh-c-negatieve patiënt:screening op c-IEA en andere IEA: Form. 27 Sanquin: **E948** **LET OP** meerling vermelden !! vanaf 27 weken **niet eerder**	 0 0	0 0 0
Voorlichting (schriftelijk en mondeling)		Secretaresse	Meegeven • Folder bevallen in het ziekenhuis • Vragenlijst verpleegkundige anamnese		0
Randvoorwaarden		Secretaresse	Afspraak plannen info bijeenkomst zwangeren Controle moment 30e week plannen, 30 weken echo plannen		0
Extra activiteit			CTG Echo Lab		0 0 0
Variantierapportage					

Resultaat	Resultaten van onderzoeken zijn besproken. Patiënt is voorbereid op volgende controlemoment (30/40) Voor Rh-D negatieve patiënt/ Rh-c-negatieve patiënt is lab order 27e week geplaatst . 30 weken-echo is gepland.

Dienst	Functie	Naam verantwoordelijke	Paraaf

Fase 6: 30 weken zwanger

Onderwerp	Code	Uitvoerder	Activiteit	Nvt	Resultaat
Anamnese / observatie		Gynaecoloog Anios Aios Verloskundige	Resultaten onderzoeken bespreken Checken of patiënt informatie heeft begrepen		0
Onderzoek / metingen		Echoscopist Gynaecoloog Anios Aios Verloskundige	Echo biometrie Fundushoogte Cortonen RR		0
Medicatie		Gynaecoloog Anios Aios Verloskundige Doktersassistent	Recept anti-D schrijven voor foetaal Rhesus positief kind Rhesus D-negatieve patiënt met foetaal Rhesus positieve uitslag : anti- D spuiten	0 0	0 0
Randvoorwaarden		Echoscopist Secretaresse	Registratie echo in Astraia Aanvraag echo Controle moment 33e week plannen	 0	0 0 0
Extra activiteit			CTG Echo Lab		0 0 0
Variantierapportage					

Resultaat	Resultaten onderzoeken zijn besproken en patiënt is voorbereid op volgende controlemoment (33/40) Rhesus D-negatieve patiënt met foetaal Rhesus positieve uitslag : anti- D spuiten

Dienst	Functie	Naam verantwoordelijke	Paraaf

Fase 7: 33 weken zwanger

Onderwerp	Code	Uitvoerder	Activiteit	Nvt	Resultaat
Anamnese / observatie		Gynaecoloog Anios Aios Verloskundige	Resultaten onderzoeken bespreken Checken of patiënt informatie heeft begrepen		0
Onderzoek / metingen		Gynaecoloog Anios Aios Verloskundige	Fundus hoogte Cortonen RR		0
Voorlichting (schriftelijk en mondeling)		Secretaresse	Folders meegeven ▪ Pijnbestrijding tijdens bevalling ▪ Het inleiden van de bevalling ▪ Hielprik		0
Randvoorwaarden		Secretaresse	Controle moment 36e week plannen		0
Extra activiteit			CTG Echo Lab		0 0 0
Variantierapportage					

Resultaat	Resultaten onderzoeken zijn besproken, bovenvermelde informatie is gegeven en patiënt is voorbereid op het volgende controlemoment (36/40) Folders meegegeven

Dienst	Functie	Naam verantwoordelijke	Paraaf

Fase 8: 36 weken

Onderwerp	Code	Uitvoerder	Activiteit	Nvt	Resultaat
Anamnese / observatie		Gynaecoloog Anios Aios Verloskundige	Resultaten onderzoeken bespreken Checken of patiënt informatie heeft begrepen Wijze van bevallen bespreken Indien sectio: start zorgpad electieve sectio	 0	0 0 0
Onderzoek / metingen		Gynaecoloog Anios Aios Verloskundige	Fundus hoogte Cortonen RR		0
Voorlichting (schriftelijk en mondeling)		Gynaecoloog Anios Aios Verloskundige	Mogelijke complicaties bespreken Folders meegeven: • Keizersnede		0
Randvoorwaarden		Secretaresse	Controle moment 38e week plannen	0	0 0
Extra activiteit			CTG Echo Lab		0 0 0
Variantierapportage					

Resultaat	Resultaten onderzoeken zijn besproken en patiënt is voorbereid op volgende controlemoment (38/40) Wijze van bevallen is afgestemd

Dienst	Functie	Naam verantwoordelijke	Paraaf

Fase 9: 38 weken

Onderwerp	Code	Uitvoerder	Activiteit	Nvt	Resultaat
Anamnese / observatie		Gynaecoloog Anios Aios Verloskundige	Resultaten onderzoeken bespreken Checken of patiënt informatie heeft begrepen		0
Onderzoek / metingen		Gynaecoloog Anios Aios Verloskundige	Fundus hoogte Cortonen RR		0
Randvoorwaarden		Secretaresse	Aanvraag echo Controle moment 40e week plannen	0	0 0
Extra activiteit			CTG Echo Lab		0 0 0
Variantierapportage					

Resultaat	Resultaten onderzoeken zijn besproken en patiënt is voorbereid op het volgende controlemoment (40/40)

Dienst	Functie	Naam verantwoordelijke	Paraaf

Fase 10: 40 weken

Onderwerp	Code	Uitvoerder	Activiteit	Nvt	Resultaat
Anamnese / observatie		Gynaecoloog Anios Aios Verloskundige	Resultaten onderzoeken bespreken Checken of patiënt informatie heeft begrepen		0
Onderzoek / metingen		Gynaecoloog Anios Aios Verloskundige	Fundus hoogte Cortonen RR		0
Voorlichting (schriftelijk en mondeling)		Gynaecoloog Anios Aios Verloskundige	Serotiniteit bespreken Folders meegeven • Serotiniteit		0
Randvoorwaarden		Secretaresse	Controle moment 41e week plannen		0
Extra activiteit			CTG Echo Lab		0 0 0
Variantierapportage					

Resultaat	Resultaten onderzoeken zijn besproken en patiënt is voorbereid op het volgende controlemoment (41/40)

Dienst	Functie	Naam verantwoordelijke	Paraaf

Fase 11: 41 weken

Onderwerp	Code	Uitvoerder	Activiteit	Nvt	Resultaat
Anamnese / observatie		Gynaecoloog Anios Aios Verloskundige	Resultaten onderzoeken bespreken Checken of patiënt informatie heeft begrepen		0
Onderzoek / metingen		Gynaecoloog Anios Aios Verloskundige	Fundushoogte Cortonen RR VT		0 0
Randvoorwaarden		Secretaresse	Inleiding plannen		0
Extra activiteit			CTG Echo Lab		0 0 0
Variantierapportage					

Resultaat	Resultaten onderzoeken zijn besproken en patiënt is voorbereid op de bevalling, inleiding is gepland.

Dienst	Functie	Naam verantwoordelijke	Paraaf

	Naam/functie:		
Eigenaar:	J. oude Lohuis; teamhoofd polikliniek gynaecologie Dr. J. Brons; gynaecoloog		
Auteur:	Werkgroep ontwikkeling zorgpad zwangeren R. ten Vergert		
Autorisator:	Dr. J. Brons; gynaecoloog	Handtekening:	Datum:
Beheerder:	E. de Rijter; supervisor DBS RVE-gynaecologie		
Revisiedatum: 01-11-2012			
Voorstellen ter verbetering kunt u door middel van een e-mail kenbaar maken bij de eigenaar met vermelding van de code van het document, uw naam, afdeling en datum.			

Appendix D Manual “Planning Tool 2012”

General

The planning tool is developed in an Excel spreadsheet called “Planning Tool 2012”. This Excel file is used to forecast the expected number of NP and CP slots needed for one patient type. In this case the calculation is done for patients with “uncomplicated pregnancy".

In the tab “Forecast Planning Tool” the outcome of the forecast is given. The planner of the department can use this information for decision making on the tactical planning.

Input actual new patients and leaving patients

Input for actual data can be entered in the tab “Actual number of new patients”. Fill in the number of new patients in the upper part of the sheet. Choose the right phase and the week in which the patients were new. If there is already entered data for a certain week and phase then add the number of patients you found to the given number in the sheet.

The lower part of the sheet is for leaving patients. Choose the right phase and the week in which the patients left the pathway. And again, if there is already entered data for a certain week and phase then add the number of patients you found to the given number in the sheet.

Input forecast based on history

Input for the forecast per month can be entered in the tab “Forecast per month”. This tab contains the forecast for the average number of new patients in a week. A different number can be filled in per month. In which the months are displayed with the numbers 1 to 12. In general this tab has to be used once a year.

Input start week

At the time the tool is put into use the patients already in the system needs to be entered. This is possible in the tab “Number of patients start week”. It is very important to enter the determined start week in the sheet behind the cell with “Start week:”. Then the patients already in the system need to be entered. At the time of the start week every patient is in a certain week of the pregnancy. Therefore the number of patients can be entered distinguishing between the number of weeks that a patient is pregnant.