

Tactical planning for the Gastrointestinal and Hepatology department of Medisch Spectrum Twente

Designing a tactical conceptual planning model for the outpatient clinic and the endoscopic clinic.

C.M. Olde Keizer

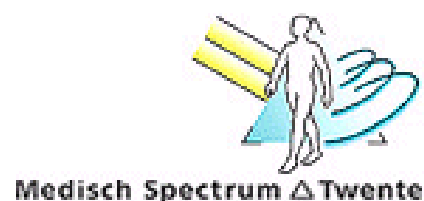
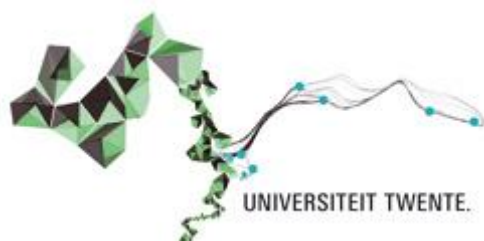
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Supervisors:

Dr. ir. E.W. Hans, University of Twente

Dr. M.M.J. Guichelaar, Medisch Spectrum Twente



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Author: C.M. Olde Keizer

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Supervisor: Dr. ir. E.W. Hans

Supervisor (2nd): Dr. J.G. van Manen

Organization: Medisch Spectrum Twente

Department: Gastrointestinal and Hepatology Department

Supervisor: Dr. M.M.J. Guichelaar

Supervisor (2nd): Drs. L. Kroes

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Foreword

Before you lies the result of my studies at the University of Twente, the report for my master thesis. With this report, my study in Enschede is ended and a new adventure will start.

I hope this report will have a stimulating effect for the GIHD at the MST, to improve/implement the demand driven tactical capacity planning at their department. Hopefully this report gain some new insights in probabilities for the GIHD, despite the developments with current waiting and access time during the last weeks of my research.

Writing my master thesis should be the last and best period of your study. Despite the many difficulties that I have come across during my research, I now look back in a positive way. I learned a lot and became more mature while writing my thesis. I am very proud now to finally present my research report, but it wasn't pleasant all the time.

Erwin, thank you for your support, insights and help during my research. You have helped me a lot with the encountered difficulties and supported me to feel more sure about my abilities. You stimulated me to make myself less modest.

Maureen and Leslie, thank you for the opportunity to accomplish my research at the GIHD. You supported me during the research, motivated me to go further and deliver me a lot insight in the actual situation at the GIHD. Although the subject kept changing during the research and the constantly deferred finish date, you two kept positive and kept supporting me. I hope you are pleased with the results and hopefully can use this developing the current planning at the GIHD.

Anita & Anne, thank you for the many information I've received from you. Also, I want to thank Richelle Rijntjes. She has accomplished similar research within the MST. Conversations with her gave me insight in possible ways to accomplish my research. I used her report as a guideline to structure mine. Further, I thank all employees of MST I spoke to, who helped me gain insight in the processes, organization and planning at the GIHD, and who thereby advanced my study.

Also I want to thank my boyfriend, family and friends. I have not been the easiest girl during the last period. I became discouraged, irritable, and cranky, but you always listened to me, remained interested, motivated me, supported me and raised me up whenever I needed it. Thank you all!

Chantal Olde Keizer
Enschede

August 20th

Management Summary

Background

During the last years, a lot has changed in the Dutch health care sector. The health care insurance act was enacted, care is organized using DRGs and DOT and market competition is introduced in the health care sector. All these have to do with one important main development: providing better care at less cost. The effects of these developments can be observed within the MST. Costs can be lowered and the quality of delivered care can be improved by changing their logistic processes. Through this developments, operations management in health care has gained lots of attention during the last years.

Research Scope and Problem

This research is executed at the Gastrointestinal and Hepatology Department of the Medisch Spectrum Twente. This departments consists of an outpatient clinic, an endoscopic clinic and a ward. Focus lies at the capacity of the outpatient clinic and endoscopic clinic. Patients can be referred to either the outpatient clinic or the endoscopic clinic. These clinics generate demand for each other, so they are interdependent. GIHD has to deal with a great demand for care which will increase in the future due to the screening for colon cancer. Therefore it is advisable to research the capacity planning. The amount of consultation rooms, treatment rooms, the capacity of GI doctors and the amount of supporting personnel is of interest.

Research objective

The objective of this research is:

To design a tactical conceptual planning model for the outpatient clinic and endoscopic clinic of the Gastrointestinal and Hepatology Department of MST and to determine the necessary steps for implementing this concept in the organization.

Method

This research can be divided into a context analysis and a literature research. Both parts deliver the input for the design phase of this research, in which recommendation are made for the possible introduction of a tactical capacity planning model.

In the context analysis, we first start with the description of the patients processes. How is the current pathway of the patient within the GIHD and which logistical indicators can be used for this patient processes? Next, we looked at the current organization of planning at the GIHD. Using a

framework derived from literature, current organization of the planning is described at strategic, tactical and operational level. Finally, we describe some performance indicators, which can be used to monitor the performance of the GIHD.

In the literature research, we search for models for tactical planning of outpatient clinics, operating rooms and endoscopy departments in scientific literature. Besides derived information, there is also used a practical example of using tactical planning. To this end, we used the description of plans in the tactical planning of ZGT, obtained from research of Rijntjes (2011). Finally, an article is described that uses an integrated approach for planning both, the outpatient clinic and operating rooms.

Conclusions

The actual way of planning at the GIHD is mainly supply driven. All referrals for the GIHD arrive at one central point. These referrals are then scored on their urgency by GI medical doctors. These referrals are then returned to the central point, after which the referrals are distributed to the outpatient clinic and endoscopy department. The patient is categorized on the basis of urgency of care and the following planning is based on this and availability of time. Every week an overview is generated of all planned appointments at either the outpatient clinic and the endoscopic clinic. On this weekly basis the department looks at the demand for care, the hours of endoscopic work and the difference between this. Based on this data it was shown that the demand was greater than the hours planned on the endoscopy suites and a project was started to eliminate the waiting times which are currently non-existing. This is achieved by using AIOs and ANIOs, who need to be supervised, which cause new problems. Supervising is not taken into account in current practice, although it is time consuming. However, the department had not yet designed their planning in a flexible way and based on tactical information.

To implement tactical planning at the GIHD, obtaining performance and logistic indicators is required. First, logistic indicators are of interest. These give a clear picture to which departments patients are referred, how the patient flow is organized and their corresponding percentages. When these logistic indicators are clear, the performance indicators can be calculated. Using performance indicators delivers insight in for instance the utilization rate, the realization and the access and waiting times of the GIHD. Currently it has been shown that it is difficult to get the right data out of the existing databases of the hospital. The best way to get accurate information is to prospectively collect by hand the data for every patient, but that is too much time consuming. However, this information is essential for tactical planning.

Literature of an integrated approach for tactical planning of the outpatient clinic and endoscopy clinic / operation rooms is very limited. Both departments within GIHD's are interdependent (in terms of both demand and capacity), which make integrated planning required for the GIHD. In the literature there are mainly mathematical models, which calculate "one optimal solution". It does not take into account restrictions applied.

Recommendations

In the daily practice at the GIHD, two software systems are used: X-care and Endosoft. These systems are inconsistent, no realistic view is obtained when studying this data. Therefore, the first recommendation is to integrate a hospital-wide software system into the MST, in which all required functions are included. By using only one system for all registrations, the inconsistency is annulated and derived data starts to be meaningful.

When speaking of tactical planning, planning of elective patients on intermediate term is meant. Recommended for the GIHD of MST is to organize their tactical planning by the use of tactical planning meetings. During these meetings, decisions are made about the distribution of available capacity to the two clinics. These decisions are based on the available control information about the past and future period (about supply, demand and performance). The chosen distribution capacity must match supply and demand in such a way the department performs well. For the tactical planning, patient categorization can be used which divides the patients into medically and logistically similar categories. It is not realizable for the GIHD to make changes during this meetings on short term because nurse staff is required for the endoscopic clinic. Scheduling this nurse staff takes place two months in advance. Operation rooms, always operations are executed and so nurse staff is always scheduled (regardless of the operating specialism). That is the difference between the endoscopic clinics and operation rooms. When there is decided to allocate more capacity to the endoscopic clinic, more nurse staff is required. So, short term changes can lead to logistic problems.

Important for the implementation of tactical planning at the GIHD is to obtain the necessary data and information. This information must then be properly used so that important process information, patient groups and tactical control information become clear. This is the input for the tactical planning meetings. Various projects must therefore be set to finally be able for implementing tactical planning at the GIHD:

- Strategic planning – Within the MST, strategic choices are made and strategic objectives are set which influence the flexibility of tactical planning at the GIHD.

- Availability of process information – It is important that information about the patient process (possible steps, the chances of this steps and the corresponding (waiting) times) is made available. It must become clear which department patients are referred to and how the flow of patients among the different clinics is organized. This can take place by following a selected group of patients or by analyzing individual patients for a certain time.
- Patient categorization – When all the required process information is derived, the next project can start. Given the numbers of referrals and the corresponding transition probabilities, groups of patients can be identified which are medically and logistically similar. Given these categories, transition probabilities can be applied to forecast the future demand more precisely.
- Availability of tactical management information – for the tactical planning meetings, tactical management information is required, on which the choices for capacity allocation are based. Supply, demand and performance information should therefore be made available for the past and future periods.
- Pilot tactical planning – after finishing all aforementioned projects, it is advisable to first start a pilot tactical planning before implementing this into the daily practice of the GIHD. Given this pilot, the possible benefits and problems become clear. Therefore it is advisable to carry out a pilot, before starting the full implementation of tactical plans on the MDL. This pilot needs to be evaluated afterwards. For this pilot support is needed of all involved staff.

Management Samenvatting

Achtergrond

In de Nederlandse gezondheidszorg zijn de laatste jaren vele ontwikkelingen doorgevoerd. De zorgverzekeringswet in werking getreden, er wordt gewerkt met DBC's en DOT en marktwerking is ingevoerd in de gezondheidszorg. Alle ontwikkelingen hebben te maken met het leveren van betere zorg tegen minder kosten. Ook in het MST zijn van deze ontwikkelingen de gevolgen te merken. Door te kijken naar logistieke processen binnen het ziekenhuis kan er efficiënter worden gewerkt en tevens gewerkt worden aan de verbetering van de kwaliteit.

Onderzoekskader en onderzoeksprobleem

In dit onderzoek richten we ons op de MaagDarmLever afdeling van het Medisch Spectrum Twente. Deze afdeling bestaat uit een polikliniek, een endoscopie afdeling en een verpleegafdeling. De focus ligt op de capaciteit op de polikliniek en de endoscopie afdeling. Aanvragen voor de MDL kunnen binnenkomen voor zowel de endoscopie afdeling als de polikliniek. Deze beide klinieken genereren weer vraag voor elkaar en zijn dus afhankelijk van elkaars aanbod en productie. De MDL afdeling heeft te maken met een groot aanbod van zorg, dit zal in de toekomst verder stijgen met het komen van de dikke darmkanker screening. Derhalve is de afdeling gestart met het nemen van maatregelen om hun wachttijden weg te nemen, hierdoor is er momenteel geen wachttijd meer voor de endoscopische onderzoeken. Een volgend stap zal zijn om de planning van de endoscopie en polikliniek in de toekomst te laten variëren met de variaties in vraag van zorg, en met tactische planningsvoorwaarden.

Het doel van het onderzoek

Het doel van dit onderzoek is:

Het ontwerpen van een conceptueel tactisch planning model voor de polikliniek en de endoscopieafdeling van de MaagDarmLever afdeling van het MST en het vaststellen van de te ondernemen stappen om dit concept te implementeren op deze afdeling.

Methode

Het onderzoek is ingedeeld in een context analyse en een literatuur onderzoek. Deze beide delen leveren de input voor de ontwerpfasen van dit onderzoek, waarin aanbevelingen worden gedaan voor de mogelijke invoer van een tactische capaciteit planning model.

In de context analyse is er allereerst gestart met het beschrijven van de patiëntenprocessen. Vervolgens is er gekeken naar de huidige planning op de MDL, op strategisch, tactisch en

operationeel niveau. Ten slotte zijn er prestatie indicatoren gegeven, die kunnen worden gebruikt om de prestatie van de MDL te beschrijven.

In het literatuuronderzoek is er gezocht naar tactische planningsmodellen voor poliklinieken, operatiekamers en endoscopie afdelingen die in de literatuur worden beschreven. Naast de informatie verkregen uit wetenschappelijke literatuur, is er ook een praktijkvoorbeeld gebruikt van tactisch plannen. Hiervoor is gebruik gemaakt van de beschrijving van tactisch plannen in het ZGT, verkregen uit het onderzoek van Rijntjes (2011). Tenslotte wordt er een artikel beschreven dat een geïntegreerde aanpak hanteert voor de planning van zowel de polikliniek als de operatiekamers.

Conclusies

Alle aanvragen voor de MDL komen binnen op een centraal punt, waarnaar vervolgens de aanvragen worden gescoord op urgentie door MDL artsen. Deze aanvragen komen vervolgens weer terug op dit centrale punt, waarnaar ze worden verdeeld naar respectievelijk de polikliniek en de endoscopieafdeling. De patiënt wordt gescoord op ernst van klachten en vervolgens ingepland op geleide van deze ernst en op geleide van open plekken op endoscopie en polikliniek. Wekelijks worden er overzichten gecreëerd waardoor wordt bijgehouden hoeveel aanbod er is op de polikliniek en endoscopie, hoeveel patiënten er gescopieerd worden, en wat de wachttijd is voor zowel de endoscopie als de polikliniek. Aan de hand van deze data werd duidelijk dat de vraag groter was dan het aanbod, waarvoor een project is gestart. Momenteel zijn er geen wachttijden meer door het inzetten van AIOS en ANIOS krachten. Hierdoor zijn echter wel weer nieuwe problemen gecreëerd. Deze zijn ontstaan doordat de AIOS en ANIOS krachten moeten worden gesuperviseerd. Hiervoor is veel tijd nodig, waarmee in het huidige schema van de artsen geen rekening is gehouden. Hier zal in de toekomst rekening mee moeten worden gehouden. Daarnaast wordt er in de huidige praktijk op de MDL gebruik gemaakt van vaste roosters, die 6 weken van te voren worden vastgesteld. Hierdoor kunnen patiënten, polikliniek medewerkers en endoscopie medewerkers worden ingedeeld in de roosters. Een volgende stap zal zijn om deze roosters te laten variëren aan de hand van vraag en aanbod voor de endoscopie en polikliniek.

Om tactisch plannen te kunnen invoeren op de afdeling, is het noodzakelijk om beschikking te hebben over logistieke en prestatie indicatoren. Allereerst zijn de logistieke indicatoren van belang. Deze geven een goed beeld op welke van de twee afdelingen de patiënten worden aangemeld en hoe vervolgens de patiëntenstroom plaatsvindt. Hieraan kunnen percentages worden gekoppeld. Wanneer deze gegevens duidelijk zijn, kunnen er prestatie indicatoren worden berekend. Hiermee kan worden gekeken naar cijfers over bijvoorbeeld de benutting van de beschikbare capaciteit, de realisatie en wacht- en toegangstijden. Echter, momenteel is het erg lastig om de juiste informatie

beschikbaar te krijgen, tenzij de informatie per patiënt wordt opgezocht. Beschikbare informatie uit de databases is niet consistent; de data ontvangen uit het Data Warehouse komt niet overeen met ontvangen data vanuit het programma Endosoft. Hierdoor hebben de prestatie-indicatoren weinig betekenis. Door deze consistentie op te lossen, kunnen er voorspellingen worden gedaan over de te verwachten vraag. Momenteel wordt gewerkt met de ICT afdeling om dit probleem op te lossen en zal er tevens een nieuw software programma van start gaan.

Literatuur op het gebied van een geïntegreerde aanpak van polikliniek en endoscopieafdeling/operatiekamers is zeer beperkt. Beide afdelingen binnen de MDL zijn echter wel afhankelijk van elkaar (op het gebied van zowel vraag als capaciteit), waardoor de planning wel geïntegreerd moet worden georganiseerd. In de literatuur worden er voornamelijk wiskundige modellen aangehaald, welke een optimale oplossing berekenen. Hierbij wordt er geen rekening gehouden met gehanteerde restricties.

Aanbevelingen

In de huidige praktijk wordt er op de MDL gebruik gemaakt van twee software systemen namelijk X-care en Endosoft. Deze systemen zijn inconsistent, waardoor de verkregen proces informatie geen reëel beeld geeft. Daarom kan er allereerst worden aanbevolen om een ziekenhuisbreed software systeem te integreren in het MST, waarin alle benodigde functies zijn verwerkt. Doordat er op dat moment gebruik wordt gemaakt van slechts een systeem, is de inconsistentie opgeheven.

Wanneer we spreken over tactisch plannen, bedoelen we de planning van electieve patiënten op middellange termijn. Wij adviseren de MDL in het MST om hun planning op tactische niveau te organiseren, waarbij er gebruik kan worden gemaakt van periodieke tactische planningsmeetings. Tijdens deze meetings worden er beslissingen gemaakt over de verdeling van de beschikbare capaciteit over de beide klinieken. Deze beslissingen worden gebaseerd op de beschikbare stuurinformatie over de afgelopen en aankomende periode (over vraag, aanbod en prestatie). De gekozen capaciteitsverdeling moet vraag en aanbod op een dusdanige manier afstemmen dat de MDL goed presteert. Het is niet realiseerbaar om deze beslissingen op korte termijn te nemen, aangezien de capaciteit op de endoscopieafdeling afhankelijk is van verpleegkundig personeel. Zij worden twee maand van tevoren ingepland. Op operatiekamers, waar sowieso altijd operaties worden uitgevoerd en dus verpleegkundig personeel wordt ingeroosterd (ongeacht de specialismen die op dat moment opereren). Hierin verschilt de endoscopieafdeling van de OKs, wanneer er meer capaciteit wordt toebedeeld aan de endoscopieafdeling, is er dus ook meer verpleegkundig personeel nodig. Hierdoor kan het invoeren van wijzigingen op korte termijn logistieke problemen geven bij het regelen van verpleegkundige ondersteuning.

Belangrijk voor de implementatie van tactisch plannen op de MDL is het verkrijgen van de benodigde data en informatie. Deze informatie moet vervolgens op de juiste manier worden gebruikt, zodat belangrijke proces informatie, patiëntencategorieën en tactische stuurinformatie duidelijk worden. Deze zijn de input voor de tactische planningsmeetings. Diverse projecten moeten daarom worden opgezet, om uiteindelijk tactisch plannen te kunnen implementeren op de MDL:

- Strategisch plannen –binnen het MST zullen er strategische keuzes en doelen worden bepaald die van invloed zijn op de flexibiliteit van de tactische planning op de MDL.
- Beschikbaarheid van proces informatie – het is van belang dat de informatie over het patiëntenproces (mogelijke stappen, de kansen hierop en de bijbehorende (wacht)tijden) beschikbaar wordt gemaakt. Het moet duidelijk worden voor welke afdeling de patiënten worden aangemeld, hoe de patiëntenstroom vervolgens is georganiseerd en welke doorstroom percentages daarbij horen. Dit kan men te weten komen door een steekproef te nemen van patiënten en deze te analyseren. Ook kunnen er voor een bepaalde periode patiënten worden gevolgd zodat hun zorgpad in kaart kan worden gebracht.
- Patient categorization – When all the required process information is derived, the next project can start. Given the numbers of referrals and the corresponding transition probabilities, groups of patients can be identified which are medically and logistically similar. Given these categories, transition probabilities can be applied to forecast the future demand more precisely.
- Patiënten categorieën – Wanneer alle benodigde proces informatie verkregen is, kan het volgende project starten. Met de percentages verkregen uit de proces informatie kunnen groepen worden geïdentificeerd die medisch en logistiek gelijk zijn. Op deze categorieën kunnen de verkregen percentages worden toegepast zodat de vraag voor de komende periode preciezer kan worden voorspelt.
- Availability of tactical management information – for the tactical planning meetings, tactical management information is required, on which the choices for capacity allocation are based. Supply, demand and performance information should therefore be made available for the past and future periods.
- Beschikbaarheid van tactische stuurinformatie – voor de tactische planningsmeetings is er tactische management informatie nodig, waarop de keuzes voor capaciteitsverdeling zijn gebaseerd. Vraag- aanbod- en prestatie informatie moet daarom beschikbaar worden gemaakt, voor zowel de afgelopen periodes als voor de komende periodes.
- Pilot tactical planning – after finishing all aforementioned projects, it is advisable to first start a pilot tactical planning before implementing this into the daily practice of the GIHD. Given

this pilot, the possible benefits and problems become clear. Therefore it is advisable to carry out a pilot, before starting the full implementation of tactical plans on the MDL. This pilot needs to be evaluated afterwards. For this pilot support is needed of all involved staff.

- Pilot tactisch plannen – nadat al de bovenstaande projecten zijn beëindigd, kan het worden aangeraden allereerst een pilot te starten waarin de mogelijke problemen en voordelen naar voren kunnen komen. Nadien moet deze pilot worden geëvalueerd. Hier kunnen vervolgens aanpassingen op worden gedaan alvorens tactisch planning te implementeren in de dagelijkse praktijk. Het nut van deze pilot moet worden ingezien door de betrokken werknemers.

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1. Introduction

This report describes accomplished research at the Gastrointestinal and Hepatology Department (GIHD) of Medisch Spectrum Twente (MST). This department struggles with the tactical planning and capacity of its outpatient clinic, endoscopy clinic and inpatient clinic. Surplus patients are referred to this department, which leads to overtime. Next to it, there is a lack of transparency of the planning at the GIHD. Through this lack of transparency, the amount of patients at the waiting list cannot be compared with the predicted availability at the outpatient clinic, endoscopy clinic or even the inpatient clinic. The research of these problems is described in this report.

Chapter 1 provides in section 1 a short description of the Dutch health care system and its recent changes. Section 2 contains a characterization of the Medisch Spectrum Twente, followed by section 3, a short description of the GIHD of the Medisch Spectrum Twente. The information of these first chapter derived from observations, interviews and conversations including information derived from the annual reports of 2009 and 2010 of the MST. This information resumed in a problem statement. This problem statement leads to a research goal, which can be achieved by using several research questions. This research questions structure the research and report in such a way that a conclusion can be given at the end.

1.1 Background

During the last years, a lot has changed in the Dutch health care sector. As can be found in the World Health Statistics of 2010 (WHO, 2010) the health care expenditures and life expectancy in the Netherlands are increasing. In 2004, TPG published a report called “Het kan ècht: betere zorg voor minder geld”. This report concludes that organizing logistic processes in health care in a more efficient way, can save 3 to 3,5 billion euro per year. Therefore, the logistic processes has to be changed from a push to a pull system whereby patient centered care is provided based on demand and not longer on available capacity. Since 2004, some changes to make health care more efficient, has taken place:

- On 1 Januari 2006, the Health Insurance Act (HIA) was enacted by the Dutch Government to make the Dutch health care system more efficient and consumer-driven, improve the quality of care and keeping the care accessible for all Dutch people (Bartholomée & Maarse, 2006; Enthoven & van de Ven, 2007; de Jong, van den Brink-Muinen & Groenewegen, 2008; Morris, Devlin & Parkin, 2007).
- Extension of the market competition between health care providers and health insurance companies is one of the main key elements of the new mandatory health insurance system.

Through this market competition, health care providers are stimulated to keep the costs at a minimum and simultaneously improve the quality of care.

- In the new mandatory health insurance system, a voluntary deductible is introduced. Every Dutch inhabitant is obliged to purchase a basic health care plan but is free to purchase additional health plans. Through the introduction of the voluntary deductible, patients must pay their first health care expenditures out of pocket (till a certain amount) through which people try more to avoid any type of health care treatment which is not necessary (Bartholomée & Maarse, 2006; Enthoven & van de Ven, 2007; de Jong, van den Brink-Muinen & Groenewegen, 2008; Morris, Devlin & Parkin, 2007).
- The financing system of health care expenditures in the Netherlands has changed by introducing Diagnosis Related Group (DRG), an agreement between health care providers and health care insurers. The financing system in the Netherlands is partly based on a fixed budget as well as on production numbers. DRGs are based on production and can be explained as a standardized payment for the treatment of a certain disease. DRGs can be divided into two financing structures: The A-segment includes DRGs which are negotiable in number but not in price, the B-segment includes DRGs which are freely negotiable (DBC onderhoud [1], 2011). In 2012 DOT is introduced in the Dutch healthcare system. DOT is the DRGs on the way to transparency (in Dutch: DBC's op weg naar transparantie). 30.000 existing DRGs are replaced by 4.400 improved DRG care products. In 2012, performance funding is introduced through which hospitals no longer receive a budget, but are paid for the care they actually deliver. Although performance funding was partly introduced in 2005, this applied only to the B-segment of the DRG financing system. With the introduction of performance funding in 2012, insurers and providers negotiate with each other on price, quality and volume of care. Functional budgets would completely disappear and the entire care would be funded based on DRGs. This results in full performance funding. Yet there remains a small part of health care based on fixed fees paid. An example to the emergency department, trauma services and transplantation teams. Through the DOT development it is possible to achieve a stable, comprehensive and transparent billing system. The new DRG care products are more recognizable because they cross-specialty and are based on the international diagnosis system ICD10. Within the DOT, DRGs are no longer defined in advance, but later determined by a grouper (a central web application). The provided care (diagnosis, care activities such as scans and treatments) is provided by the healthcare providers to the grouper. The grouper determines which type of DRG care product is in question and send it to the health care institution, which the institution in turn may declare by the insurer (NZa [1] , 2011; DBC Onderhoud, 2012; NVZ, 2012).

- Operational management is slowly introduced in the health care system in the Netherlands, stimulating patient-, health care and goods logistics. Because of patient centered care, clinical pathways is becoming important instead of one single part of this clinical pathway. An example of operational management within the MST is the department Business Process Redesign (BPR).

1.2 Medisch Spectrum Twente

Medisch Spectrum Twente (MST) is the 7th largest non-academical hospital in the Netherlands. The MST has two locations in Enschede, one location in Oldenzaal and two outpatient clinics in Haaksbergen and Losser. These locations cover a service area of 264.000 inhabitants (Medisch Spectrum Twente, 2011).

The mission of MST is to advance health of the inhabitants of Twente (the service area) by delivering curative care whereby basic care is the fundament in the supply of medical care. Beside this basic care, MST distinguishes itself by a top clinical care covering a much wider region. Top clinical care is high specialized care which is relative costly and wherefore specialized facilities and expertise are necessary. MST is authorized for this top clinical care based on the Law on special medical procedures (Wet Bijzondere Medische verrichtingen in Dutch). Because of their top clinical functions, MST aims to pay attention to research and training. Almost every medical specialty is present in MST (MST, 2011; MST, 2009).

MST has the following vision on care: MST aims to be patient oriented, in addition to offer hospitality and service in an efficient, safe and effective manner. MST aims to be service oriented to its health care professionals. MST is a multidisciplinary organization in arranging care, with clinical centers for certain specialism such as 'thorax centre' and 'vrouwkindcentrum'. With these centers, the MST distinguishes itself from other hospitals. According to the rising competition between hospitals, care have to be better adjusted en planned more efficiently. Besides that, investing in cooperation with other healthcare providers is important for MST (MST, 2011; MST, 2009).

Table 1 illustrates a general summary of patients flows in 2009. Appendix A contains an organization chart of MST. Appendix B contains the waiting lists sizes of various specialties within MST.

Table 1: some numbers of the Medisch Spectrum Twente (MST [2], 2012)

	Beds	Hospitalizations	Day admissions	Patient days	Outpatient visits
Amount per year	1070	32.400	32.200	198.400	490.800

1.3 Gastrointestinal and Hepatology department

The Gastrointestinal and Hepatology department (GIHD) of Medical Spectrum Twente is one of the largest departments in the North-East of the Netherlands. Currently, 7 medical doctors are working there, all specialized in a particular field such as Hepatology, IBD, Ischemia, and advanced endoscopy (ERCP and endo-echo). In addition, about 7 secretaries are working as well as several nurses who see outpatients (pre-sedation clinic, and chronic IBD and hepatology), and GI fellows (Guichelaar, 2011).

The daily practice at the GIHD is characterized by an *outpatient clinic*, *endoscopy clinics*, *inpatient clinic* and *additional factors*:

Outpatient clinics: Patients are referred from external areas (by general practitioners or by other specialists as a second opinion) or from inside the hospital (referring specialists). These requests arrive daily by fax. Within 24 hour after arrival, these faxes are being seen and scored by the gastroenterologist-on call. Thereafter these faxes are planned by the secretaries (new patients for the outpatient clinic) or by Planning office (endoscopies). A significant proportion of these patients will be seen at the outpatient clinic. After the first phase of diagnostic tests the patients will be referred back to the general practitioner or become a regular visitor in case of a chronic disease (Guichelaar, 2011).

Endoscopy clinics: The referral practice for endoscopies is similar to the outpatient clinics (general practitioners, second opinions by referring specialists) and are also scored within 24 hours. The field of endoscopic possibilities is increasing day by day, and includes both diagnostic and therapeutic modalities. The majority planned endoscopies procedures include gastroscopies and colonoscopies. Some of the many therapeutic modalities include placement of percutaneous endoscopic gastrostomy (PEG), stenting in case of obstruction, endoscopic retrograde cholangiopancreatography (ERCP), endoscopic ultrasound (EUS) and treatment of GI bleeds. The majority of the endoscopies are electively planned by fixed time slots. In addition, time slots remain open for emergency endoscopies. However, due to a large volume of endoscopic requests many of these emergency time slots are already in use, which leads to long working days and full programs (Guichelaar, 2011).

Inpatient clinic: The inpatient ward consists of 32 beds for GI problems. These patients are admitted due to emergent GI problems or acute-on-chronic diseases. The inpatient department is characterized by a high-volume of patients and a high-turnover (Guichelaar, 2011).

Additional factors: Every day a medical GI doctor is on –call (for 24 hrs). During day-time he/she admits the patients at the emergency department and consults. In the evening and nights this doctor

is then also on-call for emergency procedures, new admissions, and issues for the inpatient ward. In addition, the medical GI doctors participate (almost daily) in multidisciplinary meetings, in order to discuss complicated diseases. A few examples of these meetings are Hepatology, IBD, Ischemia and vascular diseases, GERA (surgical and radiological meeting), GI oncology and grand rounds (discussing all inpatients). In addition, the current practice also demands organizational input in establishing (multidisciplinary) diagnostic tracts, protocols and improvement projects. Both these meetings and organizational aspects of health care is important for the patients as well as the daily practice of the GIHD. Improvement projects, such as strategic planning at the endoscopy and outpatient clinic is of particular interest (Guichelaar, 2011).

1.4 Problem description

The mission of the GIHD is to provide service and quality with a short access time. At the GIHD a distinction is made between new patients and control patients, who suffer from a chronic disease. New patients are referred to the GIHD by the general practitioner or by another hospital or medical specialist. These referrals are scored by the Gastrointestinal (GI) medical doctor on call for its urgency and then planned. However, the current outpatient slots are mainly used by control patients and several GI doctors do not have places available for the new referrals. In addition, the majority of new patients will return at least for 1 or 2 times after diagnostic tests or become a control patient. Although there is lack of spaces for new patients at the outpatient clinic of the MST, the patients still need to be seen and are planned in extra outpatient clinics, or the existing outpatient clinic will become overbooked. The same problem exists for urgent care at the endoscopic unit, which results into overbooked programs. This leads to stress not only for the GI doctors but also the secretaries, planning office and endoscopic suites (Guichelaar, 2011).

An important deficit in the current system is the lack of transparency in planning outpatients (e.g. how many hours are planned, how many referrals are received and how many patients are on the waiting lists because for instance chronic care patients that need to be seen somewhere during the next 6-12 months). Currently, the programs are fixed 4 months in advance. Patients that need to be seen after this period will be placed on a virtual waiting list. Patients on these waiting lists are not compared to the predicted availability at the outpatient unit for that particular physician (Guichelaar, 2011).

1.4.1 Problem statement

The GIHD suffer from a lack of capacity. Capacity is described by Slack, Chambers, Johnston (2007) as “the maximum level of value-added activity that an operation, or process, or facility is capable of over a period of time”. In terms of the GIHD, the capability of this department for the maximum

amount of patients who can be seen and treated within a certain period of time. The outpatient clinic as well as the endoscopy department are organized in such a way that the supply and demand are not in good proportion to each other. All patients have to be seen, which leads to overbooked programs and a lot of stress for all employees at the GIHD. In Appendix B shows that the GIHD has one of the longest waiting lists within the hospital.

The department aims to develop their demand driven planning system, which is already available but does not work. Current patient processes, patient flows and its actual amount has not been evaluated including a lack of transparency facilitating a demand driven approach.

1.5 Research objective

The objective of this research is:

To design a tactical conceptual planning model for the outpatient clinic and endoscopic clinic of the Gastrointestinal and Hepatology Department of MST and to determine the necessary steps for implementing this concept in the organization.

1.6 Research questions

Above mentioned research objective must be reached by dividing the research in several steps. These steps are outlined through using research questions, which were mentioned in this section. There is given a systematic overview of the structure of the research report in figure 1.

In Chapter 2, the context analysis is given. The context analysis will discuss the current organization of the planning at GIHD. The main input for the content of this chapter is derived from the annual report of 2011, the website of MST and from interviews and conversations with employees of MST. In Chapter 3, a literature research is accomplished. For this literature research, the bibliography of the CHOIR research unit of the University of Twente, Orchestra (CHOIR, 2011) is used as a starting point. The exact search process is outlined in Appendix C. The composition of section 3.1 is derived from scientific information found in the search process. The information in section 3.2 is based on a research of another student at the University of Twente, R. Rijntjes (2011). She has interviewed someone of the Ziekenhuis Groep Twente (ZGT). This hospital already practices with tactical planning. Based on this interview and Rijntjes research, a practical example can be given. In section 3.3 one specific scientific article is discussed. Afterwards, with the information derived from literature combined with the information about the current planning of the GIHD, a conceptual

tactical planning model can be composed. This model is a composed plan of how to organize and implement tactical planning at the GIHD in MST.

Chapter 2: Context Analysis

How is the planning at the GIHD of the MST currently organized and how can this process be described?

2.1 Which steps can be identified in the (different) patient process(es) and which indicators can be used for describing this process?

2.2 How is the planning at the GIHD organized on a strategic, tactical and operational level?

2.3 Which indicators can be used to examine the performance of the capacity planning of the GIHD?

Chapter 3: Literature Research

Which tactical capacity planning concepts can be found in the literature which can be implemented at the GIHD of MST?

3.1 Which tactical planning concepts can be found in literature related to ...

- Outpatient clinics;
- Endoscopic clinics / Operating rooms (Endoscopic clinic planning is structured in almost the same way as operating rooms, only minor differences can be identified);
- Integrated planning for outpatient clinics and operating rooms?

3.2 How is tactical capacity planning organized in a practical setting?

3.3 How would tactical capacity planning be organized given an integrated approach built from theory?

Chapter 4: Design of a tactical planning approach for GIHD of MST

How must the development and implementation of a tactical capacity planning model be organized at the GIHD of MST?

4.1 What tactical planning concept would be appropriate for the GIHD of MST?

4.2 To implement tactical planning at the GIHD, which project need to be undertaken?

4.3 – 4.6 What are the different projects and how are they organized?

- Answering the questions what, why, how, who and when for each project

4.7 How should a pilot project be designed?

- Explanation of the pilot at the GIHD of MST
- Evaluation of process and information

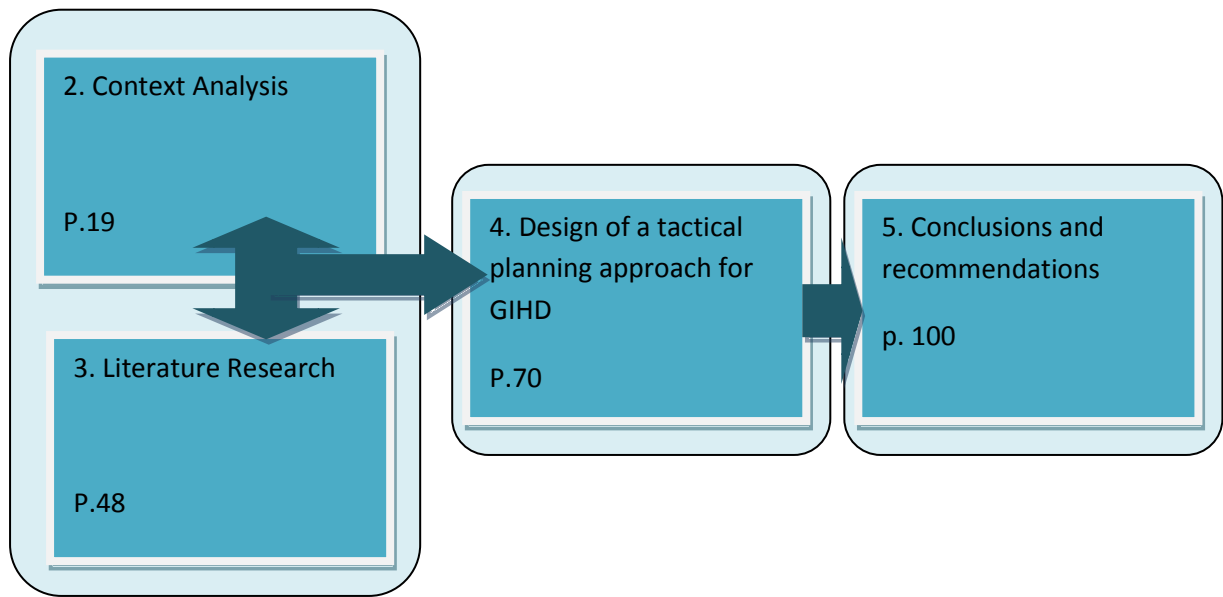


Figure 2: Organization of this research report

2. Context analysis

This chapter will provide more insight in the process of planning at the GIHD. Section 2.1 starts with a patient process description. In this patient processes first a general process will be described and subsequently all possible clinical pathways of patients at the GIHD are provided. After this patient process, a description will be given of the planning process at the GIHD in section 2.2. This description provides more insight in different types of planning and control within a hospital. Used for this description will be the framework for hospital planning and control, developed by Hans, van Houdenhoven, & Hulshof (2011). In section 2.3 some indicators, that can be used to measure the performance of the planning, are given. Section 2.4 will give the conclusions from the context analysis. With these conclusions, the research scope is better defined.

Information used for this context analysis is derived from literature, but also from observations and interviews at the GIHD.

2.1 The patient process

In this research, we will use patient process description. Hereby, processes are described in terms of how the activities within the process at the GIHD relates to each other. Different types of activities that takes place during the process are identified and the flow of patients through the process at this department will be showed. (Slack, Chambers & Johnston, 2007).

2.1.1 The referral

We will start with an overview of the planning process at GIHD in figure 3. In this figure it becomes clear that all referrals, for even the endoscopic clinic as the outpatient clinic, arrive at one point. These referrals are printed and then scored by a GI medical doctor. After that, these scored referrals are entered in the system. Through this scoring process it has become clear when the patient have to be seen at which clinic, the appointment is scheduled.

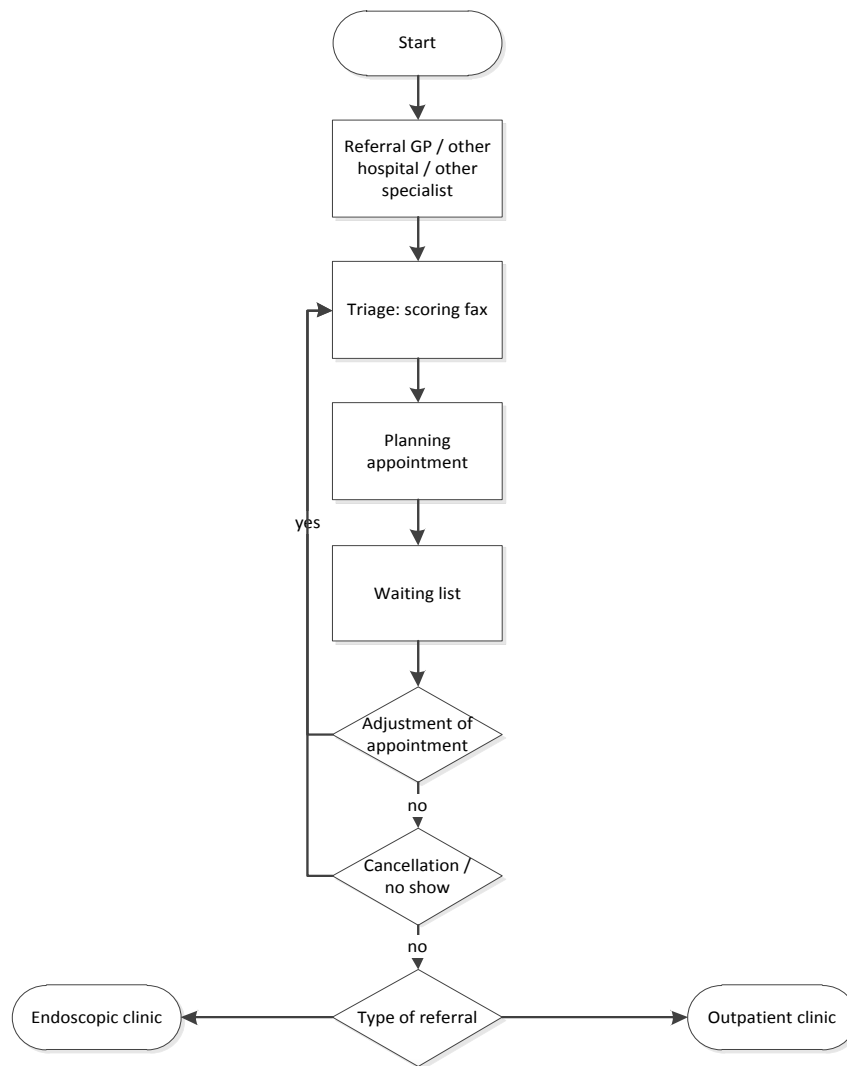


Figure 3: Planning of a referral

2.1.2 Different types of patients

At the GIHD, patients are divided into two different types: new patients and control patients. Different type of processes can be identified for these patient types. Therefore different patient process schemes are distinguished.

New patients

When we are talking about new patients, we mean the group of patients that visit the GIHD for the first time. Next to this first visitors, we also talk about new patients when a patient has already visited the GIHD in the past, but now is referred to the GIHD with other complaints than the first time.

New patients present with symptoms and are therefore referred to the GIHD. They are referred to one of the two clinics by the general practitioner (GP), the emergency room (ER), other specialists or other hospitals. For each of the clinic, different patient processes are provided.

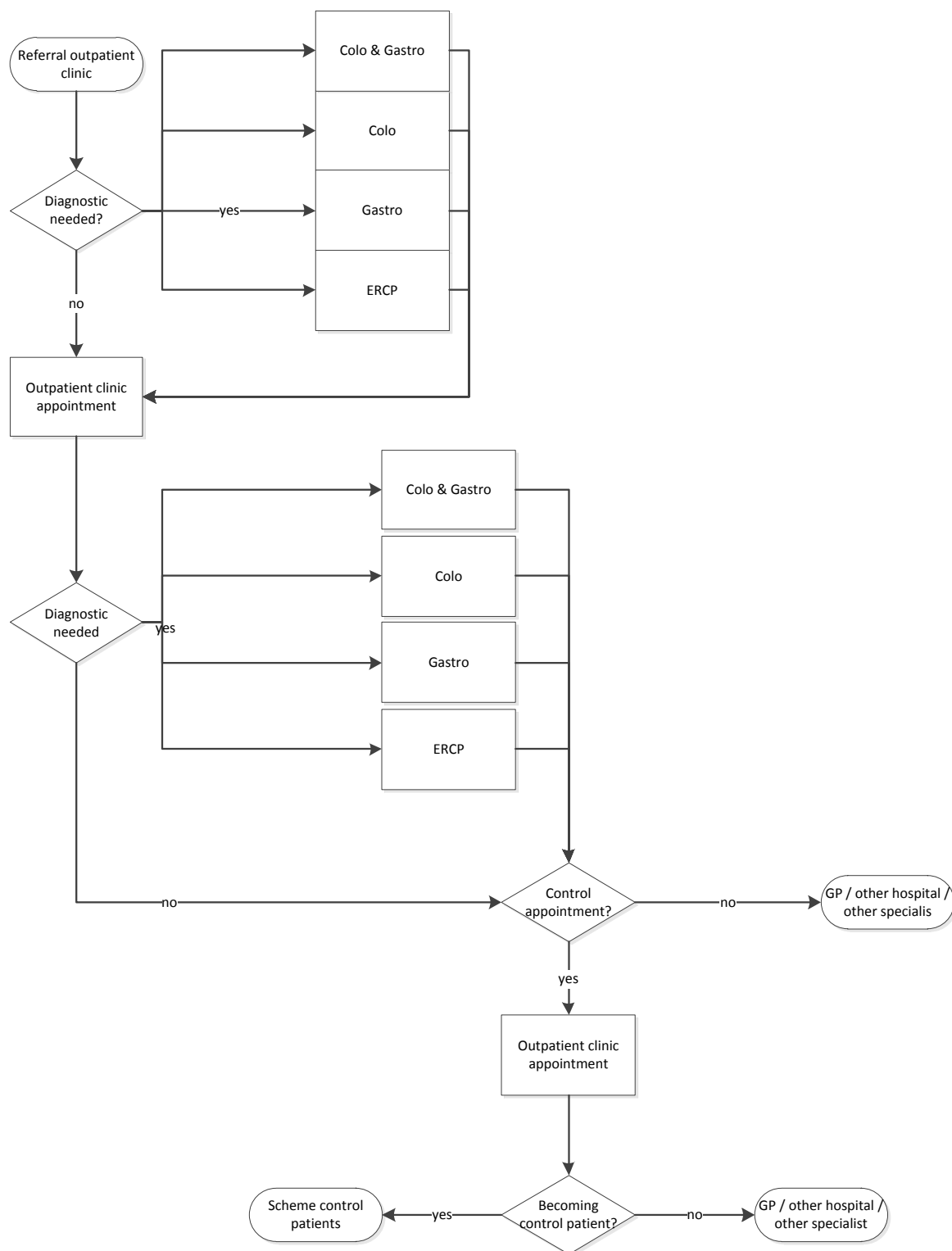


Figure 4: new patients at the outpatient clinic

In figure 4, a new patient is referred to the outpatient clinic. Then there is decided if the patient have to undergo diagnostic researches before the appointment at the OC. After that, the patient has an consult at the OC. Next there have to be decided if there is needed some additional research for the diagnosis. Depending on this diagnosis, a patient can become a control patient or can be returned to another specialist, a GP or to another hospital.

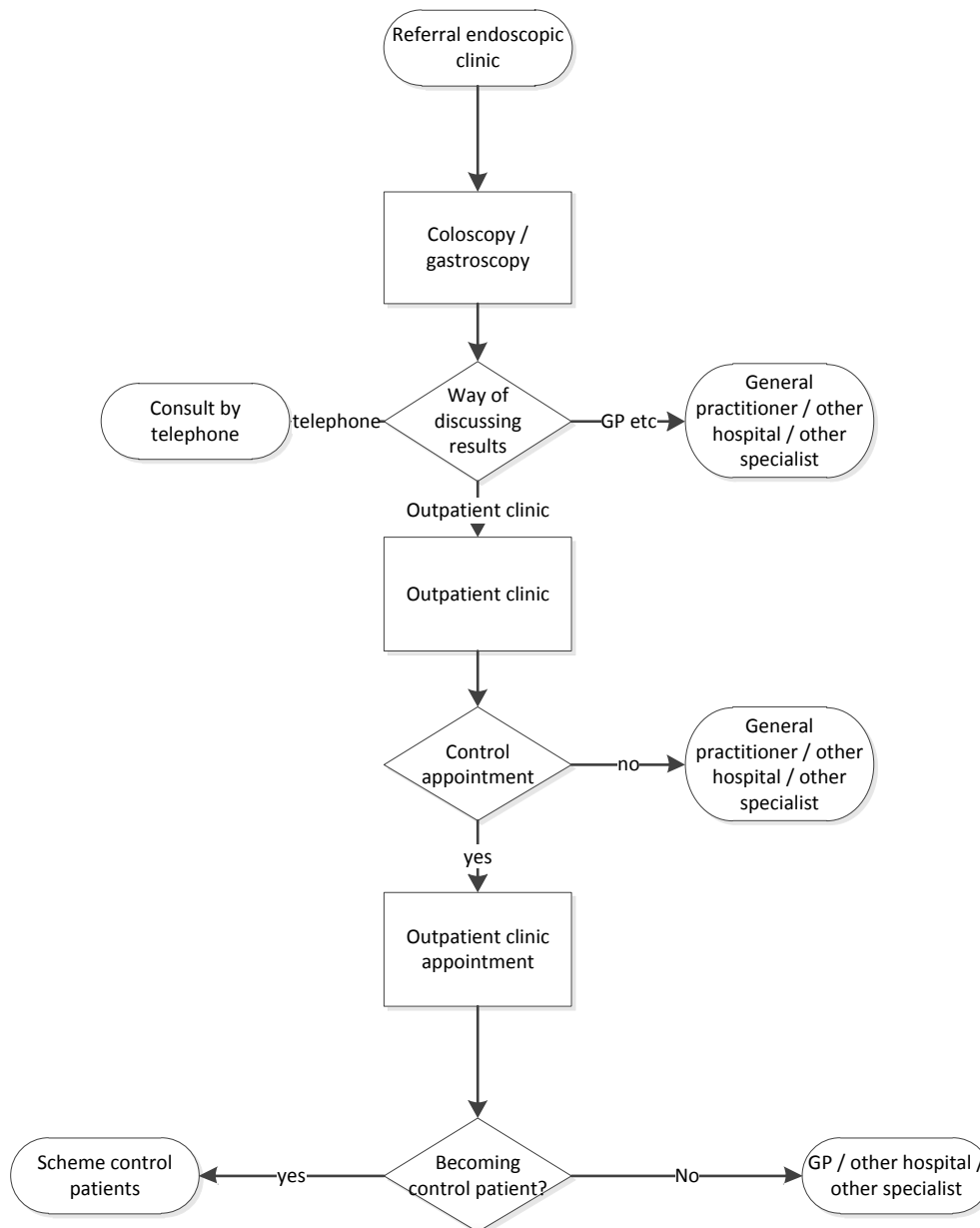


Figure 5: New patients at the endoscopic clinic

In figure 5, a new patient is referred to the endoscopic clinic. This patient must undergo some researches and/or treatments. Dependent of the diagnosis, a patient can have a consult by telephone, can be returned to the referrer or there can be scheduled an follow-up consult at the OC. The patient can become a control patient, for which follow-up consults will continue.

Control patients

Control patients are diagnosed with a chronic condition. For this chronic condition a continuation of follow-up consults is needed to control the health situation of that patient.

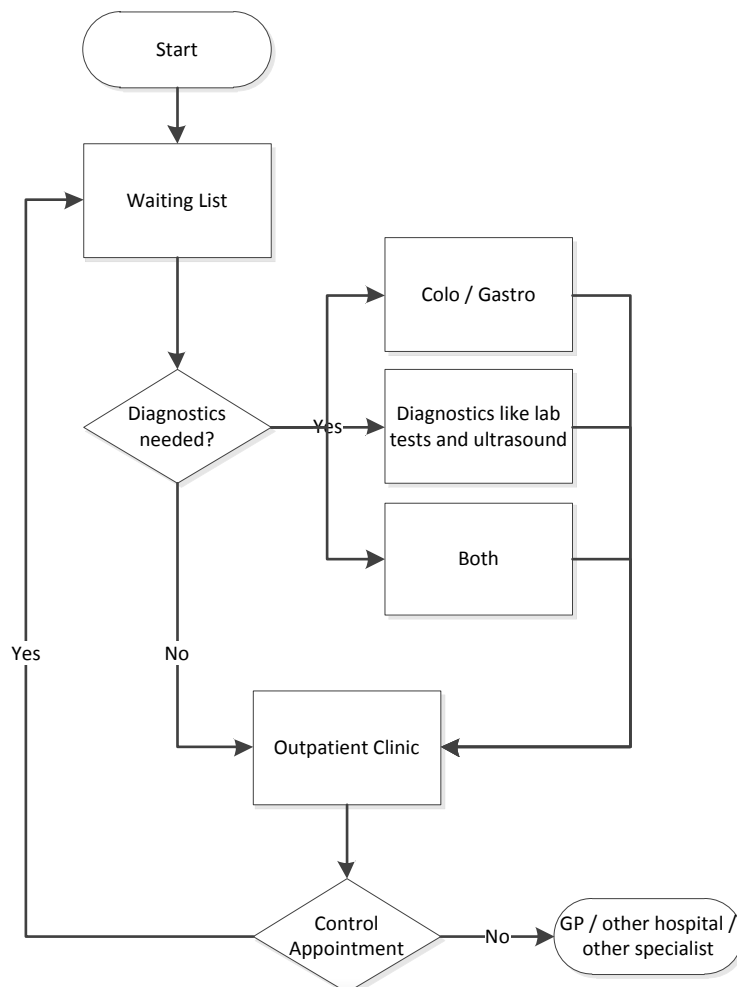


Figure 6: Patient process of a control patient

In figure 6, it becomes clear that control patients end up on the waiting list. The consults can be planned four months in advance. When a follow-up consults must take place after a longer period than these four months, a patient ends up on that waiting list. When planning a control patient, there have to be decided if there is needed some additional research before the patients consult. This depends on the chronic condition. After the follow-up consult, a patient ends up on the waiting list again or can be returned to the GP or other specialists.

2.1.3 Logistic indicators

We use supply and demand related logistic indicators to describe the patient process and the patient flow through the GIHD. Using these indicators is meaningful for the calculation of the expected

demand and capacity. Applying can take place for instance per period, per type of consult, research or treatment, per GI medical doctor or per diagnosis.

Logistic indicators related to the demand side of the planning:

- Expected volume at the GIHD;
 - How is the division elective and acute patients;
 - Which production agreements are set by the board of the hospital and the health care insurer;
 - The amount of new patient consults at the outpatient clinic;
 - The amount of follow-up consults and follow-up factor at the outpatient clinic;
 - After a first patient visit, but without endoscopic treatment/research;
 - After endoscopic research/treatment;
 - Appointment for chronic care patients, that need to be seen every 6 – 12 months.
 - The amount of requests for endoscopic treatments/researches;
 - The amount of no shows;
 - Variance in volume requirements (per period).
- Duration of the various consult, treatment and research durations at the GIHD.

Logistic indicators related to the supply side of the planning:

- Available time;
 - Of the GI medical doctors (per period);
 - Taken into account the other activities during the week (study hours, administration time, clinical day)
 - For outpatient clinic (per period);
 - For endoscopic clinic (per period);
 - Of other staff, with supportive tasks to the GI medical doctors.
- Variance in availability;
 - Absence due to holidays and maternity leave;
 - Absence through illness.

Appendix D further discusses these indicators for supply and demand.

2.2 Planning and control

Planning and control are important pillars for the GIHD of the MST. Planning and control concern a consideration between the requirement of the market and the resources of an organization, in this case MST. The activities of planning and control are described by Slack, Chambers and Johnston (2007) as the activities which provide systems, procedures and decisions which bring together different aspects of supply and demand. It determines the goals of an organization and it defines the means for achieving them (Daft, 2008). The intentions of what is going to happen at some time in the future is called planning. The process of monitoring what really happens, the coping of any deviations of the intended plans, is called control.

To describe the planning process of a hospital, the framework for hospital planning and control will be used (Hans, van Houdenhoven & Hulshof, 2011; van Houdenhoven, 2007). In figure 7, the framework can be found.

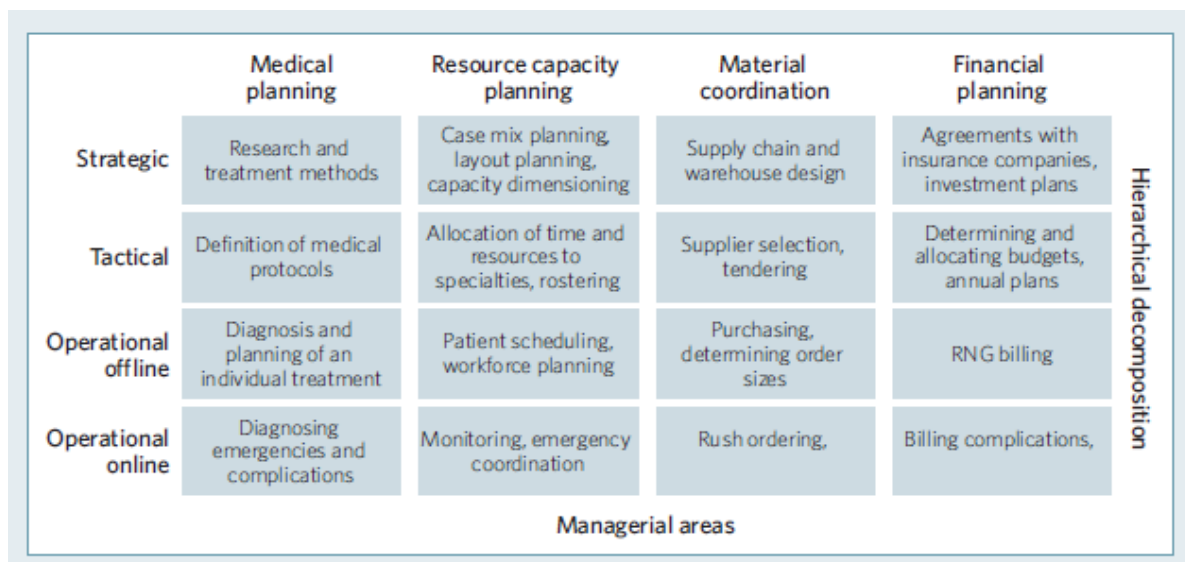


Figure 7: Framework for hospital planning and control (Hans, van Houdenhoven & Hulshof, 2011)

2.2.1 Managerial areas

The framework identifies four managerial areas: *medical planning*, *resource capacity planning*, *material coordination* and *financial planning*.

The *medical planning* exists of the planning process of medical activities whereby medical decisions made by clinicians are related to other areas of interest such as financial control and material logistics. Performance indicators which are important in this field of interest can be quality of care or research output. Decision making by clinicians regarding for example medical protocols, treatments, diagnoses and triage is the medical planning according to Hans, van Houdenhoven & Hulshof (2011).

Resource capacity planning can be described as dealing in a efficiently manner with scarce resources such as people, tools and MRI scanners. Planning, scheduling, monitoring and control of renewable resources are addressed by the resource capacity planning. Performance indicators in this field of interest can be overtime and utilization (Hans, van Houdenhoven & Hulshof, 2011; van Houdenhoven 2007).

In the health care, material which support the primary process are needed. Dealing with the distribution of these materials is called *material coordination*. Beside these materials, the acquisitions, storage, distribution and retrieval of all these consumable resources/materials are discussed in the material planning. Inventory control and purchasing are very important in this field of interest and possible performance indicators can be service or response rate(Hans, van Houdenhoven & Hulshof, 2011; van Houdenhoven 2007).

The last field of interest in the framework for hospital planning and control is the *financial planning*. Here, financial planning addresses how an organization should the costs and revenues of that organization should be managed, in such a way that the objectives are achieved under current and future organizational and economic circumstances. Liquidity or solvability are possible performance indicators in this field of interest (Hans, van Houdenhoven & Hulshof, 2011; van Houdenhoven 2007).

2.2.2 Hierarchical levels

Next to the managerial areas of hospital planning, the hospital planning can also be divided into four hierarchical levels of control: strategic, tactical, operational online and operational offline planning. Interaction should be emphasized between above mentioned areas of interest and the levels of control, which will be discussed below.

Strategic planning

The strategic planning is the planning at the long term. This strategic planning addressed structural decision making. It consists of broad statement where the organization stands for and wants to be in the future, the mission statements and long-term objectives. They are the stated intentions of what an organization wants to achieve. In this strategic planning, the organization is seen as a whole and not as specific departments. Strategic plans are the steps taken to attain the strategic goals so it defines the hospitals activities and resource allocations. As said earlier, strategic planning is long-term planning, it defines organizational action steps from two to five years in the future. To turn hospitals goals into reality, consistent and concrete strategic objectives for each field of interest of the framework for hospital planning and control need to be developed. For the strategic planning, there is often used forecasting and/or historical information (Daft, 2008; Houdenhoven, 2007; Hans, van Houdenhoven & Hulshof, 2011).

Tactical planning

Tactical planning is concerned with the medium-term planning of the hospital. It consists of goals that major divisions and departments within the hospital try to achieve within the organizations intend to achieve. These goals are formulated for middle management and with achieving this goals, there is made a contribution for achieving the overall goals of the hospital. So it can be said that tactical plans define what there have to be done, to implement the strategic plan into the hospital. Tactical planning of each specific department accomplish a specific part of the hospitals strategy. The time horizon of tactical plans is shorter than of strategic plans, it can be over the next year. Tactical planning is dealing with actual or expected amounts of patients. It is almost similar to operational planning, but the planning horizon is longer for tactical planning which creates more flexibility (Daft, 2008; Houdenhoven, 2007).

Operational planning

Operational planning is the planning that concern department, work groups and individuals. The operational goals which are set, are often measurable and precise. The goals are stated in quantitative terms and there is described precisely and detailed how this goals will be achieved. The operational goals require specific steps and are developed for the lower levels of the organization. Operational plans are developed to support the tactical plans and to achieve the operational goals. Within operational planning, scheduling is very important. With scheduling there are set precise time frames for the completion of each operational goal which in its turn is required for achieving the tactical and strategic goals. Beside the scheduling, handling a budget is recommended, scarce resources have to be allocated (Daft, 2008; Houdenhoven, 2007).

Medical processes can be variable, which means that there have to be dealt with a lot of uncertainty in health care. Unplanned events such as emergencies can occur, which divide the operational planning into offline and online operational planning (Daft, 2008; Houdenhoven, 2007). Each type will be shortly described:

Operational offline

Operational offline planning has to deal with expected activities and can take place in advance. It consist of the detailed coordination of resources which are deployed in previous planning layers. The decisions taken in this planning layer are delegated to the lower management or clinicians(van Houdenhoven, 2007; Daft, 2008). The scheduling of a patients appointment and the distribution of patient to different surgeries are examples of operational offline planning

Operational online

Operational online planning has to deal with unforeseen and unanticipated events. Control mechanisms have to be used to monitor the process and react correctly to these events. Dealing with emergencies are an important part of operational online planning. Most of the time this type of planning must take place directly (Daft, 2008; van Houdenhoven, 2007).

2.2.3 Application of the framework for hospital planning and control at the GIHD of MST

In this section, we will give an application of the framework for hospital planning and control at the GIHD. Beside the categories strategic, tactical, operational online and offline, we will introduce five entities of planning. These five entities are demand, supply, planning horizon & hierarchy, decision conditions and performance indicators. The outlining of these entities can be found in Appendix E. Each of these five entities will be discussed for the strategic, tactical and operational offline and online planning.

Strategic planning

Demand

Demand on a strategic planning level contains agreements made which influence the demand side of the GIHD. These are agreements made with health care insurers. Through the introduction of market forces in health care, health insurance companies purchase care from health care providers. Purchasing this care is based on costs and on quality. Therefore, the GIHD must deliver care with a high quality and simultaneously keep the costs at a minimum. In this case demand is purchased by the health care insurer. In the strategic planning, these agreements are made. Offered type of care and production numbers of the GIHD are set in these agreements. For determining these agreements, historical information is used to forecast the expected demand (Glöckner et al, 2009).

Supply

We consider the supply of the GIHD on the strategic level for each of the four managerial areas of the framework of Van Houdenhoven (2007).

Medical planning:

Here, the supply concerns the research and treatment methods used at the GIHD. These ways of doing research and treating patients must be in agreement with protocols and quality requirements. The MST has several protocols and quality requirements that determine in which way the care of the GIHD has to be organized. To ensure the quality and safety of delivered care, the following quality systems are used within the MST (MST [1], 2012).

- Quality indicators Visible Care Netherlands (Kwaliteitsindicatoren Zichtbare Zorg Nederland): This program has made the quality of care transparent by means of so-called indicators. These are measurable aspects of care, which are indicative of the degree of quality. Two different types of indicators can be identified: *care substantive questions* and *customer preference questions*. The focus of the *care substantive indicators* is on the provided quality of care of an institution, whereby effectiveness and safety are important pillars. The indicators are linked to medical guidelines. Working groups consisting of medical specialists and the representatives from insurers, nurses and patients associations, have developed the indicators. The focus of the *customer preference questions* is on the needs of patients with respect to choice information about the care the hospital can offer at the present patients condition. The customer preference questions are developed using patient input. This development is accomplished by the Consumers' Association and the NPCF (Zichtbare Zorg Nederland, 2012; MST [1], 2012).
- Performance indicators published by the Inspection for Health Care (in Dutch: Inspectie voor de Gezondheidszorg, IGZ): The IGZ publishes each year a document containing the specific quality indicators for all departments within a hospital (IGZ[1], 2012; IGZ [2], 2012; MST [1], 2012).
- Other indicators in the field of quality and safety (MST [1], 2012).

Resource capacity planning:

Here, supply concerns the available capacity of renewable resources, which we describe below.

The GIHD has employed eight GIHD doctors at this moment. Together, these doctors are good for 7,9 fte (full-time equivalent). There is employed a ninth doctor who will start in the end of 2012. In addition to these doctors, there are 4 AIOs (Doctor in training for specialist; in Dutch Arts in Opleiding tot Specialist) and 4 ANIOs (Doctor not in training for specialist; in Dutch Arts Niet in Opleiding tot Specialist) employed at the GIHD. ANIOs can be scheduled at the OC, the ward and at the Emergency Room. AIOs can also be scheduled for endoscopic, but supervision is required. Beside the doctors, ANIOs and AIOs, two retired doctors are working at the EC to the end of august. Together they are working 10 half days.

The GIHD can be separated into an endoscopic clinic and an outpatient clinic. At the outpatient clinic, there are seven *consultation rooms*. The endoscopic clinic has six *treatment rooms*. One of these treatment rooms can be used for surgeries where *X-ray equipment* is needed. After surgery in the endoscopic clinic, a patient has to rest up to 90 minutes at the recovery room. The recovery room has 10 *recovery beds*.

For surgeries at the endoscopic clinic, *scopes* are needed. 53 Scopes are available for this department. Cleaning one scope takes 45 minutes.

For some of the renewable resources maintenance have to be contracted. Decisions for contracts for equipment

Material coordination:

Here, supply concerns the availability of disposables and inventory. Inventory can be defined as a stock or store of goods. Goods as drugs, surgical supplies, food supplies, life-monitoring equipment and many more are stocked in hospitals. This stock has to be controlled, because inadequate control can cause understocking and overstocking of items. Understocking can result in cancellation of treatments / consults and in worst case scenario, it might cause death of a patient. According to Ozcan (2009) funds that might be more productive elsewhere are unnecessary tied up. Overstocking seems to be the lesser of the two evils but this is associated with higher holding or carrying costs. Therefore, a trade-off have to be made about having the right products in sufficient quantities at the right place in the right time, and the costs of ordering and carrying inventory. This trade-off is the task of inventory management (Ozcan, 2009).

Financial planning:

Here, supply concerns investment plans and contracting with insurance companies. As mentioned above, in 2012 DOT was introduced in the Dutch Health Care system. Through this change to performance funding, functional budgets would completely disappear and the entire care would be funded based on DBCs. Therefore, health care providers and insurers have to negotiate with each other on price, quality and volume of care(NZa, 2011; DBC Onderhoud, 2012; NVZ, 2012).

Planning horizon and hierarchy

The planning horizon of strategic planning must cover the long-term objectives of a hospital. Long-term objectives can cover several years. At the GIHD several decisions have to be made of which the effects can be perceived daily. An example of these decisions is the new construction of the MST. Choices are made about the amount of treatment rooms for the endoscopic clinic as for the amount of consultation rooms for the outpatient clinic.

The planning horizon can diver for several resources. The planning horizon of amount of consultation rooms and treatment rooms differ from the amount contracted doctors. MST is realizing a new building wherefore decisions had to be made on the needed capacity for consultation rooms, treatment rooms and the size of the inpatient clinic as well. This new building must act for several years. Consequences of made decisions about the capacity of this new building can be perceived for

years. Amount of doctors at the GIHD is more flexible in comparison with the decisions made for the new hospital building. When the demand exceeds the available capacity, there can be decided to contract new doctors whereby the period of this contract can be determined through the RVE of the GIHD. Attracting or shedding staff can occur any time in contrast to consultation- and treatment rooms, of which the amount is fixed for several years.

Strategic planning is performed by the RVE (Result Responsible Units, in Dutch: Resultaat Verantwoordelijke Eenheden) management of internal medicine in agreement with the board of directors. These RVEs are organized by dual management: each RVE has two managers, a business manager and a medical manager. The objective was that each RVE at the end of 2011 would have a multi-year business plan. This is not achieved. The business plans of the RVE internal medicine and MDL are currently under development. It is expected that this business plan is completed this summer (MST[1], 2011).

Decision conditions

Here, decision conditions concerns conditions which influences decisions made through the RVE of internal medicine or the board of directors. The effects of this decisions will be perceived for a long time. Setting up criteria for decisions about the capacity of the GIHD according to the waiting list is an example of decision conditions in strategic planning.

On the strategic planning level, decisions have to be made about the capacity dimensioning.

Performance indicators

The performance indicators are set by the Board of Directors in cooperation with the RVE intern medicine. These indicators must be in agreement with the indicators of the IGZ and made appointments with the health care insurers. As mentioned before, quality indicators published by Visible Care Netherlands, performance-indicators set by the IGZ and other indicators in the field of quality and safety are followed to assess the quality and safety and protection. Also, the Commission of quality and safety monitors compliance with the recommendations of the IGZ and the development of the number of complaints, claims, disciplinary cases and emergencies.

MST has established strategic objectives for the period 2012 – 2015. Starting point is the continuously improvement of quality of care. At each objective is to improve one or more of the following quality factors central: interpersonal quality, the interaction between patient and staff; medical quality and safety, the outcomes of medical interventions and available medical knowledge; environmental quality, facilities and atmosphere in and around the hospital; administrative (logistics)

quality, efficient and effective planning, implementation and support of operations. The developed objectives are (MST [1], 2011):

- MST continues to offer a wide range of care and expands the top clinical care;
- MST makes a change from discipline-oriented care to care that is organized around the care needs of the patient;
- MST invests in facilities and resources that strengthen the top clinical profile;
- MST develops into a financially healthy and stable organization.

Tactical planning

Tactical planning is the intermediate-term planning of a hospital. Tactical planning addresses the goals that major divisions and departments within the hospital try to achieve. Tactical planning at the GIHD will be explained by outlining the aforementioned five planning entities.

Demand

The planning process at the GIHD takes place by using faxes. Each request for consults, treatments or researches at either the outpatient clinic or endoscopic clinic, arrives by fax. These faxes will be printed out and scored by the doctors at this department. The following scores were used:

Table 2: Available scores for a patients referral to the GIHD

Planning Code	Urgency of the referral
Code 1	Patient have to be seen within 1 day
Code 2	Patient have to be seen within 1 week
Code 3	Patient have to be seen within 3 weeks
Code 4	Patient have to be seen within 4 to 6 weeks
Code 5	Patient have to be seen when there is space and time for this patient

Once a week an overview is generated of all planned patients and the available capacity. The data manager of the MST and the GI doctors then discuss these overviews to solve met problems.

Supply

Again, supply of the GIHD is considered using some of the managerial areas of the framework of Van Houdenhoven (2007).

Medical planning:

Here, supply concerns the definition of medical protocols. These protocols must be consistent with quality indicators set by the IGZ and visible care. Support of doctors for using this protocols is necessary, otherwise these protocols never are going to be executed. The reason why the content of

these protocols are not discussed in dept, is the relevance for this study. Noticing that there is discussed about the development of these protocols is more important for the capacity planning of GIHD than the content of these develop protocols.

Resource capacity planning:

Here supply concerns the allocation of time and resources to specialties and roistering. Roistering concerns doctors and rooms at either the outpatient and the endoscopic clinic.

Types of shifts: what types of shifts will be used at the GIHD: at the GIHD the doctors work with an twelve hours shift. Each workweek for a doctor is divided into four days which can be scheduled at the OC or EC. The fifth day is a clinical day. At this clinical day a doctor can be contacted, but cannot be scheduled. Beside this clinical day, two of the doctors spend one fixed day of their workweek for other pursuits than patient-care. A workday for a doctor at the GIHD is always divided into one shift at the outpatient clinic and one shift at the endoscopic clinic. There exist some exceptions to this condition. Different timetables are used for scheduling patients at the OC and EC, which are showed in table below:

Table 3: Timetable for the Outpatient Clinic

Monday	Tuesday	Wednesday	Thursday	Friday
8.30 – 12.30	8.30 – 12.30	8.30 – 12.30	8.30 – 12.30	8.30 – 12.30
13.30 – 16.30	13.30 – 16.30	13.30 – 16.30	13.30 – 16.30	13.30 – 16.30

Table 4: Timetable for the Endoscopic Clinic

Monday	Tuesday	Wednesday	Thursday	Friday
8.45 – 12.30	8.30/8.45 – 12.30	8.30 – 12.30	9.00 – 12.30	8.45 – 12.30
13.30 – 16.30	13.30 – 16.30	13.30 – 16.30	13.30 – 16.30	13.30 – 16.30

Beside the shifts at the OC or EC, each day one doctor have to invigilate at the nurse department of the GIHD. This will take one to two hours each day. This has to be taken into account in the planning schedule.

Planning weekends and evenings: During the evenings and weekends, doctors, AIOSs and ANIOSs must be scheduled. An AIOS or ANIOS is not authorized to perform endoscopy (an AIOS is not authorized without supervision). Therefore, a rear guard (in Dutch: achterwacht) have to be scheduled. When this rear guard is not competent to carry out an intervention endoscopy, an intervention rear guard should also be scheduled. The distribution of these shifts is proportional,

wherefore a scheme is maintained by the data manager of the GIHD (Anita Westerhof). Some planning rules exist for the planning of weekends and evenings:

- During a weekend shift, a doctor is intern at the hospital. As reason can be shown that the scheduled doctor, next to the emergencies, also have to invigilate at the nurse department of the GIHD. A rear guard and an intervention rear guard are working on call, they are not obliged to stay in the hospital.
- Each doctor is allowed to only run one evening shift in sequence. Reason for that is the working day following the evening shift.
- After a weekend shift, doctors, AIOs and ANIOs will receive some compensation. Doctors getting a half-day compensation which is normally scheduled on the day after the weekend shift. In agreement with the planning office, this compensation can be used on another day or in a different way. Assistants getting a full day compensation which always is scheduled on Tuesdays.

Scheduling doctors: Six months in advance it becomes clear for the doctors which days they are scheduled. Six weeks in advance the format of the shifts become clear. From this moment on, patients can be planned in the schedules of the various doctors. This scheduling can continue to one day in advance, or the same day in case of emergency.

Way of scheduling consults: The planning of patients at the GIHD is different for the OC and EC. At the OC new patients consults, follow-up consults and telephone consults can be planned. For each of these types of consults, a fixed amount of time is scheduled:

- New patient consult: 20 minutes;
- Follow-up consult: 15 minutes;
- Telephonic consult: 5 minutes.

The OC does not work with preset slots in their planning. For each week, the planning system of the data management gives an overview of the patients who have to be scheduled that week by each specific doctor. These consults then are distributed over the week. It is possible that the amount of consults planned for that week exceed the amount of capacity of a doctor. Then a personal consultation takes place to discuss how to solve this problem. At the EC different types of treatment/researches can be planned. For the EC the same applies as for the OC: fixed amounts of time are scheduled for the specific treatments/researches. The most important treatments/researches are:

- Colonoscopy: 30 minutes;
- Gastroscopy: 15 minutes;
- Sigmoidoscopy: 15 minutes;
- ERCP: 45 minutes;
- Endo-echo puncture: 60 minutes;
- DBE: 90 minutes.

In contrast to the OC, the EC uses a combination of some preset slots in their planning and further the same type of planning as the OC. Using this preset slots does not imply that these slots are left free if there is not enough demand for that type of treatment/research. Then, these blocks are filled with other treatment/researches.

Certain planning rules are applied at the EC. Below you can find an overview of the most important planning rules for the EC:

- Every day about 1 hour must be blocked at the x-ray program for emergencies of that day;
- Every day in the afternoon 2 hours blocked for urgent <72 hours and emergencies of that day;
- Every morning there should be half an hour block for emergencies of the day;
- Up to 16.00 hours, the last colonoscopy may be scheduled. After 16.00 hours only treatments or researches without sedation may be scheduled. Otherwise, this will result in overtime for the nurses in the recovery;
- Only 4 of the 8 doctors can work at the room where they have to work with X-ray equipment. Only these doctors are capable and authorized to execute an intervention endoscopy.

Financial planning:

Each year, the MST composes an annual plan including financial production targets. Table 5 gives the financial production targets for B-segment, per specialty. The specialty GIHD is thick bordered. GIHD has met their production target of 2010 with a realization of 180%. With given realized production of 2010, the production agreement for 2011 is determined. As mentioned above, the DOT is now introduced through which the previous B-segment has been expanded. Therefore, the production agreements for 2012 will be constructed in a different way than that of 2011.

Table 5: B-segment productions agreements and realization per specialty for 2010 and the set production agreements for 2011 in million Euro's (Medisch Spectrum Twente, 2011 [1])

Speciality	Production agreement 2010	Realized production 2010	Realization		Production agreement 2011
Cardiology	9.8	10.8	1.10	110%	10.7
General Surgery	9.1	8.3	0.91	91%	8.7
Orthopedics	7.2	8.3	1.15	115%	8.5
Gynecology	7.4	7.7	1.04	104%	7.0
Neurosurgery	5.0	4.6	0.92	92%	6.0
Neurology	4.7	5.0	1.06	106%	4.9
Internal Medicine	3.2	3.3	1.03	103%	3.1
ENT	2.9	3.0	1.03	103%	3.0
Urology	2.6	2.7	1.04	104%	2.8
Ophthalmology	2.3	2.6	1.13	113%	2.9
GIHD	1.0	1.8	1.80	180%	1.9
Rheumatology	1.2	1.3	1.08	108%	1.3
Anesthesiology	1.4	1.6	1.14	114%	1.2
Dermatology	0.9	0.8	0.89	89%	0.9
Pulmonary disease	0.5	0.9	1.80	180%	0.9
Plastic surgery	0.8	0.7	0.88	88%	0.8
Pediatrics	0.1	0.1	1.00	100%	0.1
Total	60.1	63.9	1.06	106%	64.7

Planning horizon and hierarchy.

At the GIHD of MST, the planning schedule will be set up four months in advance. The data manager of the GIHD has the hierarchy of these planning. She will put all incoming requests for consults and/or treatments and researches into a specially composed computer system. All these requests have to be scheduled into the system. Preferably will be that all patients that need researches or treatment at the GIHD, have direct access to this department. At this time there is a long waiting list for this department. This waiting list have to be shortened to reach this goal.

Decision conditions

Decision conditions are decisions made as a result of problems met in the current work situation at the GIHD. How will the available capacity be used is the main question in this situations. Temporarily hiring extra staff or temporarily offering extra shifts through which waiting lists can be shortened are examples of this decision conditions.

The GIHD hires retired doctors to execute endoscopies for ten half working days. These retired doctors are deployed to august 2012. Given this decision, the increase of the waiting list will be

resisted and must decrease. Beside the retired doctors, there are hired two additional doctors at the GIHD. One of them is already working, the other doctor will start in the end of 2012. Next to this additional doctors, there are four AIOs and four ANIOs. Through this decisions, the waiting list for the OC for new patients is eliminated. But there will always remain a waiting list for the control patients, because of their follow-up consults which sometimes take place with one year return. Because the starting up of the planning schedule takes place four months in advance, these patients have to be placed on a waiting lists. There is a catching up with regard to the waiting list of the EC.

Performance indicators

As told earlier, the performance indicators are measuring if the planning is working as it is intended to be. At tactical planning level there can be thought about norms of the staff and patients. Norms of the staff contains questions like: 'are the weekend shifts equally distributed', 'how is the workload experienced by the staff' and 'how will there be dealt with overbooked programs'? Norms of the patients can be questions like 'how long is the waiting list' and 'are the patients treated at their appointment time or is there question of sprouting appointments.

Beside the norms, service utilization and the average service time per type of treatment or consult are important indicators for tactical planning. Service utilization is the extent to which the GIHD delivers care to the patients in the scheduled time. For instance, it can be calculated by dividing the amount of scheduled outpatient clinic consults through the amount of planned outpatient clinic hours. The average service time is the average duration of a specific consult. For a specific consult is scheduled a fixed amount of time. Comparing this fixed slot with the average service time for that type of consult gives an insight of how the department is performing.

The waiting list is an example of a performance indicator. Through studying this list, we determine the quality of capacity: are supply and demand in balance over time. According to the RIVM (2012), treeknormen are set up for the Dutch Healthcare System. Treeknormen are agreements on waiting time between the insurance companies and the health care institutions. These treeknormen can be found in table 6.

Table 6: Treeknormen for the maximum acceptable waiting times (RIVM, 2012)

Hospital Care	Maximum acceptable
access time to the outpatient clinic	4 weeks
Waiting time for diagnosis and treatment selection	4 weeks
Waiting time until the actual treatment (Outpatient)	6 weeks
Waiting time until the actual treatment (inpatient)	7 weeks

Table 7: access time to the outpatient clinics and waiting times to treatment (Medisch Spectrum Twente, 2012[1]) of MST, in weeks (retrieved June 20, 2012)

Specialism	Waiting time Outpatient Clinic (weeks)		Waiting time treatment Endoscopic clinic (weeks)		Comments
	Location Enschede	Location Oldenzaal	Location Enschede	Location Oldenzaal	
GIHD	5	5			emergency <1 week
Gastroscopy			12	12	emergency <1 week
Coloscopy			12	12	emergency <1 week

Comparing table 6 and table 7, the access time of the OC is longer than the treeknorm. This access time has to be shortened with at least one week. The waiting time for treatment at the Endoscopic clinic is double so long as it is maximum acceptable. So we conclude that the GIHD has a bad score on the performance indicator waiting time.

It have to be noticed that some changes have occurred in the waiting times mentioned above. During the last weeks of this research, a project was started whereby ANIOSs and AIOSs are employed to help decrease the waiting and access times. Through the implementation of this project, waiting lists are currently non-existing. Instead, new problems arise. ANIOSs and AIOSs needs to be supervised by a GI medical doctor. This supervising is time consuming and not scheduled in the already overbooked programs of the GI medical doctors. As a result, the registrations are not filled in complete which in its term leads to unfinished files.

Operational planning

Operational planning is the short-term planning of a hospital. Operational planning addresses the goals that departments, work groups and individuals try to achieve. It is the capacity allocation to patients. Because of a lot of uncertainty in health care, operational planning can be divided into offline and online operational planning. Each of these types of planning will be explained by outlining the aforementioned five planning entities (Glöckner et al., 2009).

Operational Offline Planning

Operational offline planning is the in advance planning of elective patients which can be executed in advance.

Demand

Here, demand concerns the requests for consults, treatments or researches at the GIHD. These requests derives daily by fax. These faxes are scored into five aforementioned categories. With given

scores, the patient can be planned into the appointment schedule to a specific doctor at a specific time at a specific place.

Supply

Again, supply of the GIHD is considered using some of the managerial areas of the framework of Van Houdenhoven (2007).

Medical planning

Here, supply concerns the diagnosis and planning of an individual treatment. What type of treatments are needed for a specific patient, in which room will the appointment take place and which doctor is linked to that specific patient. With all given information, a specific schedule can be given with all patients, times and rooms for a certain day.

Beside planning this appointments, there might be needed some additional medical research such as taking blood samples or an ultrasound research. This additional research have to be taken into account when scheduling some patient because this have to be done prior to the appointment at the GIHD.

Resource capacity planning

Here, supply concerns the planning of doctors. Given the resource capacity planning, shifts are distributed among the doctors through which it becomes clear which types of shifts a doctor has to work at a specific week. An important aspect in this resource capacity planning is the relation between the available capacity of doctors/rooms and the demand of patients.

The scheduling of patients at the OC is executed by the secretariat whereby the program X/care is used. Known patients are usually scheduled with their own specialist, but new patients are scheduled at the first available place in the schedule (this can be in the schedule of an AIOS, ANIOS or a doctor).

If a patient requires endoscopic research/treatment, scheduling of the patients take place by the planning office of the EC. Although there can be started to schedule patients six weeks in advance, the actual patient schedule of the EC is only secured one week in advance. In this schedule, some slots are left free for emergency patients. Planning rules according to this emergency slots are mentioned above, in the tactical resource capacity planning section.

Financial planning

The financial planning is organized by using the different types of patients and consults, treatments or researches. First new patients and control patients. In operational planning different new patient consults exist: it can be a consult for a patient that has never visited the specialty before; a consult

for known patients that visit the specialty for a new problem;; and a consult for patients for whom the previous consult took place over a year ago. For a new patient consult more time needs to be scheduled than for a follow-up consult. For the financial part, only the first type of new patient consults is a certain first outpatient consult (EPB). The third case can also be declared as an EPB if the last declared consult took place over a year ago. This principle is used when scheduling a patient for a long term follow-up consult (Rijntjes, 2011).

Beside the distinction between new patient consults, follow-up consults and telephone consults, the GIHD also works with different types of researches or treatments at the EC. Executed consults, treatments or researches are registered in X/care. For the OC, the secretariat complete this data entry and then close the operation. The information then is send to a grouper. This grouper determines which type of DRG care product is in question and send it to the health care institution. The institution may declare in turn by the insurer (NZa, 2011; DBC Onderhoud, 2012; NVZ, 2012).

Planning horizon and hierarchy

To schedule the patients, there exist an overview in which it becomes clear when a certain patient have to be seen, for both patients at the OC and the EC. This schedule is made visible four months in advance. With given schedule, patients can be scheduled six weeks in advance. This schedule can be filled further until one week in advance. Then the schedule becomes clear and only emergencies and unforeseen events can change something in this schedule. The data manager of the GIHD is responsible for this overview of patients. Scheduling patients at the OC is the responsibility of the secretariat and scheduling patients at the EC is the responsibility of the planning office at the EC.

Decision conditions

When it becomes clear that the overview of patients offers more patients than there is capacity, this problem have to be solved. Therefore, deliberation between the doctor concerned and the responsible for the planning takes place.

4.2.3.2 Online Operational Planning

Operational online planning has to deal with unforeseen and unanticipated events. It considers on the day patient scheduling (resulting from disturbances). Control mechanisms have to be used to monitor the process and react correctly to this events. An example of such an event at the GIHD is an emergency patient who must suffer an endoscopy treatment. Due to this patient, there have to take place rescheduling (Daft, 2008; van Houdenhoven, 2007; Hans, van Houdenhoven & Hulshof, 2011).

Demand

Operational online planning deals with unforeseen events such as emergencies. When talking about emergencies at the GIHD at MST we can talk about emergencies of that day or emergencies which have to be seen within 72 hours. After an emergency endoscopy has taken place, a short-term follow up consult can be required. If there is no time available on the short term, an overbooking needs to be made which is an overlap of two consult durations. Next to the overtime, an emergency endoscopic or consult must be prepared: a treatment room must be prepared and there must be placed a rush order for the necessary medication and/or sedation.

Beside emergencies, the planning at the GIHD has to deal with other unforeseen events such as not showing up of patients at their appointments, cancellations of appointments or moving an appointment to another day and/or time. Usually rescheduling is required of this cancelled consult, through which the access time will increase.

Supply

Operational online planning of supply has to deal with unforeseen events on the health care delivery side. Thereby we have to think on doctors calling in sick. These appointments have to be moved, cancelled or taken over by another doctor. Consequences of this sick calling can be overtime, a growing waiting list or hiring other doctors.

Besides the calling sick of doctors, the equipment can deliver problems. This equipment can be broken through which it is impossible to execute the planned surgeries or researches. This equipment has to be replaced as soon as possible.

Next to the emergencies and unforeseen events, overtime is another problem that has to be tackled in the operational online planning. Both, the OC and the EC has to deal with overtime. For instance, some telephonic consults take longer than the five minutes which is planned for it. The same applies at the EC. Sometimes the doctor does not succeed to perform the endoscopy in the way it is used to be. Dealing with this is done differently by each doctor: One doctor remains trying as long as it succeeds, the other doctor discontinues the research/treatment and where necessary schedules a new appointment. Beside problems in the execution of these endoscopies, some other time-consuming activities take place at the EC. So is each doctor required to write a report after each endoscopy, will there a time-out procedure take place prior to each endoscopy and, in case of bad news, the family must be prepared.

Planning horizon and hierarchy

Operational online planning is on the job planning, it is the handling of unforeseen and unanticipated events at a very short time. The planning horizon will be at most a couple of days, but mostly some hours. There is no one specific responsible for the hierarchy, problems have to be solved quickly through the persons who can solve this problems.

The day coordinator of the OC and EC is responsible for the monitoring and control of that day. This includes for instance the handling of acute patients

Decision conditions

In cases of emergencies and unforeseen events, most of the time decisions have to be made. There have to be decided what is the best solution in given situation. Therefore, first the situation have to be monitored. With given situation there have to be thought in solutions and its consequences. These solutions have to be weighted resulting in one procedure to tackle the problem.

2.3 Performance of outpatient clinic and endoscopic clinic

Chapter 2.3.1 considers the performance indicators. Section 2.3.2 discusses the key performance indicators. In both sections the current performance of the MST on these indicators is described.

2.3.1 Performance indicators

Discussing the performance of a hospital, three stakeholders and their goals have to be taken into account. The management requires delivering care with a good quality for minimal costs, the patient wants to be satisfied just as the employees. Taken this goals into account, the following performance indicators can be composed to measure the performance of the planning at the outpatient clinic and endoscopic clinic:

- Occupancy and utilization rates
 - Experienced work load
- Work in progress
- Cancellation rate
- Overtime
- Outpatient waiting time

Occupancy and utilization rates

The occupancy rate is an indicator of efficient use of a certain resource and can be calculated for different periods of time. For instance it can be calculated for the room capacity or for the specialists capacity. When it is calculated for the OC or EC capacity, we talk about utilization rates. The higher the utilization rate, the higher the access times are expected to be.

At the GIHD the outpatient clinics has their own consult rooms. Through the recent division of the department in front- and back offices, the department has sufficient capacity at the OC the entire week. The occupancy rates do not provide very useful information on efficient use of this capacity.

Calculating the occupancy and utilization rates is not possible for the GIHD because inconsistent data in the endosoft system and in the data ware house.

Experienced workload

Capacity of even the OC and EC differs per day of the week. Planned workload differs as well, for even the specialists, nurses and secretaries. If more patients should be planned than the available capacity, overlap and overtime are used to still plan every patient. This leads to a high experienced workload.

Work in progress

Work in progress (WIP) is an indicator which presents the total amount of opened and closed DRGs. It provides the WIP for the entire patient process at the GIHD. Measuring the WIP is executed for financial purposes. For the EC the WIP is composed of patients at the waiting list, most of these patients afterwards have a follow-up consult at the OC, through which the WIP of the OC can be seen as an overall WIP.

Cancellation rate

Patient satisfaction can be measured by using cancellation rates. Cancellation rates relates to even the tactical as the operational planning. Though most of the changes are of operational nature, far in advance scheduling can also lead to changes on the tactical nature. Due to this cancellations, rescheduling should take place. Another option will be patients who are diverted to another hospital. Required data to measure this cancellation rates cannot easily be obtained by using the MST systems and the cancellation rate is not available as a performance indicator in the MST.

Overtime

Overtime of a specialist indirect leads to overtime from other personnel: secretaries in the OC and EC personnel for treatment/research. Although overtime is a problem of operational nature, solving the problem will be executed on strategic level. Also, overtime may result from poor tactical planning (planned consult/surgery durations). For the OC and EC of GIHD, overtime information cannot as easily be obtained because the end times are not scheduled in systems. In addition, MST does not use overtime as a control measurement.

Outpatient waiting time

Outpatient waiting time is notices on the operational level, though it also may result from poor tactical planning. Patient satisfaction can be measured by judging the outpatient waiting time. The time a patient is waiting before a consult, is not registered (or not necessarily registered at the correct time) and also the start of the consult is not documented as such. To find out the outpatient waiting time, it can be recommended to accomplish a stopwatch study.

2.3.2 Key performance indicators

This section gives the key performance indicators (KPIs) and describe the current performance of MST on these indicators. KPIs represent performance critical to the core business activities and success of the organization. The following indicators are key to MSTs performance. Although these indicators are measured at operational level, they are related to the performance of the tactical planning:

- Realization
- Access and waiting time
 - Service level

MST performance

Realization

The realization of production of MST is presented in the dashboard that is accessible to tactical and operational management. The realization is discussed in the speed-dates with Finance and Information. The realization could be monitored weekly, by accessing the financial registration from the Data Warehouse. This allows each specialty to keep track of their realization. Still, planning is often adjusted to realization deficiencies in a reactive manner. In table 5, the B-segment production agreements and realization is shown. This table made clear that the realization of the GIHD is 180 %. 2011 production agreement is adjusted to 2010s realization.

Access and waiting time

The access time to the outpatient clinic is determined by the secretaries based on the third available time slot in the planning and is displayed on the website of MST each month. The waiting times for certain treatment types are also displayed. These numbers are part of government indicators and are displayed on the kiesbeter.nl website as well. Table 7 shows the recorded numbers of access and waiting times for the GIHD. The access and waiting time of GIHD can be found in table 6.

As mentioned above in table 4, the norm for access time to the outpatient clinic is four weeks. The norm for access time to outpatient and inpatient treatments is respectively six and seven weeks

(RIVM, 2011). With given data, there can be concluded that the GIHD does not meet the maximum acceptable waiting and access time requirements.

Now we compare the waiting and access time of GIHD of MST with average waiting and access times of all Dutch Hospitals. When we compare the access time of the OC, MST has the same scores as the average of all hospitals, that is somewhere between the four and six weeks. Waiting time for diagnostics is only given for a gastroscopy. The average of all the hospitals has passed the treeknorm (2 until 4 weeks), in contrast with the MST where the access time is 12 weeks.

Access times can also be calculated in another way. Each consult is scheduled in X/care. Using the actual consult date and comparing this with the scheduling date, gives us the actual access time. Necessary information can be retrieved from the already existing systems, but this is not easily done. Determining the access time to treatment can be determined by using the data from the referral to the EC.

Service level

MST does not use service level indicators (e.g. % of patients scheduled within weeks) for its performance measurement. Service level indicators are closely related to the access and waiting time mentioned above. Beside the access and waiting time, no additional data is needed to calculate the service-levels.

2.4 Conclusions

The patient process

- Patients can be referred to even the Outpatient clinic as to the Endoscopic clinic;
- Referrals to the GIHD are scored by a GI medical doctor on its urgency;
- OC and EC generates demand for each other;
- Available hours of GI medical doctors are divided among the OC and EC;
- OC and EC capacity are critical resources in the patient process;
- For describing the patient process, logistic indicators can be used;
 - Demand (multiplying the amount of patients by the planned durations of their consults);
 - Supply (available capacity);
- To forecast the demand at either the OC and OC, knowledge of the patient process is required;

- Identifying the different possible steps in the process at the GIHD and the transition probabilities and times.

Planning and control

- Resource capacity planning is supply-oriented;
 - Availability of specialists, consultation/treatments rooms and the nursing staff provides the starting point for planning;
 - OC and EC capacity are not calculated from/do not match production targets;
 - There is a fixed structure in the division of a specialist's hours to either the OC and EC, this is not based on demand;
 - Planning the OR planning determines the availability for the EC planning and vice versa;
- Planning is organized separately per specialist, per week;
- Type of scheduling used at the GIHD;
 - At the OC, patients are scheduled within the GI medical doctors time. For each type of consult at the OC, a fixed amount of time will be reserved, but there is no fixed division of a specialist's working day;
 - At the EC, a combination is used. Patients can be scheduled within the available capacity, whereby again a fixed amount of time will be reserved for a specific research/treatment. Beside this freedom, there are fixed time slots in which for example only a colonoscopy can be planned. Also emergency slots are reserved each day, of which a couple of them are reserved at the inventory treatment room.
- Patient categories are not used for (tactical) planning .

Performance of outpatient clinics and endoscopic clinics

- Not all defined indicators mentioned in this part are used within the MST or at the GIHD;
 - Required data to calculate these indicators is not always available or consistent;
 - The required data is not always easily converted to information
- Lacking performance in:
 - Waiting time: the waiting time exceeds the treeknorm;
 - Access time: the access time at the GIHD is twice as high as it should be.
- Good performance in:
 - Realization: the achieved realization in 2010 is 180%. Therefore, the production targets for 2011 have been adjusted on the past realization.

Concluding: Increasing the communication and the coordination on the tactical level can deliver benefits for the MST. Thereby, the patient care will be improved and it would be enabled to use the capacity in a more efficient way. Patients categories can't be allocated because of lacking data: there exist some inconsistency between the data warehouse en data derived from the used program Endosoft. When this data is accurate, demand characteristics can be calculated and with it, transition probabilities and times. As a result, the planning can be improved and control mechanisms for the KPIs are provided. In addition, the information which is required for the performance indicators are not always available, or available in a way this cannot be converted into information. Improvement in the data systems is therefore required to measure GIHDs performance and to forecast the expected demand, supply and performance for the coming period.

3. Literature research

Chapter 3 discusses the tactical capacity planning in hospitals, described in literature. Section 3.1 introduces the tactical capacity planning and also, the tactical planning literature for outpatient clinics, operation rooms (endoscopic clinic) and an integration of that two clinics will be described. In section 3.2 we will describe a tactical planning concept from practice; tactical planning in Ziekenhuisgroep Twente (ZGT). Finally, in Section 3.3 there is used one specific article in which a tactical planning concept from theory can be found.

3.1 Tactical capacity planning

In this section, first the characteristics of tactical capacity planning, mentioned in scientific literature, are described. These characteristics are summarized in table 8. After this summary, the tactical planning for outpatient clinics and operating rooms (endoscopic clinic) are discussed in respectively section 3.1.1 and 3.1.2. As Hulshof, Boucherie, Hans & Hurink (2011) already mentioned, many articles only focus on one department or resource, not on the combination of two differently organized departments. Therefore, this discussion is done separately. After these separate discussions, section 3.1.3 will discuss an integrated approach.

Table 8: Summary of tactical planning characteristics from literature

Characteristics	Sources
Planning of elective patients	[3]
Intermediate term planning horizon	[2], [3], [4]
- Strategic goals are translated into tactical goals	[3], [4]
Different ways to allocate the available capacity	
- Dividing it over specialties	[2], [3], [4]
- Dividing it over patient categories	[1], [3]
Degree of flexibility, by using some temporary capacity expansions	
- Overtime	[2], [4]
- Staff	[2], [4]
- Working hours	[1]
Main goals of tactical capacity resource planning	
- Equitable access times	[3]
- Equitable throughput times	[3]
- Realization of production agreements	[3]
- Maximization efficient use of resources	[3], [4]
- Balanced workload	[3], [4]
Type of tactical planning approaches	
- Static approach	[3]
- Dynamic approach	[3]
Information used to determine tactical planning	
- Forecasting based on demand	[2]

- Forecasting based on waiting list	[2]
- Forecasting based on down streaming demand in care pathways	[2]
- Amount of actual / expected patients	[4]

[1] (Glöckner, et al., 2009), [2] (Hans, van Houdenhoven, & Hulshof, 2011), [3] (Hulshof, Boucherie, Hans, & Hurink, 2011), [4] (Van Houdenhoven, 2007)

Tactical planning is the planning level which lies between the strategic and operational level. Due to tactical planning, the operations within a hospital are organized. Decisions are made on an intermediate planning horizon. In comparison to the operational level, tactical planning has more flexibility, has less demand certainty and as a result, is less detailed than operational planning. Comparing to strategic planning, the opposite is true. In tactical planning capacity expansions are possible like overtime or temporarily hiring extra staff. Forecasting based on demand, waiting list and down streaming demand in care pathways of patients currently under treatment, can help tactical planning. Allocating the resource capacity over the two clinics can take place using block planning, staffing and admission planning on the tactical (hospital) planning level (Hans, van Houdenhoven, & Hulshof, 2011).

Van Houdenhoven (2007) also defines the tactical planning on the intermediate planning horizon, whereby the strategic goals are translated into tactical goals. The resource allocation deals with the efficiently distributing the scarce resources of a hospital which can be specialists, operation rooms or specific tools e.g.. Resource allocation over specialties is considered by the use of rostering. Because of the possibility to expand the capacity (temporarily) and through the longer planning horizon, there can be assumed that tactical planning is more flexible than operational planning. Typical performance indicators of resource capacity planning are utilization, overtime and underutilization.

Tactical planning of resources is, according to Hulshof, Boucherie, Hans, & Hurink (2011), one of the key elements of hospital planning and control concerning the elective patients admission planning and the intermediate term allocation of resource capacities. Achieving equitable access and treatment duration for patients groups is one of the main objectives for tactical resource planning. Other main objectives are meeting the production target, achieving a balanced workload and maximizing the resource utilization. Tactical resource planning from a specialists perspective is the subdivision of available specialists hours into segments (e.g. OC and EC hours, administration time, clinical days) and also determining the number of patients from a particular patient group at a particular stage of their care pathway. Care pathways can connect multiple departments in the hospital, through which the demand at multiple departments relates to each other. This connection must be taken into account using tactical planning.

Tactical planning subdivides the settled resource capacities among patient groups to reach strategically set targets and to facilitate operational planning. This subdivision is also used by Glöckner et al (2009), which is accompanied by the determination of working hours. Tactical resource and admission planning approaches are static or dynamic. The static approaches results in long-term cyclical plans, dynamic approaches results in intermediate-term plans. Given these intermediate-term plans, there can be responded to the variability in supply and demand. This dynamic approach results in lower access times and higher resource utilization (Hulshof, Boucherie, Hans, & Hurink, 2011; Vermeulen, Bohte, Elkhuizen, Lameris, Bakker, et al., 2009). Due to this flexibility in planning, changes can be accommodated when needed. These changes are necessary because variability cannot always be reduced but must be dealt with. Therefore, periodic evaluation is a good tool in tactical planning, to enable the anticipation to variability, minimize the waste and maximize the utilization.

3.1.1 Outpatient clinic

In this section, we will discuss some articles relating to the patient scheduling, appointment systems and some kind of capacity block or staff planning of the outpatient clinic. A broad spectrum of outpatient clinic literature will be offered due to the fact that tactical and operational level literature are hard to distinguish. Not only specific literature of gastrointestinal and hepatology outpatient clinics is used but literature of all outpatient clinics is selected. Outpatient clinics are almost always organized in a similar way which well may be compared. Therefore, GIHD is not a search criteria used for this literature research.

Organization of tactical planning in outpatient clinics

Patient scheduling systems

Evaluation of appointment systems literature is given in the literature review of Cayirli & Veral (2003). In this review different characteristics and performance measures of this patient scheduling systems are discussed. Different appointment systems/rules which are found in literature and different analysis methodologies are described by Cayirli & Veral (2003). Three decision areas of appointment systems can be identified: The appointment rule (which is the way in which the appointments are scheduled, e.g. using an appointment interval), the use of patient classification and at last the adjustment for cases as no-shows and walk-ins.

According to Gupta & Denton (2008) hospitals use appointment scheduling systems to schedule elective patients. Application of this systems takes place for three application areas: to schedule elective surgeries, primary care and specialty clinic. The goal of an appointment scheduling system is the delivery of timely and convenient access to health services for all patients. Liu, Ziya & Kulkarni

(2010) add that this systems must be protected against fluctuation in demands which can lead to inefficiency, with low utilization levels on some days and overloads on other days.

Discussing the aforementioned application areas, there can be concluded that each environment within a hospital uses another process of scheduling appointments. Care delivered at the GIHD can be seen as a specialty clinic. Patients service times in this clinic shows high variability based on patients' diagnoses and other characteristics. Therefore, it is not advisable to use standard time slots, but appointments are booked by medical assistants or the referring doctor. For the specific type of consult required for a patient, a fixed amount of time must be scheduled. At the specialty clinic, the delivered care is more-expensive because of specialists time. Therefore, high utilization needs to be realized whereby care deliverers must be aware of overutilization which can affect the quality of care (Ozcan, 2009). Besides that, capacity must be reserved for urgent care (Carve out model, according to Green & Savin, 2008). These aspects are making the appointment scheduling complicated for specialty clinics (Gupta & Denton, 2008). According to Bailey (1954), the variance in demand mainly derives from new patients. Hospitals has merrily little control on this randomly fluctuating demands, because it arises from the activities from GP or other specialties. When we compare it with control patients, this demand is more stable, since this demand derives from given consultations to new patients.

Queuing problems

Queuing problems with waiting lists and appointment systems existed for a very long time. Bailey (1954) discussed this problem and mentioned that the supply of medical advice and treatment must be sufficient to cope with the demand, whereby it is important that this demand has to be satisfied reasonably quickly. He also mentioned the undue waiting in the waiting room. Bailey (1954) quoted some main aspects for the provision of medical care from the point of view of the queues theories. First, the numbers or sizes of a clinic session needed to be coped with the demand for outpatient attention. Second, each clinic session need to be adopted in the appointment system. Therefore, queuing theory is used for service in batches of patients. Given formulas for clinic size makes it possible to check the cause of waiting. When patient waiting time and consultant's idle time are considered, the optimal appointment system can be found. Thereby there are used batches of two patients for the initial block, whereby the block size is equal to the average consultation time.

This block size is also discussed by Brahimi & Worthington (1991). They discuss how the patient waiting time, the number of waiting patients and the busy time of a doctor are influenced by the number of slots and the amount of patients assigned to it.

Rohleder & Klassen (2000) also use some of Baileys findings. The rule of two patients in the initial block is used to compare different appointment scheduling methodologies. They developed Bailey2,

through which low server idle time can be obtained. This is combined with the usage of a certain planning rule: “patients with high variability in service time are scheduled later in the program, to minimize patient waiting time”. In this article the impact of special appointment requests is also discussed just as the appointment scheduler uncertainty.

Gallucci et al. (2005) stated that the longer the appointment delay, the higher the chances that a patient cancels the appointment or does not show up. This delay is distinguished by Gupta & Denton (2008) into two types. *Indirect delay*, which is the waiting time between the request for an appointment and the time that an appointment actually takes place. *Direct delay*, which is the waiting time between a patient's appointment time and the actual time an appointment takes place. According to Murray & Berwick (2003) this indirect waiting time can pose a serious safety concern. Given this waiting time and its consequences, Green & Savin (2008) tried to develop a possible solution. They implement advanced access scheduling, which goal is to reduce delays by offering every patient a same-day appointment, irrespectively the urgency of a patient's condition. It is based on the fundamental idea ‘doing all of today's work today’. As a result, patients do not have to wait (indirect) for their appointments, capacity is not wasted by holding appointments for same-day urgency, and it is more likely that a patient visits its own physician. Green & Savin (2008) therefore determine panel sizes to implement the advanced access scheduling. Amount of cancellations and no-shows are included, because the cancellation factor and the probability of rescheduling can have a significant impact on the performance of the system and its maximum panel size. This is measured in the expected backlog is measured in days and the probability of same-day appointment. Liu, Ziya and Kulkarni (2010) and Silvester, Lendon, Bevan, Steyn & Walley (2004) also mentioned the advanced access policy to schedule patients. They propose scheduling with using the net reward of serving a number of patients on a day, given a certain number of scheduled appointments as a performance measure. Muthuraman & Lawley (2008) try to solve the no-shows in an outpatient clinic by using overbooking. Thereby, the profit objective have to be maximized. The attended patients, patient's waiting costs and staff overtime must have a positive value. Adding more patients have to be stopped when there is showed a decrease in the profit objective.

Performance measurement

For defining the performance measurement in the outpatient clinic, the following four main indicators can be used: queuing, throughput, utilization, and overtime. In figure 8 an overview is given of these indicators and their relation to their outpatient clinic visit. Table 9 summarizes the evaluated outpatient clinic literature on these performance indicators.

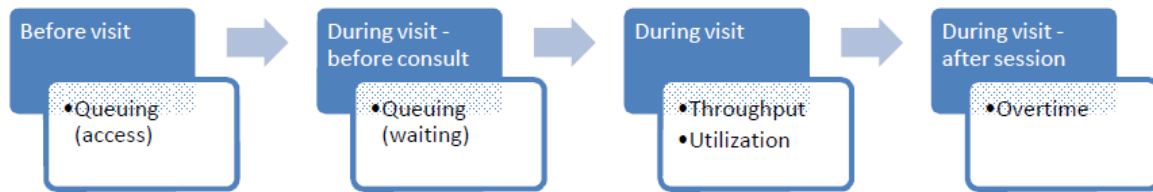


Figure 8: Performance measurement areas, related to the patient visit

Queuing can be distinguished into two types: *Access time* and the *waiting time during a visit, but before the consult*. *Access time* can be explained by the number of patients waiting for a service at the outpatient clinic considers, including the expected backlog (Green & Savin, 2008; Silvester, Lendon, Bevan, Steyn, & Walley, 2004), mentioned by the authors Liu, Ziya & Kulkarni (2010), Murray (2000), Murray & Berwick(2003) and Vanden Bosch & Dietz (2000) as the access time to the outpatient clinic, which is also called delay. Gupta & Denton (2008) and Liu, Ziya & Kulkarni (2010) are speaking of indirect delay when a patient is waiting between the request for an appointment and the time that an appointment actually takes place. *Queuing during the visit but before the consult*, can be seen in two ways. According to Brahimi & Worthington (1991), Côté (1999) and Muthuraman & Lawley (2008), it can be seen as the number of patients in the actual waiting room, waiting room congestion in other words. Queuing during the visit but before the visit can also be seen in terms of time, the actual time a patient have to wait (also called direct delay). This waiting time can be differentiated in voluntary waiting time (when a patient arrive early for the appointment) and involuntary waiting time (when an appointment starts later then scheduled) (Gupta & Denton, 2008; Liu, Ziya & Kulkarni, 2010).

The amount of patients served and the time spent of these patients in the outpatient clinic can be considered as throughput and patient flow (time). Beside these two indicators, staff productivity is also a good performance measure (Côté, 1999; Hashimoto & Bell, 1996). Another performance indicator is utilization, which can be expressed as a rate (for staff, room and/or session use), which is defined through idle time, and can be indicated by the number of vacant slots. Finally, overtime can be mentioned, which is the amount of time or consults that take place after planned sessions or outside working hours of the clinic/specialist. Overtime can be indicated using amount of consults in overtime, the overtime of staff and the ending time of a session.

Additional performance indicators can be defined: profit indicators, mentioned by Liu, Ziya & Kulkarni (2010), the probability of planning an appointment on the same day (Green & Savin, 2008) and the availability of an appointment, using the third available appointment method, according to Murray & Berwick (2003).

Table 9: Summary of performance indicators for the outpatient clinic received from literature

Performance indicators	Sources
Queuing (access):	
• # waiting	[1], [7], [8], [9], [19]
• Access time/delay	[1], [3], [5], [7], [8], [12], [13], [14], [15], [19]
Queuing (waiting):	
• # in waiting room	[4], [5], [6], [12], [20]
• Patient waiting time	[1], [2], [4], [5], [11], [12], [16], [18], [20]
Throughput	
• # patients served	[2], [13], [16], [17]
• Patient flow time	[2], [6], [11], [20]
• Staff productivity	[2]
Utilization	
• Utilization rate (%)	[2], [3], [5], [6], [8], [16], [17], [19], [20]
• Busy or idle time	[1], [4], [11], [18], [20]
• # vacant slots	[12]
Overtime	
• # consults in overtime	[5], [16]
• Doctor/staff overtime	[12], [16]
• Session ending time/length	[11], [18]
Other	
• Probability of same day appointment	[9]
• Profit (net reward/patient revenue)	[13], [16]
• Appointment availability	[15]

[1] Bailey (1954), [2] Benninger & Strode (1998), [3] Vermeulen, Bohte, Elkhuisen, Lameris, Bakker & La Poutré (2009), [4] Brahimi & Worthington (1991), [5] Cardoen & Demeulemeester (2008), [6] Côté (1999), [7] Creemers & Lambrecht (2009), [8] Elkhuisen, Das, Bakker & Hontelez (2007), [9] Green & Savin (2008), [10] Gupta & Denton (2008), [11] Hashimoto & Bell (1996), [12] Vanden Bosch & Dietz (2000), [13] Liu, Ziya & Kulkarni (2010), [14] Murray (2000), [15] Murray & Berwick (2003), [16] Muthuraman & Lawley (2008), [17] Qu, Rardin, Williams, Willis (2007), [18] Rohleder & Klassen (2000), [19] Silvester, Lendon, Bevan, Steyn & Walley (2004), [20] Ozcan (2009)

Access times are an organizational aspect of care which is, according to Murray & Berwick (2003), a persistent and undesirable feature in health care. Several researches are accomplished to this access times and its causes. Silvester, Lendon, Bevan, Steyn & Walley (2004) have identified possible reasons for the high access times for medical care in the UK. Mismatching between the variation in demand and capacity is considered as the main reason for this access time problem. In addition it can be stated that to achieve high utilization rates, the queues are used as a buffer. Access time is considered by many authors e.g. Creemers & Lambrecht (2009) and Elkhuisen, Das, Bakker & Hontelez (2007). In both articles, other approaches according to access time are handled.

To obtain waiting list performance measures such as the average access time and the amount of patients waiting, Creemers & Lambrecht (2009) have developed a customer assignment system.

Given this system, demand, supply, frequency and the batch size of service sessions can be evaluated. Elkhuisen, Das, Bakker & Hontelez (2007) introduce another approach to evaluate access time. Required capacity an outpatient department is evaluated by using performance measures as the length of the queue, access time and the utilization (dividing demand over capacity). To evaluate aforementioned performance measures, a queuing model must be used to obtain the basis indication. Additional, event simulation can be used to evaluate the capacity requirements, whereby both, structural and temporary, capacity expansions and/or reductions can be evaluated.

Beside queuing models, there are developed other models to evaluate and improve access time. Efficient use of space and staff in an otolaryngology clinic is discussed by Benninger & Strode (1998). In their article, they determine the optimal ratio of support staff and examination rooms per practicing physician. Through simulation there can be experimented with different settings. Most effective use is found in 1.5 support staff and three rooms per physician. Staffing numbers are also included by Hashimoto & Bell (1996) to simulate the patient flow in the OC. For the evaluation of this patient flow the registrar, triage nurse, the physician and discharger are mentioned. In this simulation there can be experimented with affairs like changes in staffing, no-show rate and appointment intervals. Then these changes are evaluated by using a sensitivity analysis.

Patient classification

Patient classifications can be used for appointment scheduling systems. This is considered by Cayirli & Veral (2003), whereby the limitations of the First-Come First-Served (FCFS) scheduling are discussed. Through the use of patient classification to schedule appointments, scheduling become less flexible and the amount of unused slots or delay between requests and appointments increases. Possible classifications which can be used are: new patients and return patients (control or follow-up), variability level of service time, and procedure types (Cayirli & Veral, 2003).

One way to limit the waiting / access time and delays for medical care, is the use of aforementioned advanced access or open access scheduling. Advanced access is mentioned by Murray (2000), Murray & Berwick (2003), Liu, Ziya & Kulkarni (2010) and Green & Savin (2008). Six elements are important in its application. These elements are balancing of supply and demand, reducing backlog, reducing the variety of appointment types, developing contingency plans for unusual circumstances, working to adjust demand profiles, and increasing the availability of bottleneck resources. Other systems include the differentiation between urgent and elective patients in this advanced access system. In the traditional model non-urgent demand is pushed back to make room for more urgent cases, while a carve-out model (as used at the GIHD) reserves capacity in planning based on the expected demand for urgent cases (Murray & Berwick, 2003). According to Liu, Ziya & Kulkarni (2010) advanced access

only performs well when average demand is smaller than average capacity, while Silvester, Lendon, Bevan, Steyn & Walley (2004) emphasize that carve-out typically worsens the access time for patient because slots reserved for urgent care may not be filled, which causes greater capacity loss, and misusing carved-out spaces may lead to more variation and an increase of the maximum waiting time.

Another way of scheduling patients is using a combination between prescheduled and open-access appointments. Qu, Rardin, Williams & Willis (2007) evaluate the optimal percentage of this combination. The no-show rate for prescheduled appointments and the possibility of unused capacity when using open-access scheduling must be balanced, whereby the number of served patients is maximized. The ratios of both types of planning determines the percentage which will be evaluated.

In many researches or articles, the elective patient planning or scheduling are described without the use of different patient types/categories. In health care it often occurs that patient types are used in this planning. First, we can distinguish the new patients, mentioned by e.g. Bailey (1954) & Elkhuisen, Das, Bakker & Hontelez, (2007). Scheduling this new patients is sometimes combined with the use of follow-up consults or control patients (Cardoen & Demeulemeester, 2008; Côté, 1999). Beside the use of new patients and control patients, scheduling can also occur using DRGs or clinical pathways. Using this patient categories is limited described in literature (done by Benninger & Strode, 1998; Cardoen & Demeulemeester, 2008). Alos, in scheduling there can be used a carve-out for urgent patients, which is mentioned by Rohleder & Klassen (2000) and Vermeulen, Bohte, Elkhuisen, Lameris, Bakker & La Poutre (2009). Additional to the new and control patients, use of DRGs or the carve-out system, the no-show probabilities can also be used to categorize patients (Muthuraman & Lawley, 2008).

Using patient classifications in scheduling can help estimating a more accurate service time. With the patient waiting time and doctor's overtime taken into account, the optimal order in which the patients should be scheduled is determined. Vanden Bosch & Dietz (2000) Expected demand for each patient category must be incorporated, through which the patient schedules are a combination of several days.

One way of addressing resource allocation over patient categories is executed by Vermeulen, Bohte, Elkhuisen, Lameris, bakker & La Poutre (2009). They applied this method for CT-scans, whereby slots are reserved for specific patients. Five levels can be distinguished of which two levels are (different) urgency levels. Size of these slots are on or two times the size, which makes it possible to reallocate. Using this dynamic scheduling procedure, patients categories are reallocated to previously reserved,

but yet unfilled slots, as the appointment date approaches. Its objective is to minimize the deviation which derives from the planning window of the patient.

3.1.2 Operation Rooms / Endoscopic clinics

In this research, the surgery department is the endoscopic clinic (EC). An EC has similarities with operating room (OC) scheduling. However, endoscopy is not the same as surgery, general anesthesia is not required and the surgery rooms are used by only one specialty. Despite these differences, similarities can be found by planning this endoscopies. Therefore, endoscopic specific literature is combined with OR literature in this section, because there are many more studies on the planning and scheduling problem of general operating rooms than there exist of endoscopic clinics (Marcus, 2006; Joustra, et al, 2010; Fei, Meskens, Combes & Chu, 2009). The activities concerning the planning and scheduling of the endoscopic clinic and ORs receive increasing attention in the scientific literature. Important reasons for a hospital to focus on this operation rooms (including EC) are the fact that managing and developing is associated with high costs while simultaneously the OR and EC has a large share in the revenue of a hospital (Cardoen, Demeulemeester & Beliën [1], 2010; Testi, Tanfani & Torre, 2007).

At an endoscopic clinic or an operation room, all types of patients have to suffer surgery: the elective patients, which can be divided into the in- and outpatients, and the non-elective patients whereby a distinction can be made between urgent and emergent patients (Cardoen, Demeulemeester & Beliën [1], 2010). This distinction is made in the OR literature, no distinction is made in the selected endoscopic literature. Of the evaluated OR related articles, only three evaluate the elective and acute patients (Vanberkel & Blake, 2007; Van Houdenhoven, Hans, Klein, Wullink & Kazemier, 2007; van Houdenhoven, van Oostrum, Hans, Wullink & Kazemier, 2007). The planning or scheduling of elective patients is the focus of the other selected articles.

Performance management

In table 10 gives an overview of performance indicators found in the literature according to operating rooms and endoscopic clinics. Utilization is an important subject in recent research of ORs an/or ECs (Cardoen, Demeulemeester & Beliën [2], 2010). This is discussed in almost all of the selected articles. Overtime, throughput and waiting time for surgery are other main performance indicators for the endoscopic clinic.

Table 10: Overview of tactical planning performance indicators for the OR and EC, received from literature

Performance indicators	Sources
Overtime	[3], [5], [9],[10], [11]

Throughput	[1], [2], [3], [4]
Utilization and/or efficient use of resources	[1], [2], [3], [4], [5], [6], [7], [8], [9], [10], [11]
Waiting time for surgery	[3], [4], [11], [12]

[1] Adan, Bekkers, Dellaert, Vissers & Yu (2008), [2] Adan & Vissers (2002), [3] Testi, Tanfani & Torre (2007), [4] Vanberkel & Blake (2007), [5] Van Houdenhoven, Hans, Klein, Wullink & Kazemier (2007), [6] Van Houdenhoven, van Oostrum, Hans, Wullink & Kazemier (2007), [7] van Oostrum, van Houdenhoven, Hurink, Hans, Wullink & Kazemier (2008), [8] Velásquez & Melo (2006), [9] Velásquez, Melo & Küfer (2008) [10] Fei, Meskens, Combes & Chu (2009), [11] Joustra et al (2008), [12] Sonnenberg (2000)

Determining the theoretical maximum utilization rate for the OR per surgical department can be executed by using the described method of Van Houdenhoven, Hans, Klein, Wullink & Kazemier (2007). In this method, both elective and emergency cases are included. Through the capacity reserving through using the standard deviation of duration, variability in surgery duration is included. This is dependent of the probability of working in overtime. The higher the risk of overtime, the higher the utilization rates and vice versa. Besides that, utilization rate is also dependent of the patient mix. Complex patient mixes achieve lower utilization rates than less complex mixes.

Improving the efficiency of the OR is done by Van Houdenhoven, van Oostrum, Hans, Wullink & Kazemier (2007) through applying mathematical algorithms. Using this algorithms, the total required OR time must be reduces through the reallocation of the elective surgeries over Ors. Portfolio effect for planned slack calculation is included in this algorithms.

For the maximization of the utilisation and the minimization of the overtime costs, Fei, Meskens, Combes & Chu, (2009) have developed a tactical planning model for the endoscopy department, using a column-generation-based heuristic procedure. Afterwards they also solved the daily scheduling problem by using a Gonzalez-Sahni algorithm in order to schedule the surgical cases assigned at the planning stage.

Patient classification

As mentioned above, there is no patient classification used in the endoscopic literature. In the OR literature, there are used different categories of patient types. We can distinguish a categorization using the duration of the operation (Adan, Bekkers, Delleart, Vissers & Yu, 2008), categorization based on the operationtime (Adan & Vissers, 2002), diagnosis type as a base for the categorization (Vanberkel & Blake, 2007), categorization whereby the frequency, mean and standard deviation of the operating time are used (Van Houdenhoven, van Oostrum, Hans, Wullink & Kazemier, 2007) and finally a categorization based on diagnosis or department (van Oostrum, van Houdenhoven, Hurink, Hans, Wullink & Kazemier (2008). Last authors have also discussed the maximum number of different planning horizons used in a hospital, but no conclusion is given of this maximum number. In the mentioned articles, these number of categories varies from 4 to 11.

3.1.3 Integrated approach of capacity planning

Integrated capacity planning in hospitals is few researched, most found literature only focuses on a few parts or resources of the patient pathway instead of the entire patient pathway. The entire pathway is described by Hulshof, Boucherie, Hans & Hurink (2011) using a combination of OC and OR. It is important to look at the whole care chain, because changes in demand and resource availability at the OC may affect the EC and EC in turn affects the OC.

In this section, methods found in scientific literature are described for the OC and EC/OR, using an integrated approach.

Outpatient clinics

When we are looking at the outpatient clinic, using an integrated approach, diagnostics must be included. This is for instance executed by Bowers, Lyons, Mould & Symonds (2005): they included a diagnosis treatment centre and by Taylor III & Keown (1980): they use a network model to integrate diagnostic and bed facilities. Another way of integrating OC and OR in a simulation model is by using clinical pathways, which is discussed by Cardoen & Demeulemeester (2008).

As mentioned before, Bowers, Lyons, Mould & Symonds (2005) developed an outpatient planning model for a diagnosis treatment center (DTC). Endoscopic clinic in the MST can be seen as a diagnosis treatment centre, because patients are researched (diagnostics) or treated. However, the EC the diagnosing and treating of patients is being executed by one specific specialty. At the DTC, expected demand derives from the expected demand for outpatient clinic consults. With given model, required capacities can be calculated.

Outpatient departments can combine different disciplines in health care. For instance, Huarng & Lee (1996) have simulated an outpatient department which includes the following disciplines: general medicine, general surgery, skeletology, dermatology, a cash desk, pharmacy, immunology, and lab. With given simulation model performance measures as the patient waiting time (before a visit and before a treatment, during the visit), utilization rate, the amount of waiting patients, amount of served patients and also the idle and busy times of all functions. A given solution using this model, is that a specific department (dermatology in this case) need expansion of their capacity.

Another method found in literature is found in an article of Côté (1999). Côté developed a model for a family practice in which physician examination, a nurse station and diagnostics take place. Through the use of discrete event simulation, insight was provided in the delivery of health care in a family practice. Impact of the patient arrival rate and also the number of available rooms per specialist can

be calculated through experimenting with variables as the patient flow time, the room queue length or the room utilization.

Another method for the tactical capacity planning is network modeling of an outpatient clinic (Taylor III & Keown, 1980). Again, many disciplines are included: registration, physician consultation, nurse's clinic, psychiatrist, allergy clinic, gynecologist, pharmacy, X-ray and infirmary. For each of these stations has an own queue, a number of servers and a certain server time. There exist a certain transition probability for patients to flow through the different stages in the network. Performance measures as the waiting time, amount of patients waiting, idle time and the utilization for each stage in the network are used to perform a scenario analysis.

As mentioned in the introduction of this section, an integrated approach for discrete event simulation is discussed by Cardoen & Demeulemeester (2008). Both, consultations in the OC and surgeries in the OR are included in this simulation. This simulation made is possible to improve the patient pathways, analyze the use of resources, give insight in the variation at the OC and OR and also it enables strategic analysis. Cardoen & Demeulemeester deliver three simulated scenarios whereby different standard consultation times are used and the need for same-day appointments is eliminated. Due to the different patient categories, different rules can be composed, for instance it can be stated that a higher variability in cases can better be scheduled at the end of a session.

Operating rooms / endoscopic clinics

When we are looking at endoscopic clinics or operation rooms with an integrated approach, we found papers wherein the impact on the ICU (Intensive Care Unit), PACU (Post Anesthesia Care Unit) and the wards is discussed (Cardoen, Demeulemeester & Beliën [1], 2010). This is discussed in many articles, for instance by: Adan & Vissers (2002), Adan, Bekkers, Dellaert, Vissers & Yu (2008) & Testi, Tanfani & Torre (2007).

An integrated approach whereby the yearly demand for the OR and its subsequent departments (ICU, Medium Care and ward) are used in combination with different patient categories (with given workloads for resources) is explained by Adan & Vissers (2002) and Adan, Bekkers, Dellaert, Vissers & Yu (2008). These two articles discuss approaches that seems to be similar because in both approaches (mixed) integer linear programming is used to optimize deviation of set targets. These targets are set for the utilization and throughput of beds, the capacity used at the OR, and nursing staff. However, we found some differences between the different approaches. The respective deterministic and stochastic nature of length of stay can be designated as the main difference.

Testi, Tanfani & Torre (2007) introduce a three-phase approach for the OR scheduling, whereby the ward is integrated. In the first phase, a bin packing-like problem is solved, by selecting an amount of session that will be scheduled weekly for each ward. Taken into account the waiting list of each ward and the reduction of residual ward demand, updated priority score is used to define the proposed and original selection criterion. Second phase in this model is the use of a blocked booking method. Optimal time tables are determined using this method, whereby assignment takes place between wards and surgery rooms. These optimal time tables are also known as Master Surgical Schedule (MSS). The last phase is the usage of the simulation software environment (called Witness 2004) with which the different sequencings of surgical activities can be analyzed. For this activities, different priorities can be given: Longest waiting time, longest processing time and the shortest processing time. So in this phase, patients are scheduled based. With given results of the simulation, also organizational improvements can be outlined.

A similar method to Testi, Tanfani & Torre (2007) is used by Velásquez, Melo & Küfer (2008). In this method again a bin-packing approach is used with which desired scheduling periods are included. Tactical planning is used for scheduling elective surgery using a planning horizon for several weeks. Performance indicators such as the utilization (over and under) of resources, staff overtime and bed use leveling are included in the article.

The MSS, aforementioned in the literature of Testi, Tanfani & Torre (2007) is not extensively researched. Beside, different definitions are handled of that MSS, according to Cardoen, Demeulemeester & Beliën [2] (2010). Testi, Tanfani & Torre (2007) use procedure types for their MSS in contrast to van Oostrum, van Houdenhoven, Hurink, Hans, Wullink & Kazemier (2008), who assign procedures over ORs by using a division over specialties and surgeons. These procedure types are of the same diagnosis and the performance is executed by the same surgical department. In the MSS only frequent elective procedures are included. For other procedures such as non-elective or emergencies, time is reserved. Both applications of the MSS have the objective to minimize the required capacity of the OR and leveling of bed requirement.

Capacity planning decisions and the evaluation of the performance of a (general) surgery division can be enabled by developing a discrete event simulation (Vanberkel & Blake, 2007). Performance measures as throughput and waiting time are connected in this simulation model to resource capacities (e.g. OR time, amount of beds) and the efficient use of it, because these factors are consistent. Used patient categories are logistically and medically recognizable, whereby factors as diagnosis, OR time, and length of stay are used for the categorization.

For the maximization of the utilisation and the minimization of the overtime costs, Fei, Meskens, Combes & Chu, (2009) have developed a tactical planning model for the endoscopy department, using a column-generation-based heuristic procedure. Afterwards they also solved the daily scheduling problem by using a Gonzalez-Sahni algorithm in order to schedule the surgical cases assigned at the planning stage. Aim of this model is to schedule as many surgical cases as possible into the endoscopy centre. This scheduling must occur within its fixed opening hours, whereby as few ORs as possible are used. Beside this minimization of ORs, overtime must be avoided.

Sonnenberg (2000) has evaluated three types of scheduling strategies for comparing the costs at an endoscopic clinic with different schemes for scheduling. Researching and treating of patients can occur using the following three strategies: In strategy 1, the most promising procedure for the patients complaints is evaluated. In case of normal findings, the next most promising procedure will be evaluated. This will continue until a deviation is found or a patient can be diagnosed. In strategy 2, physicians have to start with the least expensive and least complex diagnostic test given a patient's health. Then they proceed with the tests of increasing costs and complexity, depending on the outcome of the previous test. In strategy 3, all promising tests are executed simultaneously to expedite the evaluation and also to shorten the waiting times. These strategies are compared using a Monte Carlo Simulation whereby two hypothetical populations of 5000 inpatients or outpatients are subjected to each strategy. As a result of this simulation, strategy 2 seems to be the cheapest diagnostic strategy, but in case of limited access and long waiting times, strategy 3 seems to be the best solution.

3.2 A tactical planning concept from practice

An application of tactical planning in practice can be found in the ZGT (Ziekenhuis Groep Twente). In this hospital, tactical planning is already part of common procedure, whereby the outpatient clinic, the OR and the ward are incorporated. For the introduction of this tactical planning, first a pilot is started with three large surgical specialties. Evaluation of this process has taken place half a year later. It has resulted in better use of OR and ward, the access time to the OC is decreased and due to underutilization, less OR blocks are cancelled. Given the results and the evaluation, the tactical planning was expanded further into the organization and there was developed a system to help generate overviews of required information. Planning meetings, whereby capacity is allocated over specialties and patient groups by using management information, have to organize the tactical planning within the ZGT (Rijntjes, 2011). This is further described in section 3.2.1 to 3.2.3. In section 3.2.4 the creation of support for the tactical planning model is described.

3.2.1 Tactical planning meeting

Every two weeks, ZGT is held a tactical planning meeting to discuss the allocation of their capacity. This meeting is prepared by a manager care and is attended by representatives of (the larger) surgical departments, chief OR, chief admission, and the director care. For the data analysis, the program DynamicPlanner™ is used. DynamicPlanner™ is an advanced tool which is used for decision support and optimization of the environment (Care Dynamics, 2012). Prior to this meeting, a pre tactical planning meeting takes place with the chief OR and chief admission. They prepare the meeting and distribute the findings, which will be presented and discussed during the tactical planning meeting. Validation of the used data is important and the focus must be on the visible trends, not on the exceptions (Rijntjes, 2011). Through the introduction of tactical planning at ZGT, the filling of the OR scheme is improved 4,5%. Moreover, the waiting lists are shortened drastically (ZGT, 2010).

3.2.2 Patient groups

For the categorizing of patients, similarities in OC pattern, surgery duration and length of stay are used, whereby the main groups from DRG coding are used as a starting point. Patients that are too different to be included in a formed group, are allocated to a surplus-group. Capacity is allocated over these formed patient groups, through which it is possible to construct an OR master plan. Given this master plan, expected bed use at the wards is known and therefore can be leveled (Rijntjes, 2011).

3.2.3 Management information

Management information is formed from gathered data to enable the tactical planning. Based on this information, capacity can be allocated. For the consideration of demand, the inflow of patients is evaluated, whereby there is looked for a probable in- or decrease. Performance measures used in ZGT are access times for the OC, utilization rates for the OR (whereby a distinction is made between assigned and used capacity), ward utilization and the amount of work in progress at both the OC and OR.

Utilization rates of past periods (8-12 weeks) and the expected work in progress determine the allocation of OR blocks. In agreement with the OR process coordination, overviews are generated through which it become for instance clear if the capacity is sufficient. A decrease in the performance measure utilization and a decrease in the OR waiting list could indicate a low inflow from the OC. To solve this problem, not only the OR time must be decreased, the OC time for new patients must be increased and the OC/OR time ratio may be changed.

3.2.4 Support

For the introduction of this tactical planning approach in ZGT, support have to be created. For this support, an external party is of great importance. For this purpose, Ernst&Young is appointed. The need for tactical planning is acknowledged within the higher management levels, but specialists need to be convinced when changing their standard way of working. Creating trust can take place through focusing on utilization and honoring agreements on capacity allocation. Insight in performance is also a manner to create support for this implementation (Rijntjes, 2011).

3.3 A tactical planning concept from theory

A tactical planning concept that integrate the OC and OR is described by Hulshof, Boucherie, Hans & Hurink (2011). Allocation of resource capacities among various consecutive stages of different care pathways is executed by using mixed integer linear programming. With given model, a patient admission plan can be computed for multiple consecutive time periods, fluctuation in demand and resource availability taken into account. Target values like access time, throughput time and production numbers are improved, using this model. Characteristics of this model are described in section 3.3.1. Used methods for the patient admission plan are discussed in 3.3.2.

In the article, the following main objectives of tactical planning are mentioned:

- Achieve equitable access for patient groups
- Achieve equitable treatment duration for patient groups
- Serve the strategically agreed target number of patients (production target or quota)
- Maximize resource utilization
- Balance workload (Hulshof, Boucherie, Hans & Hurink, 2011)

3.3.1 Model

Resources

In the described model, different hospital resource types are included, like OC, OR, ward and diagnostics. Hospitals have to deal with a limitation in this available capacity, which have to be allocated over different patient care pathways.

Patient care pathways

Patient care pathways are a method used to model the patient process within a hospital. Different stages are identified in the patient process for which certain demands different resource types are required. Between these stages, there can occur delay which must be minimized. Each patient pathway can be unique by differentiation in the number of stages, the requirements of resources and

the minimum time delays. Patient can step in a certain pathway at each possible stage and it is possible to continue or leave this pathway at each stage.

Queues and waiting lists

Queues for service occur for each stage in a patient's pathway. These are modeled separately for each resource. Serving patients take place using the First Come, First Served principle, whereby patients are served from the waiting list. This list is starting point for queuing. Hereby is a maximum for the waiting list included, to prevent for unreasonable waiting times for service.

Patient admission plan

Hulshof, Boucherie, Hans & Hurink (2011) determine a patient admission plan for each period in the planning horizon. At this admission plan, the amount of patients which must be served at each queue or stage is determined. These numbers are composed using the length of queues and numbers of periods a patient have been waiting.

3.3.2 Method

Objective function

Method used by Hulshof, Boucherie, Hans & Hurink (2011) is the Mixed Integer Linear Programming (MIP) model. Functions are developed whereby the probability of achieving the aforementioned main objectives of tactical planning are taken into account. The main objective of the model is to minimize the number of patients waiting at each queue over the planning horizon. This is multiplied by a weight, which reflects, According to Hulshof, Boucherie, Hans & Hurink (2011), the priority to serve patients at a particular stage in a particular care pathway.

Iterative procedure

An iterative procedure is applied to determine the weights and as a consequence the patient admission plan. To solve the MIP, an initial value is chosen for weights. These weight must be updated then to be based on the aforementioned main objectives equitable access and treatment duration and the realization of the production numbers. Then, the MIP is solved again. Until the weights reaches a certain small value, this process will be repeated.

Weights

Through the use of weights, the objectives of equitable access, equitable treatment duration and the realization of the agreed production numbers are incorporated. For these objectives, a target value is set for comparison. Through this comparison, weights for the different queues and waiting lists can be determined (Hulshof, Boucherie, Hans & Hurink, 2011).

3.4 Conclusions

Tactical capacity planning

- Goals of tactical capacity planning;
 - Equitable access times;
 - Equitable throughput times;
 - Realization of production agreements;
 - Maximization efficient use of resources;
 - Balanced workload.
- Tactical capacity planning considers;
 - Different types of tactical planning approaches;
 - Static: long-term cyclical plans;
 - Dynamic: intermediate-term plans in which can be responded to variability in demand and supply and which therefore is more useful for the demand driven tactical capacity planning at the GIHD.
 - Appointments scheduling systems are used for the planning of elective patients;
 - Block planning can be used to organize tactical planning;
 - Over patient categories;
 - Over types of consults, researches and treatments.
- Scientific literature is not directly applicable to tactical planning for GIHD of MST;
 - Integration of OC and EC/OR is limited in literature;
 - Complex mathematical models are used to implement tactical planning;
 - Models often provide “one optimal solution” for a certain point in time;
 - The solution can differ extensively per planning period;
 - Cannot include all restrictions and preferences;
 - Demand and supply varies all the time, which means that the model have to be used frequently.
- Patient categories;
 - Different patient categories can be used for planning at the OC;
 - Elective and urgent patients;
 - New patients and follow-up patients;
 - Using no categories, which is required for the advanced/open-access scheduling, which is extensively researched.
 - Different patient categories can be used for planning at the EC/OR;
 - Using the treatment/research duration (which are logistically similar);

- Using the different diagnosis types (which are medically similar);
 - The maximum amount of categories which can be used at a specific department is not clear.
- Different performance indicators can be used to measure the performance of the clinics;
 - OC: Queuing, throughput, utilization and overtime;
 - EC/OR: Utilization, overtime, throughput and waiting time;
 - Main focus on efficiency/utilization.

Tactical planning from practice

- ZGT is using tactical planning in their daily practice;
 - In this tactical planning the greater outpatient clinics, operating rooms and wards are included;
- The tactical planning within ZGT is organized using tactical planning meetings;
 - For this tactical planning meetings tactical management information is required;
 - Overview of the demand and supply in the previous period;
 - Expected demand and supply;
 - The realized and expected performance;
 - Some scenarios due to different capacity allocation opportunities.
 - Decisions are made for the capacity allocation for the coming period;
- To make use of tactical planning within the ZGT, patient categories are used;
 - Based on similar patterns for OC, OR and length of stay (logistically similar patients);
 - DRG coding (medically similar patients).
- For the implementation of the tactical planning, support (of the employees) have to be generated. Some steps to generate this support are;
 - Involving an external party in the implementation of the tactical planning;
 - Honoring agreements on capacity allocation;
 - Delivering insight in the process and the performance of the hospital, using tactical planning.

Tactical planning from theory

- Mixed integer linear programming is used by Hulshof, Boucherie, Hans & Hurink (2011);
- For the allocation of resources, patient pathways are used;
 - Pathway: steps with certain resource capacity requirement, minimum time delays
- The objective of this developed model:
 - Minimization of access and throughput times;

- Equitable access times;
- Equitable throughput times;
- Realization of production agreements.
- The model has in our view some practical limitations;
 - Due to variation in demand and supply, the resulting planning can differ extensively per period;
 - Required information must be very detailed (especially demand and production targets) which can cause problems;
 - Pathways used are the same for each patient in it, which is not true at the GIHD;
 - In the resulted work schedule, less input of the specialists is used. This can cause problems with the acceptance of the specialists.

Concluding: At the GIHD a tactical planning model need to be implemented which is demand driven. To accomplish this model, capacity needs to be allocated over the endoscopic and outpatient clinic. In the literature, some mathematical methods are found to implement tactical planning at the GIHD. This models only offer 'one optimal solution' which applies for a certain point in time. In this optimal solution, not all restrictions used at the GIHD are included and also the difference in the solutions is extensively for the various periods. Therefore, a whole new model needs to be developed to implement tactical capacity planning at the GIHD, taken into account the gained insights delivered by literature. Current tactical planning practice within the ZGT should be used as an example. Tactical planning meetings are required for discussing the accurate information about demand, supply and performance and therefore they will be introduces within the GIHD. When obtaining the right information, necessary decisions can be taken through which the tactical planning could become a workable method.

In the next chapter the design of a tactical planning approach for GIHD of MST is elaborated upon further.

4. Design of a tactical planning approach for GIHD of MST

This chapter describes how to change the current planning procedures at the GIHD into a tactical planning approach, wherefore different projects are used. In section 4.1 an outline will be given of the tactical planning concept for the GIHD. For this conceptual planning model, several project steps must be undertaken, which are shortly described in section 4.2. In section 4.3 to 4.6 these project steps are described more in detail. Finally, in section 4.7 a pilot process will be described and with it the organization of the tactical planning process at the GIHD.

4.1. Tactical planning for MST

This section shortly introduce a conceptual tactical planning model for the GIHD, that we advise. In the sections 4.3 to 4.7 the characteristics of the steps which should be undertaken are explained more detailed.

When using tactical planning at the GIHD, the intermediate term planning of (elective) patients will be changed. It is important to match demand and capacity for the minimization of waiting lists, utilization levels and overtime. Allocation of capacity must be discussed frequently and if necessary this capacity must be reallocated. Management information is required to make decisions about this (re)allocation of capacity. For this conceptual tactical planning model information is required about the ratio between outpatient clinics / endoscopy department. For instance it is important to which department patients are referred and which patient flow can be identified from OC to EC and from EC to OC. Next to this ratio, the policy of overtime and working hours must be clear and eventually (temporarily) adjusted. For the allocation of capacity, the EC and OC are scheduled in a different way. At the outpatient clinic, time must be reserved for new patients appointments, outpatient appointments and telephone consults. This reservation of time for the specific types of appointments need to be discussed frequently. At the endoscopic clinic, some blocks of time are reserved for different types of endoscopies and some blocks are reserved for emergency cases. It have to be taken into account that not every endoscopy can be executed at each treatment room through each specialist. This is a difficulty which have to be taken into account when scheduling (and scheduling emergencies). At the GIHD, a basic capacity must be guaranteed, but the availability exist to allocate additional (flexible) capacity when the expected demand rises above the basic capacity and as a result the performance of GIHD will decrease.

Tactical planning meetings

As mentioned in the introduction of this section, the allocation of capacity must be discussed frequently.

Therefore, we advise tactical planning meeting. In this meetings, the allocation of capacity will take place. Performance of the GIHD in the past twelve weeks (but especially the last two weeks are of importance) and the expected demand for the next period are discussed in this meetings. How must the capacity be allocated, is there sufficient capacity and in which way should the capacity be spread over the endoscopic clinic and outpatient clinic. Ratios between the endoscopic clinic and outpatient clinic are discussed as also the ratio between first and follow-up consults. Then the available time for EC and OC is distributed among the different patient categories.

This tactical planning meetings, first must be attended by the specialists of the GIHD. Beside the specialists, it is important that the chief Endoscopic Clinic and chief Outpatient clinic are present. Additional, the data manager and the business and medical manager of the RVE internal medicine must attend this meeting.

Tactical planning meetings are used in the ZGT to divide the capacity of the specialism between the ward, outpatient clinic and operation room, which has differences with the GIHD setting. At operation rooms, operations are executed all the time. Therefore, nurse staff can always be scheduled, regardless to the operating specialism. So when there is decided to allocate more operating time for one specific specialism, there are no changes for the operating room nurse staff. The endoscopic clinic has its own operation rooms and nurse staff. When there is decided to allocate more capacity to the endoscopic clinic, more nurse staff is required. Therefore, during this tactical planning meetings, it is not possible to make changes on short-term notice because this demands flexibility of the nursing staff and planning systems. So, the tactical planning meetings can be used at the GIHD to discuss current performance, met problems and expected demand and capacity for a certain period, but it is not realizable to implement these meetings for short-term changes in the planning systems. But this tactical planning meetings may be included in the development of the schedules, two months in advance.

Tactical management information

For the tactical planning meetings, management information is needed whereon the capacity decisions should be based. This management information must include performance information. This performance information can be offered in co-operation with the data manager of the GIHD, who makes up lists of all performed consults and researches/treatments at the GIHD. Overtime need to be registered, which does not take place at this time at the GIHD. Beside the information about

the performance, demand and supply must be visible. This information must be delivered for the past period and the expected numbers must be calculated for the next period. Process information is required to calculate the expected demand for surgeries and follow-up consults. This is done by determining the amount of follow-up consults and endoscopies for already planned consults and endoscopies. Therefore, historical expected demand will be used. For the calculation of expected performance, different scenarios have to be simulated with a given capacity combined with a certain expected demand. To make this decision, some additional training may be required for the involved actors in this tactical planning process of the GIHD.

4.2. Project steps towards tactical planning

To introduce and implement (in the end) tactical planning at the GIHD, several project steps can be identified which should be undertaken. In the sections 4.3 to 4.7, these project steps are described. Required conditions for the tactical planning model at the GIHD are achieved by executing these project steps. The following project steps can be identified:

- *Strategic planning*, described in section 4.3. At strategic planning level, different goals are set and choices are made which can influence the availability and conditions for tactical planning. This choices can influence for example the availability of treatment rooms, consultation rooms and the amount of specialists.
- *Availability of process information*, described in section 4.4. An important step for the implementation of tactical planning at the GIHD is the identification of the patient process, including related percentages and numbers of the patient flow at the department. This information is required for the demand forecasting at the GIHD and determining the patient categories.
- *Patient categorization*, described in section 4.5. At the GIHD, patients are divided into different categories. Available capacity is distributed over given categories, which make the demand forecasts more precise.
- *Availability of tactical management information*, described in section 4.6. Another project step which have to be undertaken is providing management information. This information is necessary for planning decisions to be made. Tactical management information includes figures on demand, supply and performance.
- *Pilot tactical planning*, described in section 4.7. For the identification of the benefits and possible problems of implementing a tactical planning model at the GIHD, a pilot must be executed. First, this model have to be tested en evaluated before implementing it into the

entire department. Proven benefits and improvements can contribute to a rising support for implementing tactical planning in current business of specialists.

Some of these projects can start immediately, some are dependent on the outcomes of the previous projects. Therefore, an overview is generated in figure 9 (Gantt Chart) in which it become clear which project can start when, which projects can run parallel and which projects are dependent on which output of previous projects.

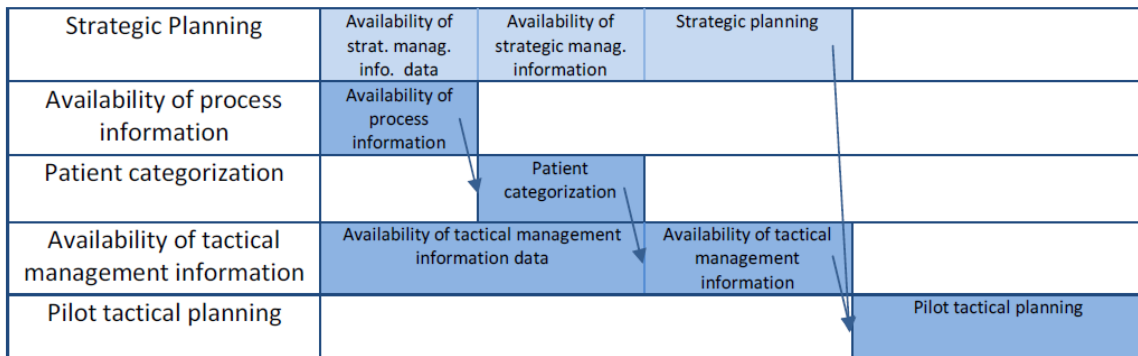


Figure 9: Project chart; steps toward tactical planning for GIHD at MST

Each of the projects will be outlined detailed about it importance, the extent and the involved actors in this project. To structure this description, for each of the projects the following questions are answered:

- **What** is determined or facilitated in this project step;
- **Why** is the undertaken so important;
- **How** is this executed;
- **Who** is involved in this project step;
- **When** is it executed?

4.3. Strategic planning

Decisions made according to strategic planning and its goals on strategic level influences the tactical planning level. This can result in restrictions. Aforementioned questions describe the strategic planning project and its influence on the tactical planning. Due to the focus of this research, which is the tactical planning, this strategic planning is not elaborated as extensively as tactical planning will be.

4.3.1. What

As mentioned in the context analysis, strategic planning determines an overall strategy of the hospital, which leads to strategic choices and goals. This goals are set on long term and then are

divided in several intermediate term tactical goals. Made strategic choices shape the organization (e.g. the amount of specialists at each department, the amount of beds and the amount of consultation rooms) and its working environment.

Several strategic choices must be made, to shape and structure the organization. These choices influence the tactical planning at the GIHD. These choices and its relation to the GIHD are given in the overview below.

Table 11: Strategy and strategic choices

Strategy	Strategic choice
Case mix	Which type of patients are treated at the GIHD? How many patients of each type must be treated?
Personnel	How many FTE is required at the GIHD? Is there an option for flexible personnel? How many AIOS and ANIOS are required beside the specialists?
Working hours and overtime policy	What are the standard working hours for the OC and EC? When is it allowed to deviate from standard working hours? When is deviation from standard hours allowed? What is the accepted risk of working in overtime (in planning)? (When) does overtime result in cancellation?
Available ORs	How many treatment rooms are available at the EC? How many of them are inventory treatment rooms? How many recovery beds are available for the EC?
Organization of elective vs. acute care	How is the emergency care organized at the GIHD? (Which type of model is used: traditional, carve out, or open access model)

Following main strategic goals which are determined for a hospital are:

- Minimization of the costs, whereby the utilization must be maximized and the amount over overtime must be limited;
- Minimization of the access times, waiting times and throughput times for a patient (in case of our research, for a patient at the GIHD);
- There is also set a production agreement realization. This target is set each year and there must be strived for achieving this target.

Given strategic goals are transformed into target values. They can be seen as quality indicators for patient care which can be complemented with many other indicators which are both, internal and government indicators.

4.3.2. Why

The importance of strategic planning for the tactical planning is its interdependence. It defines the main goals, strategic choices and set targets of a hospital. For achieving this main goals, different goals with an intermediate planning horizon are set up, to give meaning to the made strategic choices.

For the hospital, a tension field exists for the three main stakeholders: patients, management and personnel. Whishes of these stakeholders should be taken into account, so a focus within this tension field is provided through strategic planning. This is outlined in figure 10. Included in this figure are the logistic indicators and main strategic goals.

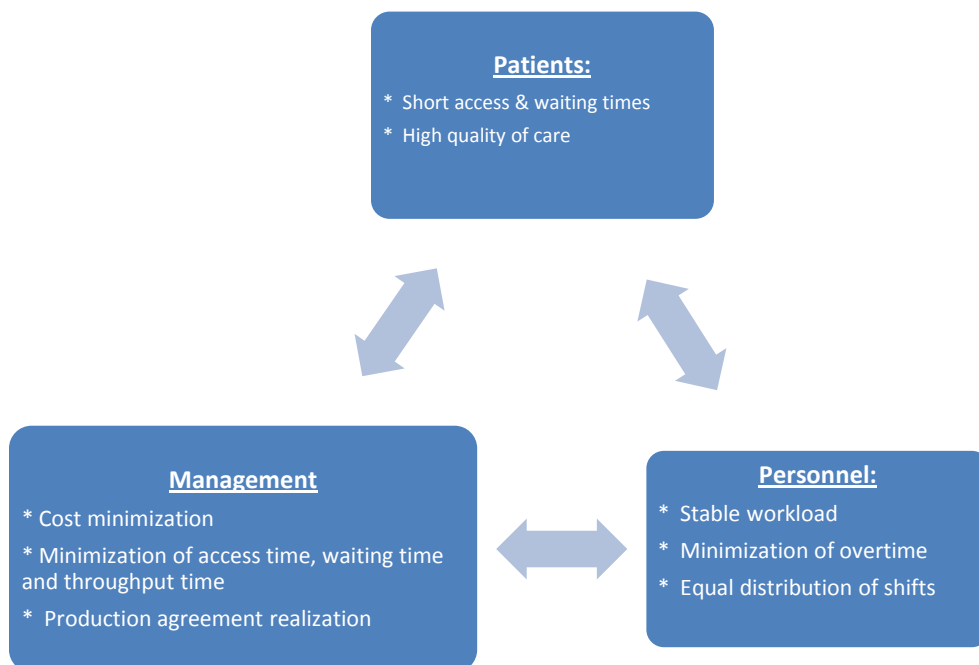


Figure 10: Tension field between patient care performance indicator stakeholders

A balance have to be found between for instance the minimization of the access time, a stable workload and cost minimization. These indicators mostly are interdependent and sometimes conflicting as is displayed in figure 10. High utilization is associated with long waiting times and short waiting times is associated with a low utilization rate.

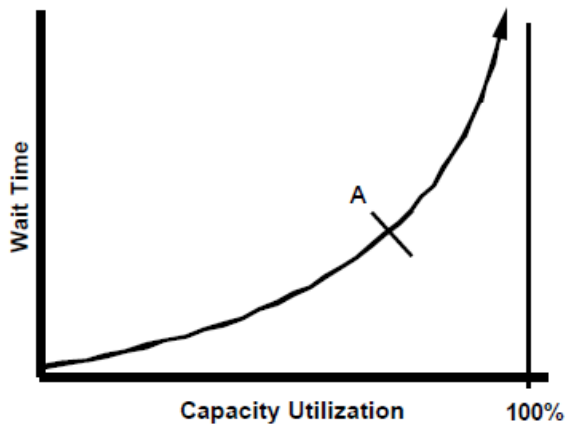


Figure 11: Relation between the capacity utilization and waiting time (Howell, Ballard, & Hall, 2001)

Beside, variability is an important factor for demand and utilization. Demand at a certain department in a hospital is variable, the higher the variability of demand, the harder it is to obtain a high utilization level and simultaneously keep the access and waiting times as low as possible. Therefore it is important to reduce this variability, to improve the logistic indicators at the GIHD. In figure 12. An overview is given of this relation between variability, access and waiting times and utilization.

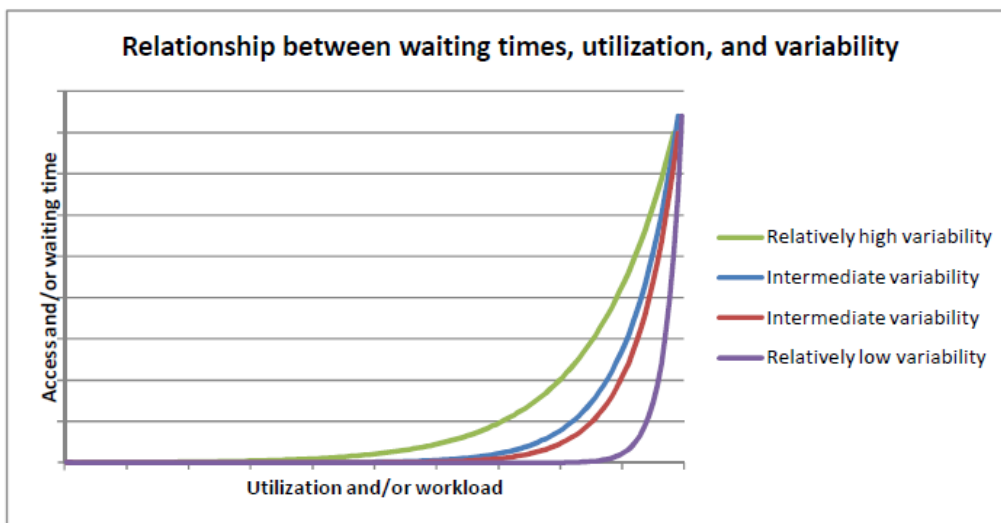


Figure 12: Waiting times and utilization influenced by variability(Howell, Ballard, & Hall, 2001)

4.3.3. How

Made strategic choices and set strategic goals are determined at the strategic hospital levels. Not all choices made and goals set apply to the whole hospital e.g. working hours and overtime policy. Additional there are set strategic goals and made strategic choices for a specific department/specialty. For instance, variability in consults or surgeries is an important cause of

overtime. Some specialties are not dealing with a high variability through which overtime need not be accepted for this specialty. Besides, there can be handled different norms on performance indicators for specific specialties and also the organization of elective and acute care can differ for the different specialties.

To make these strategic choices and set these targets, management information is required. This information is based on the same data used for tactical management information, but it differs through its aggregation level (yearly). Strategic management information includes the ratio between elective and acute patients, the composition of different types of patients at specific departments and financial information (consideration of the amount of FTE). Tactical management data is outlined further in section 4.3.6 whereby also the required data is mentioned.

4.3.4. Who

Strategic planning is executed by the board of directors, the medical and business managers of a RVE, the department Business Process Redesign (BPR), the department Finance and Information (F&I) and the department care logistics. Responsible for the strategic planning is the board of directors. The managers of the RVEs are responsible for the tactical management and have knowledge of the performance of a specific specialty. Other mentioned departments are responsible for the data gathering and programming, and changing this data into useful and reliable information. They are aware of the government requirements and must be present in the evaluation of the performance of a specialty (Rijntjes, 2011).

4.3.5. When

Using MST systems is another way to obtain the required data, which can be executed simultaneously for strategic and tactical management information. It may be advisable to develop a system that allows the hospital to obtain required information readily available from existing data systems. Strategic choices can be made and strategic targets can be set when the required information is available for the involved actors in this process.

4.4. Availability of process information

An important project for the implementation of tactical planning at GIHD is to obtain the required process information. Due to the inconsistent systems, it can be hard to gather all the required data for the process information. For this project, again the questions what, why, how, who and when are answered according to the availability of this required information.

4.4.1. What

In this step the required process information is determined. This required process information can be divided into different categories, namely the outpatient clinic and the endoscopic clinic and also the new patients and control patients. First the distinction is made for the new and control patients.

- New patients:
 - Amount of new patient referrals per period;
 - Amount of follow up consults per period;
 - Follow up consult before an endoscopic treatment or research;
 - Follow up consult after an endoscopic treatment or research.
 - Amount of telephonic consults ;
 - Determining the relation between this consults and endoscopic treatment or researches. Which percentage of discussing the results takes place per telephonic consult.
 - Amount of endoscopic researches or treatments;
 - Percentage of new patients who become a control patient.
- Control patients:
 - Amount of follow-up consults for control patients:
 - Follow up consult before an endoscopic treatment or research;
 - Follow up consult after an endoscopic treatment or research.
 - Percentage of control patients that requires endoscopic treatment or research;
 - Average amount of endoscopic treatments or researches per patient;
 - Percentage of control patients that finally leave the GIHD;
 - Can there be made a distinction for this percentage into different types of diseases.

Beside the distinction between new patients and control patients, a distinction can be made between the outpatient clinic and the endoscopic clinic. Of this two types of departments, also process information is required for the tactical planning.

- For the outpatient clinic:
 - Amount of referrals of new patients to the outpatient clinic;
 - Amount of outpatient clinic consults;
 - Amount of new patient consults;
 - Amount of follow-up consults;
 - Amount of telephonic consults;

- How are these types of consults distributed.
- Percentage of new patients leaving the process after their first consult;
- Percentage of patients where a follow up consult is required (in cases before an endoscopic treatment or research or where no endoscopy is needed);
- Percentage of patients requiring a follow up consult after a surgery;
- Percentage of patients requiring an endoscopic treatment or research;
- Percentage of patients who become a control patient.
- For the endoscopic clinic:
 - Amount of referrals of new patients to the endoscopic clinic;
 - Amount of endoscopic researches or treatments which are executed;
 - How many endoscopic researches or treatments of each type;
 - How is the distribution of these different endoscopic types.
 - Percentage of different ways to discuss the results of an endoscopic treatment or research;
 - Discussing the results with the GP;
 - Discussing the result through a telephonic consult with a specialist;
 - Consult at the outpatient clinic.
 - Percentage of patients leaving the process after their endoscopic treatment or research;
 - Percentage of patients for which a follow-up consult is required (after discussing the results of the endoscopy);
 - Percentage of patients who require an additional endoscopic research or treatment;
 - Percentage of patients who become a control patient.

Some additional information may be required for the tactical planning model:

- Can there be identified seasonable variability;
 - In demand;
 - In capacity.
- What are the throughput times in the system.

4.4.2. Why

Above mentioned process information is important for the tactical planning, several reasons can be given. When an overview is given of factors discussed in section 4.4.1, insight is provided of the patient flow at the GIHD. For the different patient types (new patients and control patients) a division is given with which the expected working pressure can be determined, given the referrals of

new patients and the planned control patients. In the end, this probabilities and throughput times can be used to forecast the demand.

4.4.3. How

To obtain the required process information, process data is necessary which include the realization of the GIHD, probabilities of certain steps in the patient process, probabilities of transitions between the OC and EC and the amount of patients. In addition, the knowledge and experience of the specialists of great importance. They maintain the diagnosis and can give a good estimation of the required care for a specific patient through which the expected workload for the OC and EC are more shaped.

Times of transitions are in the actual planning method hard to interpret. Times between the referral and the first patient visit and times between consecutive consults or researches/treatments can be obtained out of data derived from the data manager or out of X-care data. Difficulty when using this data is the coding strategy which is used at the GIHD. As mentioned before, patients are assigned to a specific code, which determines the urgency and desired minimum and maximum between the different stages in the patient process. It is therefore very important to find an alignment between these dates, the time between transition actually realized must be in accordance with the limits defined by the selected planning code. There must be found a way to realize this alignment.

Data collection

The Data Warehouse of MST can provide all required data recording to the amount of patients and its possible transitions at the GIHD. Data in this Warehouse derived from all registrations in X-care. An overview can be given per patient in which each consult, research, treatment, diagnostics and other cases is registered for each department within the hospital. A selection can be made for the GIHD department and DRG codes can be used in the data file. Using DRG coding, a distinction can be made of types referrals and different patient types.

Table 12: overview DRG codes used for patient categorization

Type of Care	
Code 11: Regular Care	A DRG is opened when a patient visits the outpatient clinic for the first time. This code 11 will be closed when: the diagnosis and treatment are completed, the patient moves over to the continuation care, when the treatment process has changed or the code will be closed after 365 days
Code 21: Continuation care	When a medical specialist at the GIHD judges

	that the diagnosis and treatment of a certain patient is ended, the DRG type 11 will be closed. One day after closing this DRG, there can be opened a continuation DRG (type 21) for patients who must be treated in the long term.
Code 41: Traject care	Traject based on remaining treatments: when a patient is referred to the endoscopic clinic, a DRG 41 is opened. Whenever a patient visit the outpatient clinic of the GIHD, the code 41 will be changed into a code 11.

(DBC Onderhoud [1], 2011; DBC Onderhoud [2], 2011; DBC Onderhoud [3], 2011; DBC Onderhoud, 2009).

For the obtainment of a dataset, it must be clear which data is required out of the Data Warehouse. A query should be formulated to obtain the required data. The following data is necessary for a good overview of the patient flow within the GIHD and the performance of this department:

- A selection has to be made for the GIHD specialism: the concerned departments have to be selected (e.g. Outpatient clinic, Endoscopic clinics in either Oldenzaal and Enschede, Operating rooms, Nurse department). Therefore exist some department codes which can be selected into the query.
- Period selected are the years 2010-2011.
- A selection of operations executed at this department (e.g. first outpatient clinic consult, follow-up consult, telephonic consult, ERCP, gastroscopy and colonoscopy)
- For each patient included all the actions executed at the GIHD in the selected period have to be included, with given date.
- In the dataset, the DRG care type code have to be included (of which the overview is given in table 13)

Table 13: Result of a query to the Data Warehouse of MST

Year	ACT Patient Code	DRG type of care Code	Internal Operations Code	Date of execution	Name of caregiver	LU Department
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In Table 12, a possible result of a Data Warehouse Query is displayed. This table can be supplemented by for example descriptions of the treatment, information of patients such as patient's condition or the date of birth, and the starting dates of the various DRG codes.

Through the use of pivot tables, required information of each step in the patient process can become clear. Programming might be needed to obtain numbers of previous steps, required for transition probabilities. This also applies for the time between consecutive steps in the patient process, which can be calculated easily for individual patients but become difficult for a whole dataset with patients. The obtained data, derived from the data, should be checked by the specialist or the data manager.

This data can for instance be compared with data out of Endosoft (a tool used for treatments or researches at the EC). Experience has shown that these data may differ.

Take note: Derived data from the Data Warehouse is the data entered for the financial registration.

A financial first patient consult can differ from a logistic new patient consult.

Also, there can exist some outliers in the data set (patients with an extremely high number of follow-up consults, long follow-up times or an extremely amount of endoscopic treatments/researches. This outliers must be excluded, because they increase the variability in such a way, that it cannot longer be seen as representative. But, this outliers has to be taken into account for the demand forecasting, when using historic demand. Last discussion point are the emergency consults, treatments or researches. The dataset is not clear what was carried out under adversity. This need to be resolved, so that in future the GIHD can use also historical information about emergency cases.

4.4.4. Who

Specialists, the data manager of the GIHD, F&I and BPR employees are the main actors involved in the patient process information project. *Specialists* are involved directly, because all the required data is entered by them in X-care, which complement the Data Warehouse. The specialists have a good view of different patient flows at the GIHD. The desired minimum transition times are well known by them. The same applies for the data manager of the GIHD. All referrals are received by her, entered into the system, of which overviews can be generated. Further, an *employee* is required who has knowledge of data gathering and programming. First, the required data need to be obtained before it is converted into useful and reliable information. This whole process need to be supported by the business managers of the RVE GIHD.

4.4.5. When

This project can start directly at the moment it become clear that the planning at the GIHD will change into tactical, demand driven, planning. For the obtaining of the required data, some programming is required, to obtain all the useful information. This have to be executed first, but some data can be obtained without this programming. When a model is developed, all the required information can be obtained automatically from the data.

4.5. Patient categorization

With the process information, patient categories can be defined. These categories are a part of the tactical planning process. Again, section 4.5.1 to 4.5.5 will answer the questions what, why, how, who and when, this time for the patient categorization project.

4.5.1. What

At the GIHD, patients have to be divided into different categories to facilitate the tactical planning. These categories have to be logistically and medically similar. Different process steps for this patient categories can be defined just as the associated transition probabilities. We do not have the necessary medical knowledge to shape the patient categorization, but it is advisable to use the DRG codes as a starting point (medically similarity).

4.5.2. Why

Patient categorization is necessary at the GIHD because two types of referrals are used: referrals to the Outpatient Clinic and referrals to the Endoscopic Clinic. Specialists time must also be divided over these two departments, taken into account the demand. Time at the OC is mostly departed into new patient consults, follow-up consults and telephonic consults. This is more complicated at the EC. In the current planning system, the demand for specific endoscopic examinations is weekly scheduled, using some fixed slots for specific endoscopic types and some fixed slots for emergencies. In the other available time, all endoscopic researches or treatments can be scheduled, taken into account some planning rules (e.g. there is only one treatment room for intervention scopies). To allocate the capacity to the demand . For matching the available capacity to the actual demand for consults, researches or treatments, it is important to have a good insight in the different patient flows (and its percentage of occurrence) of the used DRG codes. This allows dividing the available capacity in a good way to the two departments.

4.5.3. How

Medically and logistically similarity of the chosen patient categories is very important for the planning process. For the determination of medically similar categorizations, DRG coding must be used as a starting point referred to formatting these DRG codes into different medically similar patient categories. This step is executed by the GIHD specialists. For the logistic similarity, process information must be used, which include similar patient steps, transition probabilities and times, but also the duration of different consults, researches or treatments. Given these patient categories, there can be identified similar patient processes and similar capacity demand per step in the process. When the necessary categories are determined, the required process information mentioned must then be aggregated for the different category levels.

Data collection

The required data for this patient categorization

- Capacity demand per DRG: the average capacity demand and its standard deviations have to be calculated per patient category.

This capacity demand have to be calculated over a certain period. Comparing this periodic figures can give a good insight in changes.

- Duration of the different consults, treatments or researches per patient. It is advisable to check these data also per specialist.
- An overview must be given per patient category of these data, over a period of two years.

Used for this data can be the data derived from the Data Warehouse and Endosoft. Data derived from Endosoft contains information about the treatments and researches executed at the EC. For the visualization of the duration per DRG, box plots can be used. Using this box plots, possible clusters can be composed with (almost) equal durations of treatments/researches. An example of such a box plot is given in figure 13.

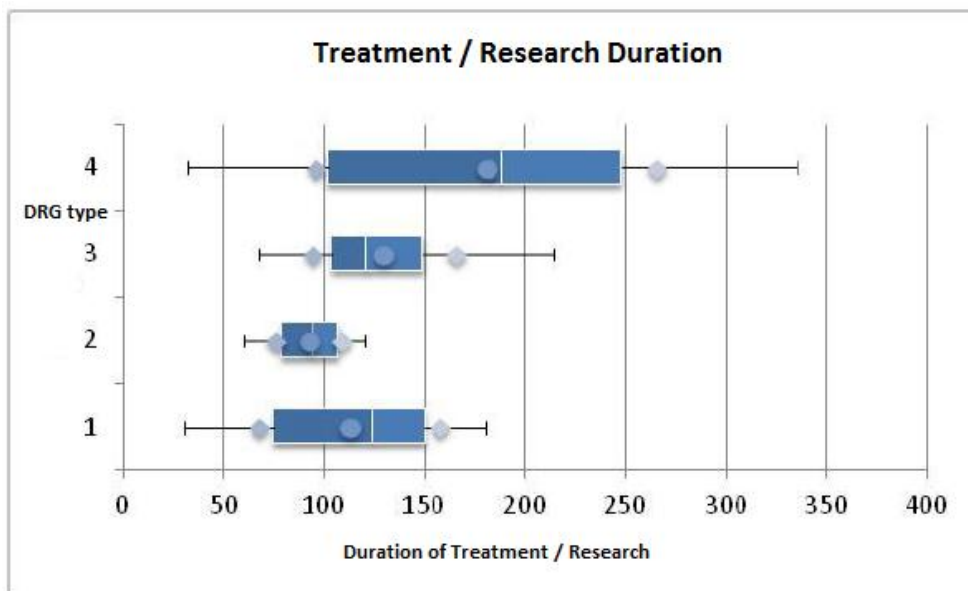


Figure 11: Box plot of the research/treatment duration for different DRG types

Take note: Just as in the process information project, outliers can occur in the duration for treatments or researches. These outliers are due to incidents and are excluded because they are an exception at the normal affairs.

4.5.4. Who

For the patient categorization, involvement of GIHD specialists, the data manager, employees of the planning department of the EC, and employees of the BPR and F&I is important. GIHD specialists have experience with the various patient types and have to be involved in the creation of these categories. Besides it, the required knowledge of the employees of the abovementioned departments

can deliver knowledge of data gathering and the visualization of these data. Again, the business managers of the RVE GIHD support this project.

4.5.5. When

Gathering the required data and presenting it can start directly. For the categorization, first the process information must be available. After defining the patient categories, different variables can be calculated for this categories and the demand capacity can be determined for the patient scheduling.

4.6. Availability of tactical management information

Beside the process information, strategic planning and the definition of patient categories, tactical management information is required for implementing tactical planning at the GIHD. To start this project, first the patient categories have to be determined and the process information have to be available. Again, the questions what, why, how, who and when are answered, this time for the tactical management information project.

4.6.1. What

Another step to implement tactical planning is this project in which the tactical management information need to be made available. Performance of the OC and EC of the GIHD need to be analyzed and thereby the expected demand, available capacity and expected performance need to be discussed.

Following tactical management information is required, divided into the categories demand, supply and performance:

- Demand
 - Outpatient clinic
 - Currently scheduled patients / consults
 - Expected demand for a specific period
 - Historical data of demand and capacity needed
 - Follow-up consults received from current planning
 - Endoscopic clinic
 - Patient currently on the waiting list for an endoscopic research / treatment (both control patients and new patients)
 - Expected additions to waiting list (due to planned outpatient consults)
 - Historic expectation of demand, needed capacity and also emergency cases

- Supply
 - Availability of specialists (differs per day, per week)
 - Availability of other personnel (ANIOS, AIOS, nurse staff)
 - Division of hours between outpatient clinic hours and endoscopic clinic

- Performance
 - Utilization
 - Access, waiting, and throughput times
 - Waiting lists (Work In Progress)
 - Realization

4.6.2. Why

When tactical planning is implemented at the GIHD, tactical planning meetings must take place each set period. For this planning meetings, tactical management is necessary to evaluate the actual performance of the GIHD and to predict the performance, expected demand and the available capacity for the coming period. Tactical management information enables the allocation of capacity in such a way that the demand will be answered, keeping the performance at a high level. How will the available capacity be divided over the OC and EC and also how will the available capacity for this two departments be divided over the determined patient categories. In conclusion, the tactical management information can be used to deliver a good insight at the GIHDs performance, give a good expectation of the coming period and by which decisions making is possible.

4.6.3. How

For completing the first part of the tactical management information project, data gathering is important. Data must be obtained for the established patient categories. Given these gathered data, patient categories and the defined patient processes at the GIHD, the *input* for the tactical management information is given. With these information and knowledge, a *process* will be accomplished to define the forecasted demand. For this step, transitions probabilities and times are used for calculations, whereby historical data is used. Gathered information needs to be represented and discussed, the *output* of the tactical management information. These three steps (input, process and output) in the process are described below.

Data collection (input)

To accomplish the data collection part of the tactical management information, much data is required. Again, these data can be divided into the categories demand, supply and performance

indicators (table 14, 15 and 16). The data and information of the demand is important for either the OC and EC at the GIHD. The same applies to the supply. Of both departments, the current schedule and waiting list are evaluated and the expected demand is calculated (based on historical information). Beside this evaluation, the performance of the OC and EC are evaluated, which is used to forecast the following period.

Starting the forecasting for the demand in a certain period, first the current schedule and waiting list are studied. Second step in this forecasting process is adding the expected historic demand and also the expected demand which derives from consults or treatments/researches in the previous period. The expected amount of new referrals are added also, of which the data is derived out of the process information project. So it can be concluded that the waiting list and scheduled appointments must be combined with historical data and process information to provide a forecasting of the expected demand for a certain period.

Table 14: Required data for tactical management information, related to demand.

Information	Data	Period	Display / Aggregation	Source
Outpatient clinic				
Currently scheduled	Scheduled consults (incl. durations)	Next planning period	# of consults, divided into new, follow-up and telephonic consults (and if possible also in patient categories)	X-care
Current waiting list	Patients on the waiting list (including status and associated planning code)	Length of waiting list	# patient per patient category, whereby a selection can be made for a certain period	X-care Data managers system
Expected demand (derived from current schedule / waiting list)	Schedule consults	Previous periods	# per week (new, follow-up and telephonic) per category	X-care Data managers system
Expected demand (Derived from historical data)	Consult requests	Previous 2 years	# per week (new, follow-up and telephonic) per category	X-care Data managers system
Expected additions (follow-up)	Requests for follow-up consults, received from outpatient clinic consults / endoscopic researches/treatments	Previous 2 years	# per week, per category	X-care Data managers system

Endoscopic clinic				
Currently scheduled	Scheduled treatments/researches (incl. durations)	Next planning period	# of researches / treatments, divided into the different types (and if possible also in patient categories)	X-care Endosoft
Current waiting list	Patients on the waiting list (including status and associated planning code)	Length of waiting list	# patient per patient category, whereby a selection can be made for a certain period	X-care Data managers system Endosoft
Expected demand (derived from current schedule / waiting list)	Scheduled researches/treatments	Previous periods	# per week (per endoscopic type) per category	X-care Data managers system Endosoft
Expected demand (Derived from outpatient consults)	Historical requests for endoscopic researches/treatments (included emergency cases)	Previous 2 years	# per week (per endoscopic type) per category	X-care Data managers system Endosoft
Expected additions (follow-up)	Requests for researches/treatments received from Outpatient clinic consults	Previous 2 years	# per week, per category	X-care Data managers system Endosoft

For the data gathering of supply, there need to be defined what kind of information is relevant. Supply information is necessary to define the capacity of the GIHD. Therefore, the availability of personnel (different types) and its division over the two departments are important. This results in an amount of OC and EC hours, in which patients can be scheduled. So, the availability of EC and OC hours is limited and dependent of the amount of personnel hours. The allocation of personnel to the different departments for a certain period should be aligned with the demand in that period.

Through the use of performance data, the current and historical performance is provided. The current performance data gives an insight into the actual trends at the GIHD. When defining the capacity and allocation of it, the performance of the previous period have to be evaluated to decide if some changes are necessary to improve the performance. Beside the actual trend, an overall average performance overview can be given and evaluated (for a certain period). The forecasted performance is based on the same performance measures as used for the historical performance and both are displayed per week.

Take note: At the GIHD, some outliers in access and waiting times can occur. These long waiting or access times can be caused due to patient preferences, but also by follow-up consults which must take place after a long time. Also, the researches and treatments can take longer than expected. When this outliers are exceptions, these can be excluded as they obscure the required information.

Table 15: Required data for tactical management information, related to supply

Information	Data	Period	Display / Aggregation	Source
Available outpatient clinic hours	Planned clinic hours Available time for new patients, follow-up consults and telephonic consults	Next planning period	Per week	X-care
Available endoscopic clinic hours	Planned endoscopic clinic hours Available time for different types of endoscopic treatments/researches	Next planning period	Per week	X-care Endosoft
Available specialist capacity	Available specialist hours (total) Hours allocated to: • Other activities • EC • OC	Next planning period	Per week	Data manager systems
Availability of other personnel	Max. available consult rooms, treatment rooms, beds at the recovery room, available staff	Next planning period	Per week	

Table 16: Required data for tactical management information, related to performance

Information	Data	Period	Display / Aggregation	Source
Utilization (OC)	OC hours in planning Performed consults and (planned) duration	Previous quarter	Per week (for new, follow-up and telephonic consults)	X-care Data manager systems
Utilization (EC)	EC hours in planning Performed treatments/researches and (planned)	Previous quarter	Per week, per category	X-care Endosoft Data manager systems

	durations			
Access time	Difference between the consult request date and consult date (per patient)	Previous quarter	Per week (request date) for new and follow-up consults	X-care
Waiting time	Difference between the treatment/research request date and treatment/research execution date (per patient)	Previous quarter	Per week (request date), per category	X-care Endosoft Data manager system
Work in progress	The amount of opened DRGs	Previous quarter	# per week, per category	Data warehouse
Waiting list	Patients on waiting list (including diagnosis date). (Total waiting list and waiting list for OC and EC separately)	Previous quarter	# per week, per category, per waiting time	Data manager systems
Realization for the OC	# executed First patient visits	Previous quarter	# per week (current year), per category	X-care Data manager systems
Realization for the EC	# referrals (per type)	Previous quarter	# per week, current year, per category	X-care Endosoft Data manager systems

Calculation (process)

When we use a very basic patient process, four types of appointments can be scheduled: new patient consult, follow-up consult, telephonic consult and a research/treatment at the endoscopic clinic. For these types of appointments, the expected demand can be forecasted. For all this types of consults, information received out of previous projects in the tactical planning process is necessary. The categorization of patients is also advisable to make the forecasting more accurate because of more precise durations of consults, researches or treatments and also more precise transition probabilities and time.

First patient consults

The amount of first patient visits at the outpatient clinic can be found using the historic demand and the waiting list. Because the GIHD use coding for patients referrals, some request for first consults are placed on the waiting list. For the expected demand based on historical data, the codes which are

used for planning the referrals should be used. For the tactical planning at the GIHD it is useful to forecast the expected demand per week.

Follow-up consults

Follow-up consults are scheduled in different patient processes. First, a follow-up consult can take place after a first patient visit, but without any endoscopic research or treatment has taken place. Second, a follow-up consult can take place after an endoscopic research or treatment has taken place. A third reason to schedule a follow-up consult is for control patients which medical situation has to be monitored periodically. This type of follow-up consults are planned on longer term, through which they cannot be forecasted from current planning, they are placed on a waiting list. Each week a certain amount of these type of consults must be expected. Through this possible reasons for scheduling follow-up consults, the amount of first patient visits, amount of surgeries (and its transition probability to the OC), the expected additional consults (for control patients) and the historic demand has to be taken into account for calculating the expected number of follow-up consults.

Researches or treatments

Patients can be referred to the endoscopic clinic in four ways. First, a patient can be referred to the EC by their GP directly. By this type of referral a patient has not visited the outpatient clinic first. Discussing the results can take place during a follow-up consult, a telephonic consult or the results are send to the GP, who will discuss the results with the patients. The second type of referral for the EC is derived from consults at the OC. A GIHD can refer the patient to the EC for additional research or treatments. Discussing the results can take place scheduling a follow-up or telephonic consult. The third type of request for endoscopic treatments or researches is derived also from a referral by a GIHD doctor. A referral of a patient arrives at the GIHD. This referral then must be scored by a GIHD doctor. When it is thought that endoscopic research is necessary to diagnose the patients complaints, this patient is referred to the EC first, before visiting the OC. The last type of request for endoscopic researches or treatments arises from emergencies. A patient arrives with such severe symptoms that endoscopic research or treatments should take place as soon as possible.

Telephonic consult

After endoscopic researches or treatments, the results have to be discussed. Discussing the results can take place using a follow-up consult, sending the results to the GP who will discuss the results with the patient or by using a telephonic consults. In this case, the GIHD doctor explain the results to the patient by using telephone. These telephonic consults are also scheduled at the GIHD and

therefore the (expected) amount and the transition probabilities which arise out of the amount of endoscopic researches or treatments, must be taken into account.

Graphical overviews

Expected amounts of the different types of consults at the GIHD can be made visible. For example, excel can be used to obtain this graphical overviews.

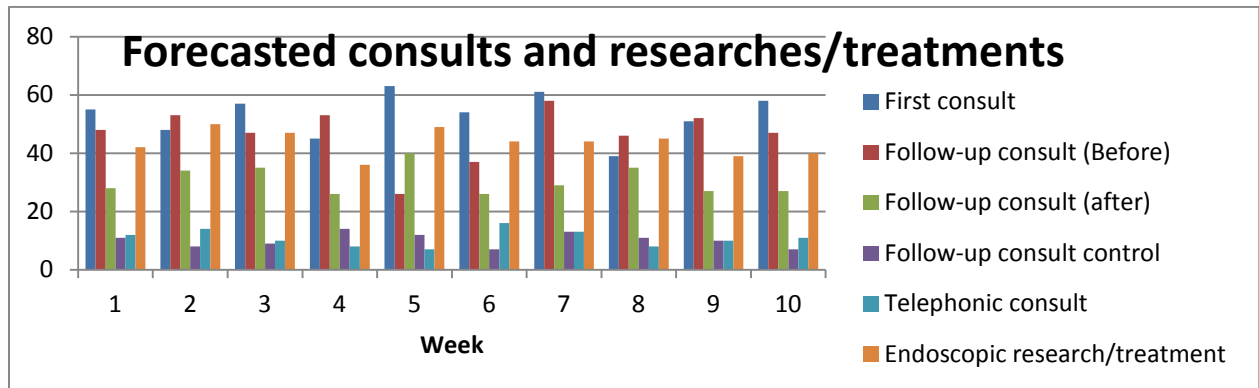


Figure 12: overview of forecasted amounts of the different types of consults at the GIHD

Figure 14 shows an overview of the amount of different types of consults. For this amount, randomly chosen numbers are used to generate this overview. In practice, the transition probabilities, historical demand and forecasting numbers should be taken into account, when calculating the expected amount of consults. Converting this number of consults to time, combining it with the available capacity for a certain week, the performance measures can be calculated.

Presentation (output)

In the tactical management information project, two types of managerial information can be identified for the performance, namely the past performance and the expected performance for the coming period. The output of the tactical management information is the visualization of the performance of the GIHD. Possible solutions are given in the following sections.

Utilization

Utilization can be calculated individually for the outpatient clinic and the endoscopic clinic, but also for the GIHD as a whole department. This is important because the capacity of GIHD doctors is divided over the OC and EC. For calculating the utilization, the available and used capacity are compared of the previous quarter (12 weeks). Using the available and used capacity, the gross utilization rate can be calculated using the following formulas:

For the Outpatient Clinic

$$\frac{\# \text{ of minutes for scheduled consults incl planned breaks between consults}}{\# \text{ of minutes planned outpatient clinic hours}}$$

For the Endoscopic Clinic

$$\frac{\# \text{ of minutes for scheduled endoscopic researches/treatments incl planned slack and overtime}}{\# \text{ of minutes available for endoscopic time}}$$

For the GIHD, as a whole department

$$\frac{\# \text{ of minutes for scheduled minutes at the GIHD incl planned breaks, slack and overtime}}{\# \text{ of minutes planned GIHD hours}}$$

Beside the utilization for an entire department, also the utilization can be calculated for specific consults, researches, treatments or for specific GI medical doctors. Utilization can also be calculated for the coming period, using forecasted numbers. Of these utilization calculations, an overview can be generated using excel (figure 15) Using graphs delivers good insight in the variations in utilization. Research can be executed to discover the cause of this variation.

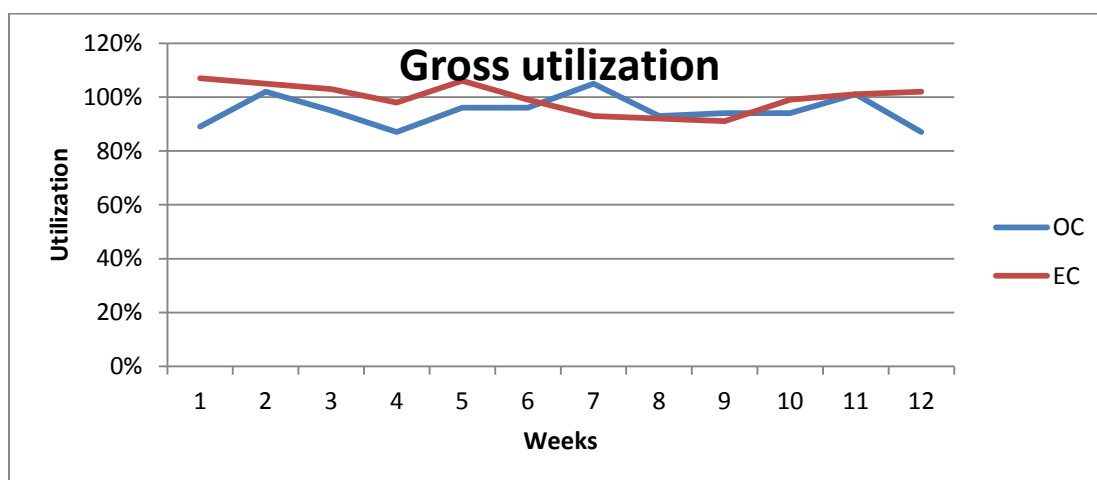


Figure 15: GIHD clinics presentation of Gross utilization rates

Access and waiting times

Another performance measurement is the access and waiting time. This must be calculated individually for the OC and the EC because they use separate waiting lists and criteria for access time at the GIHD. Again, these performance measure must be calculated for the previous quarter (past performance) and for the following quarter (expected performance). By displaying the access and waiting times in a graph, differences between the several weeks become clear. For the outpatient

clinic, there can be made a division for the different types of consults. For the endoscopic clinic, this division can be made for the different researches/treatments.

Work in progress

Work in progress within a hospital can be seen as the amount of patients in the system. Only the amount of patients does not say anything at all. Multiplying the amount of patients by the duration of the work in progress, made it possible to compare the WIP to the current allocated capacity. In this way, the capacity is compared to the expected demand, to see if some adjustments are required.

Realization

Comparing the actual realized production at the OC and EC to the planning of both clinics (and with the production target), performance can be observed and discussed. When the deviation of planning to the realized production is high, it can be decided that the way of planning have to be adjusted a little bit. The realization need to be calculated and displayed for the previous quarter. The expected realization can be calculated using the expected demand and supply and can also be displayed. Again, the realization is calculated per week, whereby the period of displaying is per quarter. In this graphs, the actual realization can be compared with the set targets (per week/per period/per year). Using this way of displaying, the deviation of the actual realization to the targets are made visible.

The formula to determine the realization can vary for the different clinics and also for the variables of interest. The realization rate for the OC, using first patient visits (EPBs) can be calculated with the following formula:

$$realization\ rate_{oc} = \frac{\# \text{ executed EPBs}}{\# \text{ of EPBs in agreement}}$$

4.6.4. Who

In the tactical management information project, the following actors are involved: First, the medical and business managers (of the RVE internal medicine) because they are responsible for the tactical planning at the GIHD and are also involved in the development of strategic planning. Second, employees of F&I and BPR because they have knowledge of gathering data and afterwards displaying this data in such a way that it become informative. Finally, the data manager of GIHD, someone of the planning office of the EC and someone of the secretariat of the OC need to be involved because they have a good insight in the actual production at the GIHD (and the specific departments).

4.6.5. When

This project can start immediately when starting to prepare the GIHD for implementing tactical planning. Data can be gathered during the entire process, but these data is turned into actual management information after the patient categorization is completed. In the initial stage of this

project, a system need to be developed through which required tactical information can be obtained out of the existing data systems of MST.

4.7. Pilot tactical planning

Finally, when all the previous projects are ended, a pilot can be started for tactical planning at the GIHD. First a description is given of this pilot, whereby again the questions what, why, how, who and when are answered. Afterwards, the pilot must be evaluated and revised.

4.7.1. Introduction

When implementing tactical capacity planning at the GIHD, the capacity will be allocated on intermediate term to elective patients. For organizing this tactical planning, we consider tactical planning meetings as required in which the demand and supply are aligned and the capacity will be allocated to the OC and the EC. This is made possible to the use of patient categories, process information and tactical management information. Tactical planning meetings take place on department level every two weeks and needs to be attended by specialists of the GIHD, chief EC and chief OC, the data manager and the business and medical managers of the RVE internal medicine. To make decisions based on the tactical management information, there is assumed that sufficient capacity is available.

4.7.2 Tactical capacity planning pilot

In this section, the pilot is described. Again, the questions what, why, how, who and when are answered what delivers a good picture of the execution of the pilot project and its necessity.

What

In the pilot project, tactical capacity planning is implemented in the actual planning method. Executing this pilot, the obtained tactical management information will be evaluated and the expected demand and supply are compared. In the end, capacity allocation decision are taken and the planning for the following period is determined. In this pilot, tactical capacity planning will be executed for a certain period, after which this period will be evaluated. During this evaluation can be decided whether the way of tactical capacity planning work for the GIHD, somewhat must be adjusted and whether everyone is excited to hit this way of working.

Executing a tactical capacity planning pilot at the GIHD is first concerned with the allocation of the capacity over the two clinics. Given the assigned capacity, the clinics can divide the capacity over the set patient categories. The division of the capacity can be altered each planning meeting (for both, the allocation of capacity over the two clinics as for the allocation of the assigned capacity of a clinic

over the set patient categories) and is dependent of the tactical management information, the expected demand and the expected supply.

Why

When implementing tactical planning at the GIHD, several systems have to be developed for obtaining the required data. Therefore, everyone have to be convinced of the efficacy of the tactical capacity planning model. In addition, there may be a lack of capacity of e.g. consultation rooms, specialists or nurses. This become clear by the execution of the pilot, this situation should be responded to before implementing all tactical capacity planning to the GIHD. Also, the shortcomings of the current tactical capacity planning model may be solved, so that the actual implemented version is better suited to the situation on the GIHD.

More detailed, the supply and demand have to be matched for either the OC and the EC, but also for the set patient categories at this clinics. This matching must occur on patient category level. Reallocation of the capacity can occur at the GIHD due to a shift in expected demand for a certain clinic, improving future performance or for the minimization of the access and waiting times.

How

As mentioned before, tactical planning meetings are organized for the tactical planning. This meetings are held on department level, whereby decisions are taken according to expected demand and supply and the division of capacity. Until tactical management information proves otherwise, it is assumed that sufficient capacity is available for tactical planning, whereby the GIHD performs well and scoring high on the chosen performance indicators. Before starting this pilot, some involved actors need to be instructed and/or trained to help them understand the tactical capacity planning process and how to execute it.

As said, tactical planning at the GIHD will be organized using tactical planning meetings. Preparing this planning meetings is important because both the past and expected performance need to be presented and discussed. Therefore, tactical management information is necessary and different capacity allocation scenarios must be pointed out. Performance must be improved/maximized given the expected demand and supply (maximum availability of specialists) at the GIHD in the coming period. Best solution of capacity allocation will be sought during this meetings.

Analysis and reallocation – outpatient clinic

Performance indicators are used to give a good insight in the performance of the outpatient clinic. For instance, the realization provides an insight if the planning and the actual production differ from one another. Though it is a performance indicator, the realized production is compared with the set

targets for e.g. first patient visits. Using realization, insight is delivered in the need for (additional) first patients visit consult slots. Combining this realization with the utilization, the cause of the problem can be identified: is the demand exceeding the set production targets or is there a capacity problem. When the realization is lacking, but the utilization is high, the capacity needs to be expanded. If there is overcapacity (low utilization, combined with a high realization), no more capacity is necessary at the GIHD, but the division of capacity must be organized in a different way.

Beside the realization, access time can also be used for insight in the performance of the outpatient clinic. Combining this access time with the utilization gives an insight in possible capacity problems (e.g. the ratio first to follow-up should be adjusted). When the access times are increasing, given a high utilization level, the capacity is not sufficient and needs to be increased. Otherwise, if the utilization is low and the access times are low or decreasing, the capacity also may be decreased.

Analysis and reallocation – endoscopic clinic

For the endoscopic clinic also performance indicators give a good insight in its performance. Waiting times can be used for the different patient categories. Increasing waiting times may indicate that the capacity should be increased. Different patient categories need to be studied, if the waiting times do not increase for all categories, the capacity allocation need to be organized in another way. categories of patients. If this is not true for all categories, there is a problem with capacity allocation on patient categories. The patient categories with increasing waiting times may receive more capacity from the patient categories of which the waiting times are decreasing.

Beside the realization, work in progress is also an important performance indicator. It shows the length of the waiting list per patient category. Increasing or decreasing waiting lists can influence the capacity allocation. Not only the length of the waiting list but also the waiting time of a certain patient is important. When there exist long waiting times, short term capacity expansion is required while a longer waiting list with shorter waiting times requires a larger portion of total capacity some weeks from now.

Next to work in progress and waiting times, realization is a good, longer term, performance measure. When work in progress and waiting times become critical for a specific patient category, the realization does not need immediately adjustment. It is important to take into account the realization numbers on larger scale, which can be done by temporarily allocating more capacity to one certain category.

Analysis and reallocation – integrated approach

Interrelation exist between the capacity allocation of the OC and the EC. When, divers patient categories taken into account, one clinic has a deficit in capacity, this can be caused by a surplus of capacity at the other clinic. Before deciding to temporarily expanding capacity at one of the clinics, both clinics need to be compared. Beside, the new patient visits can lead to requests for endoscopic researches or treatments, which in turn leads to more request for follow-up or telephonic consults. This interrelationship needs to be taken into account when judging and evaluating the performance and capacity allocation of both clinics.

Who

This pilot of tactical capacity planning is executed at the GIHD, at both clinics. Actors involved in this process are first the persons responsible for the tactical planning. This are the business manager and the medical manager of the RVE internal medicine. In addition, the chief OC and the chief EC are responsible for this tactical planning. Also, the data manager is involved in this pilot, because she has a good overview of the expected demand, supply and the capacity, through which it is advisable to involve her in the tactical management process. Beside the actors involved for the tactical planning, BPR can be involved, because of their knowledge of many improvement projects in the MST, they know how to gather data and transform this into management information. They can be made responsible for the eventual training of employees at the GIHD. Finally, also the employees at the GIHD are involved in this pilot. Execution of this pilot should be undertaken by this employees.

For the tactical planning meetings, preparation is the responsibility of the preparation need to be the business manager and medical manager of the RVE internal medicine in cooperation with an employee of care logistics or BPR. They deliver the patient category overviews, the performance overviews and the possible allocation scenarios.

When

After finishing the previous mentioned projects, the pilot can start. First, preparations are made, required actors must be involved and consultations and tactical planning meetings take place in which decisions are made. When the required strategic and tactical management information is available, the tactical capacity planning pilot can start.

Tactical planning meetings take place once every two weeks. Management information must be available of the past quarter (12 weeks) and the following period. Decisions made in this meetings can be changed until one week from now. Preparation of this meetings must take place shortly before the meeting to ensure the usage of up-to-date information.

4.7.4. Evaluation and revision

After the execution of the pilot, this pilot needs to be evaluated. Met problems need to be identified and discussed, so that there may be searched for a possible solution before tactical capacity planning becomes an integral part of the GIHD. Beside the met problems, the support of the employees at the GIHD is important, willingness of specialist needs to be evaluated after the pilot project as must be the collaboration. When necessary, personnel need to be trained further to improve the insight in the tactical planning process and its performance. But the main focus of the evaluation is the performance of the GIHD when using tactical capacity planning. Is the performance of the GIHD improved using this way of planning and does the performance differ for the outpatient and endoscopic clinic. If there are problems with the division of capacity, this can be caused by the unwillingness of specialties, but insufficient capacity may also be the cause of this problem.

Evaluation of the pilot project takes place after half a year. If there is insufficient prove, data and information available of the performance of the planning method, this pilot period will be extended by six months. After that period, evaluation takes place in which the implementation of this planning method will be discussed. During the evaluation, the actual and expected performance indicators need to be compared to decide if adjustment is required in the capacity allocation and the organization of the tactical planning.

Because the tactical planning is dependent on the tactical management information, there need to be ensured that this information is accurate and up-to-date. Tactical management information on its term is dependent on the process information and patient category characteristics. Therefore, this should be checked periodically (for instance per year), so that it is ensured that all the information is accurate and if necessary can be adjusted. For the endoscopic clinic, the durations of different treatment/researches need also to be adjusted when a new technology or protocol is introduced. This can influence the duration of the endoscopic treatments/researches which in its turn influence the amount of overtime and workload.

After this evaluation, there need to be decided if the tactical planning will be implemented at the GIHD. If the GIHD is performing well, using tactical planning and if there is enough support of the staff, implementation will be a fact. All needed adjustment need to be assessed and executed, so that the implementation can take place fluently and the problems encountered in the pilot have been resolved.

5. Conclusions and recommendations

In this chapter an overview of the conclusions and recommendations from our research will be explained. In section 5.1 the conclusions derived from executed research are given. In section 5.2 the recommendations are discussed, including the recommendations for further research in section 5.2.1

5.1. Conclusions

In our research we were interested in the demand driven tactical capacity planning for the GIHD of MST. Used research objective was to design a tactical conceptual planning model for the outpatient clinic and endoscopic clinic of the Gastrointestinal and Hepatology Department of MST and to determine the necessary steps for implementing this concept in the organization. The research was divided into different steps: the context analysis, a literature research and a design for a tactical capacity planning model. The executed context analysis and literature research both provide the input for designing a demand driven conceptual tactical capacity planning model and the recommendations for the GIHD. For each of the step in this research, a research question was set up with several sub questions. First, for each step this research question will be answered. The researched objective will be outlined in section 5.2.

Context analysis

In the context analysis we have tried to discover the current organization of the GIHDs planning. Because the objective of this research was to develop a (conceptual) demand driven tactical capacity planning model, the focus of this context analysis (and of the literature research) was at the specialists time and time available for the outpatient clinic and endoscopic clinic. These are critical resources at the GIHD, which generates demand for each other. Additional, the available consult and treatment rooms, supporting staff, inventory and other cases are mentioned in the context analysis. Tactical planning is concerned with the intermediate term planning of the GIHD, it is bounded by less planning rules than operational planning and therefore it is more flexible.

At the GIHD patients can be referred to the outpatient clinic or to the endoscopic clinic. These two clinics generates demand for the other clinic, so they are dependent: a temporarily increase in the amount of executed endoscopic researches or treatments is followed by an increase in the amount of telephonic consults or follow-up consults. This should be taken into account in the planning system.

The current planning system at the GIHD is mostly supply oriented, but not entirely. Given a certain amount of capacity for the OC and EC, patient requests are divided among this capacity. Patients on the waiting list must also be added in the schedule. In addition, working days of GI medical doctors at

the GIHD can be divided into two parts: one part they are working at the outpatient clinic, the other part they work at the endoscopic clinic. This does not apply for all GI medical doctors because the hired retired GI doctors are only working at the endoscopic clinic. Because this division of specialists capacity is fixed, the capacity division is not based on demand, but on supply. On the other hand, incoming referrals for the GIHD are scored by GI medical doctors for their urgency, through which it is determined within which period a patient needs to be seen at the GIHD. This method of scoring patients is an example of demand driven planning at the GIHD.

So, the current planning system at the GIHD is mostly supply oriented. To implement tactical capacity planning, the focus must change to demand. Capacity division should be based on demand, which means the developed planning model must be flexible. Handling the variability in supply and demand in a good way will lead to a high performance of the GIHD.

Literature research

In the literature research we tried to identify which tactical capacity planning concepts can be found in the literature which can be implemented at the GIHD of MST. For the literature research there is made a division for outpatient clinic and endoscopic clinic/operation room literature. The OC literature is mostly based on operational level, for individual patients. Performance of the discussed models is measured by using the indicators: queuing, throughput, utilization and overtime. The EC literature stated that patient scheduling only occur elective patients and in some articles the open access model is mentioned. Performance of the implemented model at the EC or OR can be measured using the indicators access time, throughput time, utilization, realization, efficient use of resources and a balanced workload. Discussed models are mostly mathematical and are providing 'one optimal solution'. In addition, not all the planning restrictions used at the GIHD can be included in this model, through which it is not advisable to use such a model. Integrated approach of the OC and EC (or of the OC and OR) is barely mentioned in literature. Integrated planning uses the probabilities of transitions through which the demand for the subsequent step can be calculated. Combining this with an example from practice, the tactical planning implemented at the ZGT, gives insights in how to design a tactical capacity planning model for the GIHD. At the ZGT, tactical planning meetings are used to organize the tactical planning. These meetings are based on tactical management information, which is used to make capacity allocation decisions. Using this meetings should be a starting point for the design of a model for the GIHD.

Design of a tactical planning approach for GIHD of MST

In the design phase of this research, there is thought about ways to develop, organize and implement a tactical capacity model at the GIHD of MST. A conceptual tactical capacity planning model which is demand driven, is developed in this chapter. The GIHD requires a model in which the capacity of GI medical doctors is divided among the different clinics, based on the specific demand. As mentioned before, tactical planning meetings must be used as a starting point. In this meetings the demand, supply and the performance are discussed. Given the tactical management information, decisions about the capacity allocation are taken. To implement such a model, several steps have to be undertaken, namely strategic planning, availability of process information, patient categorization, availability of tactical management information and a pilot tactical planning. These projects are described more in detail in the recommendations.

5.2. Recommendations

At the GIHD of MST, the planning of elective patients on intermediate term must be organized on tactical level. For the development of a tactical planning model, there is assumed that there is sufficient capacity at the GIHD, until proven otherwise. By comparing the (expected) demand and supply, and the performance of the department, decisions about the allocation of capacity are taken. To organize the tactical planning, planning meetings are organized in which the actual demand, supply and performance are discussed, the forecasted demand, supply and performance are given just as different capacity allocation scenarios. Required information for this meeting is delivered out of the tactical management information. Given this meetings, there need to be noticed that it is not realizable to make short-term changes in the nurse staff, which can lead to logistic problems while they are scheduled two months in advance. But these meetings can be used by the development of these schedules, for the discussion of met problems and for the discussion of the performance of the GIHD. Before implementing tactical planning into the planning system of the GIHD, first a pilot need to be undertaken, which have to be evaluated. After the evaluation, the model can be adjusted, employees can be trained (further) and support can be gained to entirely implement tactical capacity planning at the GIHD. Before starting the pilot, the following projects needs to be completed.

Strategic planning

Before starting the tactical planning, first the strategic planning should be clear. The choices made and goals set on strategic level determine the focus and the freedom of the tactical planning. Given the strategic choices made, the focus in the tension field between the managers, the patients and the personnel is determined. Examples of such strategic choices are the chosen case-mix, the working hours, the overtime policy or the organization of elective and acute care. Strategic goals which are set are the production targets, costs minimization, access and waiting times, throughput

times and the production realization. Involved actors in the strategic planning are the board of directors, the medical and business managers of all the RVEs within the hospital and also F&I and BPR employees. Information is required to make strategic choices and set strategic targets. This information is the same as used for the tactical management information, only a higher aggregation level is used. Setting up a system which retrieves automatically all required information should be advisable. Starting up this project can occur directly when there is chosen for implementing tactical planning.

Availability of process information

Process information is very important for the implementation of tactical planning at the GIHD. It needs to be clear to which department a patient is referred to, which possible steps can be identified in the patient process and which transition probabilities and times are associated with it. This information can be used for forecasting the expected amount of patients. This information should also be used in the next step in the process, the categorization of patients. Data for this patients normally derives from the software systems Data Warehouse (data derived from X-care) and Endosoft. Currently it is shown that this data is inconsistent. Therefore, first the software systems needs to be improved or a new software system needs to be developed. Otherwise, this process information can derive by taking a sample of patients and analyzing this or by following a group of patients during a certain period. Before, a query should be generated for gathering the data. When consistent data can be delivered, data of all patients in the last 2 years must be used. Involved in this project step are the specialist, the data manager and employees of F&I and BPR. This project is not dependent on other information, so it can start immediately.

Patient categorization

For implementing tactical planning at the GIHD, patient categorization should be advisable. Patients which process is logistically and medically similar are placed in the same category. DRG coding is used as a starting point for this categorization, which are medically recognizable. For the logistical similarity, consult and research/treatment durations can be used as also similar patient processes. Involved in this project are again the specialists, a data manager and the employees of F&I and BPR. A part of the project can start immediately (determining consult and research/treatment duration)The remainder of this project can start after finishing the process information project.

Availability of tactical management information

Another project which have to be completed for the implementation of tactical planning is the availability of tactical management information. Tactical management information is required for the tactical planning meeting in which the allocation of the capacity is decided upon. The information

consists of supply, demand and performance information of the past period, the expectance for the coming period and possible capacity allocation simulations. This information should be combined with the process information to determine on the allocation of capacity. Involved in this process are the medical and business manager of the RVE internal medicine, data manager of the GIHD and again employees of BPR and F&I are involved. This project can start immediately. Data gathering must be turned into actual management information at some specific point. Then, a system need to be developed through which required tactical information can be obtained out of the existing data systems of MST.

5.2.1. For further research

As mentioned before, two software systems are used at the GIHD: X-care and Endosoft. These systems are inconsistent, so no realistic view is obtained when studying this data. Therefore, the first recommendation is to integrate a hospital-wide software system into the MST, in which all required functions are included. By using only one system for all registrations, the inconsistency is annulated and derived data starts to be meaningful.

In this research, a conceptual tactical planning concept is defined, whereby the capacity allocation is based on the (past and) expected demand and the (past and) expected performance. Weekly capacity is divided among the days of the week, for each individual week again. For the implementation of such a system, process information and tactical management information is required. During this research, it became clear that the data derived from the Data Warehouse and the data derived from Endosoft are not consistent. This have to be research more in dept, because accurate data is a requirement for the implementation of tactical planning.

In our research, we have only taken in account the durations of planned consults, researches and treatments. Variables as overtime and waiting time for patients are not taken into account. It should be advisable to research this also, whereby sequencing is of interest. In which order must the possible consults be scheduled to reduce the patients waiting time and the overtime for the employees at the GIHD? Also some mathematical models can be researched further, as also the overbooking for no-shows and the usage of batches to schedule patients. This are also possible methods to implement tactical planning at the GIHD. These different methods can be compared for their performance.

To calculate the expected demand for a specific period, a deterministic way is used. Patient processes (and its numbers) deliver a certain expected demand pattern, which is used for the forecasting. It is advisable to research further on the demand forecasting, whereby possibly computer simulations can be used (including the stochastic nature of the patient processes).

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Interviews, conversations and observations

For the execution of this research, different interviews and conversations have taken place, of which important information has derived. With the following persons, conversations or interviews has taken place:

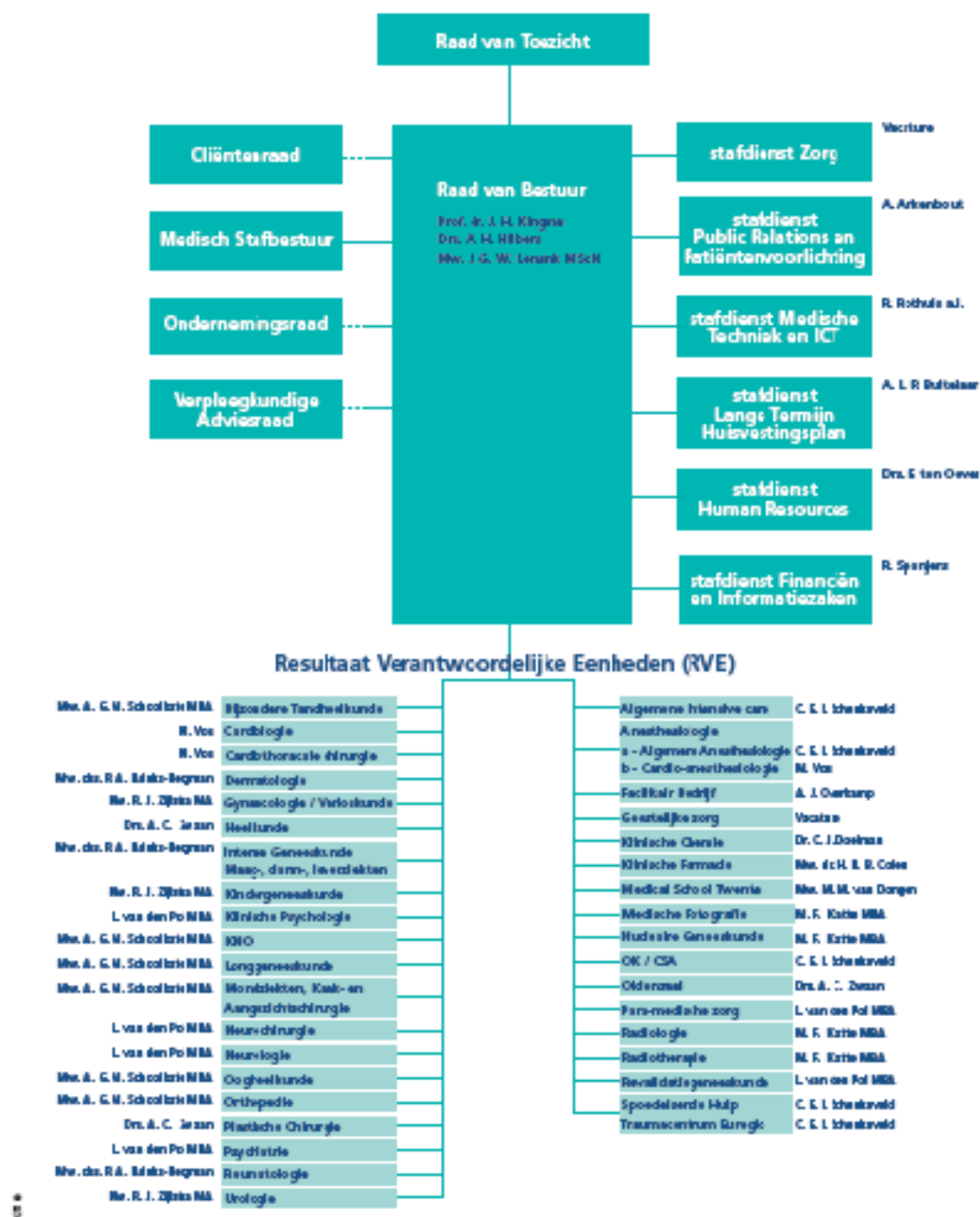
- Maureen Guichelaar, GI medical doctor – supervisor MST;
- Leslie Kroes, Quality Officer for Internal Medicine;
- Anita Westerhof, Data manager GIHD;
- Anne Scholten, (temporarily) data manager GIHD;
- Richelle Rijntjes, graduate BPR;
- Erwin Hans, Associate Professor Operations Management and Process Optimization in Healthcare - Supervisor UT;
- Marjolein van Swinderen – project employee HRM.

Beside this conversations, I have attended some care logistics lunch meetings

Appendices

- Appendix A: organizational chart MST
- Appendix B: Waiting times MST
- Appendix C: Logistic indicators
- Appendix D: Entities of planning
- Appendix E: Search strategy
- Appendix F: Abbreviations

Appendix A – Organizational Chart of MST



Appendix B – waiting times MST

Specialism	Waiting time Outpatient Clinic (weeks)		Waiting time treatment Endoscopic clinic (weeks)		Comments
	Location Enschede	Location Oldenzaal	Location Enschede	Location Oldenzaal	
GIHD	5	5			emergency <1 week
Gastroscopy			12	12	emergency <1 week
Coloscopy			12	12	emergency <1 week

Waiting times for the Gastrointestinal and Hepatology department, retrieved 19-6-2012

Appendix C: Logistic indicators

Demand

The following indicators are related to the demand side of planning:

- Expected volume
 - Elective or acute?
 - Production agreements
 - New patient consults
 - Follow-up consults and follow-up factor
 - Treatment/Research indications
 - No shows
 - Variance in volume requirements (per period)
- Consult and treatment/research duration

Expected volume

Elective or acute?

Capacity is required for the planning of patients. This planning must take into account both elective (patients that can be scheduled in advance) and acute patients (patients that need to be seen (almost) immediately).

For acute patients that require treatment/research, a subdivision is made in their urgency:

- Code 1: within 24 hours
- Code 2: within 72 hours
- Code 3: within 1 week

Patients can be categorized for planning purposes. Not all patients that are visiting the EC may require capacity in the OC and vice versa.

Production agreements

Agreements between the MST and health care insurers are a starting point in the determination of the expected required capacity. For the OC there are made some agreements which consists of the EPBs: the financial first outpatient consults.

New patient consults

The expected number of EPBs is not equal to the expected amount of new patients. Follow-up consults which take place after a year, are considered as an EPB. Another case is a patient who is

scheduled as a new patients, for a new complaint, which has visited the GIHD during that year. In that case the patient is not registered as an EPB.

Because different consult duration are used in planning, it is recommended to take the new patient consults into account (logistic instead of financial approach). The difference in capacity requirement can be evaluated using the following factor:

$$\text{new patient factor} = \frac{\# \text{ of new patients}}{\# \text{ of EPBs}}$$

Also, investigation in the number of new patient consults that is a real EPB and the amount of EPB visits that is a follow-up consult, would be useful.

At the GIHD the new patients can be divided into different groups:

- # of patients who visit only the outpatient clinic;
- # of patients who visit the outpatient clinic first and then the endoscopic clinic;
- # of patients who visit only the endoscopic clinic;
- # of patients who visit the endoscopic clinic and after that visit the outpatient clinic.

This distribution should be made to get a good picture of the patient flow that arises from all referrals. With given numbers forecasting the demand for capacity is more realistic.

Follow-up consults and follow-up factor

After a new patient consult patients may require follow-up consults. Also, a follow-up consult can be planned after treatment, possibly also before treatment, or after further diagnostic tests. For each EPB or new patient consult the follow-up factor can be determined:

$$\text{financial follow - up factor} = \frac{\# \text{ of fin. follow - up consults}}{\# \text{ of EPBs}}$$

$$\text{Logistic follow - up factor} = \frac{\# \text{ of log. follow - up consults}}{\# \text{ of new patient consults}}$$

The financial follow-up factor is used as a performance indicator of the (medical) patient process. The logistic follow-up factor can be seen as a process characteristics for planning purposes. The logistic follow-up factor determines the ratio of follow-up and new patient consults in planning. Using this logistic follow-up factor, more insight is provided and thereby more specific planning is possible.

Treatment/Research indications

A first step in determination of the required EC capacity is knowledge of the expected number of patients requiring treatment/research. This number can be determined per diagnosis type or patient category.

No shows

It can occur that a patient does not turn up at a planned consult, or turns up after the reserved time. This is called a no show (also: DNA rates (did not attend) (Bowers, Lyons, Mould, & Symonds, 2005). No shows put twice as much pressure at the planning office or secretary in comparison with a 'normal' consult because it requires capacity twice: once in the initial planning and then a second time for the replacement consult. Also they lower the utilization of capacity and increase variability in workload.

Variance in volume requirements (per period)

The demand can differ for various periods (e.g. per week or month). During holiday seasons for example, less people visit their GP. Due to this time trend, the average demand for first outpatient consults might be lower. For the determination of the required OC and EC capacity, insight in this variance is important. It might be useful to identify periods in which the demand is low, intermediate or high. According to these periods, the capacity can be adapted thereto.

Consult and treatment/research duration

At the GIHD, time is reserved for different types of consults. The consult duration differs for each type of consult or treatment/research. Determining the duration of these different types of consults is necessary to determine the required capacity. There also exists some variance in the realized consult duration.

Supply

The following indicators are related to the supply side of planning:

- Available time
 - For outpatient clinic (per period)
 - For endoscopic clinic (per period)
 - Of the specialist
 - Other activities during the week (study hours, administration time)
- Variance in availability
 - Holidays and maternity leave
 - Absence through illness

Available time

For outpatient clinic hours

To determine the available time at the OC, the amount of doctors and rooms are necessary.

For treatments or researches

The planning department of the EC decides on the allocation of time to the specific treatments or researches. The total EC capacity is limited by the availability of EC personnel (doctors and nurses).

Of the specialist

The doctors, AIOs and ANIOs at the OC are a critical resource in planning. Patients cannot be planned for a consult, research or treatment if the specialists are not available. In terms of operations management the specialists can be seen as the servers, with weekly “down time due to planned maintenance” (study hours, administration times, meeting), “unplanned down time” (absence through illness), and “predefined periods of low production” (holidays, maternity leave) (Rijntjes, 2011; Ozcan, 2009).

Other activities during the week (study hours, administration time)

Beside the time scheduled at the OC and EC, the doctors spend time for other activities such as study hours, administration time, ward rounds and meetings during the week. Administration is proportional to the time spend at the OC and EC. Study hours and meetings give absolute time requirements. These other activities during the week limit the left over capacity to schedule OC and EC hours. For the doctors at the GIHD, one day of their work week is scheduled as a clinical day. At this day they aren't scheduled for OC and EC hours, but they can finish their administration, study and can plan meetings. Two of the eight doctors are spending another day of their working week on other purposes than patient care (e.g. congress, writing an article, doing research).

Variance in availability

Holidays and maternity leave

The holidays and maternity leave are predefined periods of low production which must be considered in planning beforehand. More capacity is required during periods due to the periods of less capacity. Holidays and maternity leaves may also play a role in the periodic planning for realization. Same as for supply, periods of low intermediate and high production may be identified.

Absence through illness

Absence through illness is unplanned down time and can be seen as a temporary capacity reduction and therefore usually it is considered on the operational planning level. This need to be taken into account to determine the total available capacity for the planning (for the OC and the EC).

Appendix D – entities of planning

Demand:

Here, demand concerns the entire relationship between the quantity of a commodity that buyers wish to purchase per period of time, health care in this case, and the price of that commodity, the buyers income and preferences of the buyers .

Health is not a tradable good because it cannot be purchased directly. Therefore, the focus lies on the production of health and the demand for it by individuals, which may involve the purchase of goods such as health care. Indirectly health improvements are purchased. Therefore we can speak of a derived demand of health care, derived from the demand for health. This analysis is particularly true for health care because most of the health care is not in itself pleasurable, but it is simply undertaken to improve health.

In economic analysis, demand for health care will be distinguished in a want and an effective demand, whereby a want is the desire by someone to consume something, and effective demand is a want backed up by the willingness and ability to pay for it. Many people think that what matters in health care is not wants or demands, but needs. Need can be interpreted as the capacity to benefit from health care, so health improved by the utilization of health care. Need is far less precise as wants or demands wherefore we speak of wants and demands in the following section (Morris, Devlin & Parkin, 2007; Lipsey & Christal, 2007; Lapré, Rutten & Schut, 2006).

Supply

Here, supply concerns the whole relation between the quantity supplied of some commodity and its own price. The supplier is in this case the MST which is in the market to deliver services (health care) for the patients. Supply is a desired flow: it indicates not the amount of health care that actually is 'sold' to patients. Supply is the amount of health care that the MST is willing and capable to produce per period of time (Lipsey & Christal, 2007).

Planning horizon & hierarchy

Planning can be divided in the aforementioned types: strategic, tactical and offline and online operational. Each of these types of planning has its own planning horizon and the hierarchy for each type of planning differs. Here, planning horizon concerns the period in which the planning is of influence. With hierarchy we mean the person(s) responsible for the planning at the different levels of planning. For each level of planning different persons have the responsibility for this planning.

Decision conditions:

In a hospital, some conditions can occur wherefore decisions have to be taken. These conditions differ for the aforementioned types of planning.

- At strategic level the amount of available capacity have to be determined wherefore some conditions have to be applied.
- At tactical level the use of capacity have to be determined wherefore some conditions have to be applied.
- For operational level the use of capacity have to be made specific wherefore some conditions have to be applied.

Performance indicators:

Every planning function has its own performance criterion. Here, the performance indicators are measurable aspects of care which are indicative for quality, safety, efficiency and accessibility of care (MST [4], 2012).

Appendix E – search strategy

For the literature research, the Orchestra Bibliography was used for searching scientific information. This bibliography was retrieved on June 21th 2012 from <http://www.utwente.nl/choir/orchestra/>.

Literature included in this list is concerned with the operation research/ management science in the health care sector. Of all categories, the following were of interest:

- Admission planning
- Appointments and schedules
- Critical pathways
- Decision making, organizational
- Delivery of health care, integrated
- Diagnosis-related groups
- Equitable resource allocation
- Health facility size
- Health services accessibility
- Information management
- Models, organizational
- NA
- Operating rooms
- Outpatient clinics
- Total quality management
- Waiting lists

Based on their titles, articles were selected if they seem to be (possibly) interesting. Therefore, no exclusion criteria for publishing date was used. Not all interesting articles can be retrieved using scientific web databases or author websites.

Of retrieved, interesting articles, the snowball method was used to identify more interesting articles using references in the literature list. Especially the found literature reviews deliver more interesting articles. Beside, Richelle Rijntjes use a lot of articles which are also interesting for this research, because both executed researches are quite similar. Necessary information was extracted out of the selected articles. This information was then generated into an overview with which in the end, the literature research was executed.

Appendix F – Abbreviations

Abbreviation	Definition
BPR	Business Process Redesign
CHOIR	Centre for Healthcare Operations Improvement and Research
DOT	DRG on their way to transparency (in Dutch: “DBC’s op weg naar transparantie”)
DRG / DBC	Diagnosis Related Groups (in Dutch: “Diagnose Behandel Combinatie”)
EC	Endoscopic Clinic
EPB	First patient visit (in Dutch: “Eerste patient bezoek”)
ER	Emergency Room
GIHD	Gastrointestinal and Hepatology Department
HIA	Health Insurance Act
ICU	Intensive Care Unit
IT	Information Technology
KPI	Key Performance Indicator
MC	Medium Care
MST	Medisch Spectrum Twente
OC	Outpatient Clinic
OR	Operating Room
PACU	Post Anesthesia Care Unit
RVE	Result Responsible Unit (in Dutch: “Resultaat Verantwoordelijke Eenheid”)