FAKULTÄT FÜR !NFORMATIK
Faculty of Informatics

Impact of waiting times in health care

By the example of outpatient clinics and general practitioners

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Adviros
Assoc. Prof. Dr. Dipl.-Ing. Hilda TELLIOGLU

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Abstract

Our public health care system faces the challenges of rapidly ageing population, technological costly progress and an increasing demand for a consumer friendly health care system. Due to limited resources in public health care systems, this will present a new and major challenge to maintain the quality of health care as we know it. Part of the problem lies in the waiting times at the hospital or resident physicians. Several patients' surveys show that long waiting times are seen as one of the biggest problems in our health care system and are a psychological and physical burden for patients but also for health care professionals. Therefore, this master thesis aims to evaluate and analyse the emergence of waiting times and tries to find IT-based solutions to decrease them or their negative impact. Furthermore, the loss of GDP due to waiting and therefore not working patients is calculated.

The methodology within this master thesis bases on the grounded theory. The grounded theory can be understood as a general approach to analyse data. Due to a use of a mixture of methods and an interwoven process of sampling and generating results, generated results are not taken for granted but tested again and again against new material.

First, semi-structured expert interviews were used to get an impression of the problem space. Second, participant observation in combination with a quantitative patients' survey was used to get deep information concerning waiting times and waiting behaviour of patients. Finally, validation expert interviews were used to verify the results. The sample consists of four resident physicians (one paediatrician and three general practitioners) as well as a follow-up hospital ambulance. All in all 63 patients from resident physicians and 60 patients from the hospital ambulance took part in the survey.

The median waiting time in the waiting areas of the resident offices using appointment systems was 15 minutes, while the waiting times at physicians not using appointment systems was 50 minutes. These results show that using an appointment system is able to reduce the median waiting time a lot. The median waiting time in the hospital ambulance was 90 minutes although an appointment system was in place. This phenomenon shows that using an appointment system needs also organizational adaptions, so that the appointment system and the medical organization go along hand in hand.

Two solutions for reducing waiting times were analysed in detail: (1) visiting online doctors, (2) publishing waiting times. The majority of patients surveyed would like to see published waiting times and would also plan their visit according to this information. Approximately one half of the patients can imagine visiting their doctor online.

The extrapolated loss of GDP due to waiting times using the given example is € 2,2 bn. at hospital ambulances and € 800 mio. at general practitioners. The latter number could be reduced to € 540 mio., if all general practitioners used appointment systems.

The results show that there is plenty of potential for improvement when it comes to waiting times. Besides the reduction of waiting times due to an organizational redesign by using appointment systems, waiting times could also be moved to a more pleasant place by using online doctors or publishing waiting times. The study also showed that the loss of potential working power due to waiting times is a big factor and affects the economy a lot.

Kurzfassung

Dem österreichischen öffentlichen Gesundheitswesen stehen zukünftig neuartige und schwerwiegende Herausforderungen bevor. Neben der alternden Gesellschaft und neuen kostenintensiven Therapiemöglichkeiten, erwarten Patienten und Patientinnen zunehmend ein patientenfreundlicheres System. Da eine überproportionale Zunahme der Ressourcen im Gesundheitswesen auszuschließen ist, ist die Herausforderung den aktuellen Stand der medizinischen Versorgung beizubehalten, sehr groß. Ein symptomatisches Phänomen für dieses Problem bilden Wartezeiten im Spital oder bei der niedergelassenen Ärztin bzw. beim niedergelassenen Arzt. Umfragen haben gezeigt, dass zu lange Wartezeiten von Patienten und Patientinnen sehr häufig beanstandet werden und hier ein großer Wunsch nach Verbesserung besteht. Denn Wartezeiten erzeugen nicht nur psychologischen Stress für die Wartenden, sondern zeigen auch negative physische Begleiterscheinungen. Die vorliegende Diplomarbeit hat daher das Ziel, Wartezeiten und deren Entstehung zu analysieren und IT-basierte Verbesserungsvorschläge zur Reduktion von Wartezeiten zu liefern. Weiters wird der Verlust an Bruttoinlandsprodukt durch wartende und daher nicht arbeitende Personen berechnet.

Die Methodik dieser Diplomarbeit basiert auf dem Ansatz der „Grounded Theory“, welche als grundlegende Herangehensweise zu verstehen ist. Durch einen Mix aus verschiedenen Methoden entsteht ein iterativer Prozess, bei dem zunächst erzeugte Ergebnisse durch neue Resultate ständig hinterfragt werden. Als erster Schritt im Forschungsprozess wurden semi-strukturierte Experten- und Expertinneninterviews geführt, um einen Einblick in die Materie zu bekommen. Anschließend wurden teilnehmende Beobachtungen in Kombination mit einer quantitativen Patienten- und Patientinnenbefragung durchgeführt, um konkrete Erkenntnisse hinsichtlich Wartezeiten und Warteverhalten von Patienten und Patientinnen zu erhalten. In einem dritten Schritt wurden die Ergebnisse mit Experten bzw. Expertinnen im Zuge von Validierungs-Interviews diskutiert.

Insgesamt nahmen vier niedergelassene Ärztinnen und Ärzte (ein Kinderarzt und drei Allgemeinmediziner bzw. Allgemeinmedizinerinnen) an der Befragung teil. 60 Patienten und Patientinnen von niedergelassenen Ärzten und Ärztinnen sowie 63 Patienten und Patientinnen aus dem Spital nahmen an der Umfrage teil.

Der Median der Wartezeit bei niedergelassenen Ärztinnen und Ärzten mit Terminsystem betrug 15 Minuten, während die Wartezeit bei niedergelassenen Ärztinnen und Ärzten ohne Terminsystem 50 Minuten betrug. Diese Resultate zeigen, dass die Wartezeit bei Ärztinnen und Ärzten mit Terminsystem deutlich kürzer ist. Der Median der Wartezeit im Spital betrug 90 Minuten, obwohl ein Terminsystem implementiert war. Dies zeigt, dass die Implementierung eines Terminsystems auch eine organisatorische Anpassung mit sich bringen muss, damit Wartezeit reduziert werden kann.

Es wurden zwei konkrete IT-basierte Systeme zur Reduktion von Wartezeiten analysiert: (1) Besuch von Online-Ärzten und Ärztinnen und (2) die Veröffentlichung von Wartezeiten. Die Mehrheit der befragten Patientinnen und Patienten befürwortet die Veröffentlichung von Wartezeiten und würden ihren Besuch entsprechend danach planen. Ungefähr die Hälfte der Patientinnen und Patienten kann sich vorstellen, ihre Ärztin bzw. ihren Arzt online zu konsultieren. Die extrapolierte Berechnung des BIP-Verlusts (unter der gegebenen Stichprobe) ergibt einen Wert von € 2,2 Mrd. im Spital und € 800 Mio. bei Allgemeinmedizinerinnen und Allgemeinmedizinern. Die zweite Zahl könnte durch eine flächendeckende Einführung von Terminsystemen auf € 540 Mio. gesenkt werden.

Die Resultate dieser Diplomarbeit zeigen, dass Potential in der Verbesserung von Wartezeiten liegt. Neben der Reduktion der Wartezeiten durch die Verwendung von Terminsystemen und damit einhergehender organisatorischer Neuorganisation, kann das Warten an sich durch den Besuch von „Online-Ärzten bzw. Ärztinnen“ in eine angenehmere Umgebung verschoben werden. Weiters konnte der erhebliche Verlust an BIP durch wartende und nicht arbeitende Personen aufgezeigt werden.

Content

1 Introduction

Due to demographic trends (fewer births – ageing population) and technological progress, the population is ageing rapidly and the number of persons requiring health care services rises continuously [1, 2].

Furthermore, a new kind of consumer, who demands service quality and patient centred care, enters the health care sector [3-5]. Because of this shift of paradigms, the focus of health care in many western societies moves from a paternalistic approach to the needs of the patient including the creation of a more patient-friendly environment [6]. This gets also visible by looking at the strategy of the US-Institute of Medicine for a new health system for the 21st century. Besides safety, effectiveness, timeliness, efficiency and equity, it names patient-centeredness as one of the six aims for increase general health care quality [7].

The current Austrian government program states too, that the needs of patients have to be in the centre of health care services [8].

The Austrian healthcare system is, according to a number of national and international organizations such as the Statistik Austria or the OECD, in many categories one of the leading healthcare systems compared to other European countries. On the one hand 7.7 hospital beds and 4.75 doctors per 1,000 inhabitants as well as a life expectancy of 80 years paint a favourable picture of a high quality healthcare system [9]. But looking at the number of healthy life years (60 years) [10] and the health expenditure of 10.8% [11], the Austrian healthcare system is in the midfield of the European Union.

A survey from 2012 on behalf of the Federation of Austrian Social Insurance Institutions (Hauptverband der Sozialversicherungsträger) shows that 85% of the Austrian population are satisfied with the healthcare system [12]. However, surveys in other countries showed that the outcome of such questionnaires is influenced by the question and its wording very much. For instance, two separate studies, which are supposed to examine the satisfaction with the German healthcare system, came to different results. While the questionnaire from the Robert Koch Institut says that 87% of the Germans are satisfied with their healthcare system [13], a questionnaire from Forsa shows a satisfaction of only 50% [14]. As the results of such surveys differ that much, no general statement to the actual satisfaction can be made.

Nevertheless, taking a closer look at the surveys, most of them show potential for improvement concerning waiting times in hospitals and at resident doctors:

> "The main critiques are still the waiting times and a two-tier healthcare system"
>
> [15]

„The biggest needs for improvement are the reduction of waiting times, a concentration on health instead of illness and strengthen the patient orientation."

[16]

There are two kinds of waiting times within health science. On the one hand there is the waiting time for medical treatment, diagnostic procedure (like MRT), surgeries or transplantation of organs and other tissues. On the other hand there are waiting times in waiting rooms of doctors' offices or hospitals. Although both issues are important and currently topic of public discussions [17-19], only the latter will be part of this thesis.

Waiting times in outpatient clinics and at general practitioners occur temporarily and regional differently and depend on the type of organization and its internal processes. For instance, patients at the general practitioner often need acute care and don't have the possibility to arrange an appointment in advance. In contrast in most cases it is mandatory to arrange an appointment before seeing a specialist. In hospitals acute cases are usually treated in the emergency department, while the other departments use appointment systems.

Waiting times are not only an issue in the health care sector, but also a phenomenon occurring in different areas of life: e.g. in the shopping area or any kind of governmental course. Probably one of the most unpleasant areas where waiting times occur is the health care sector. Therefore waiting times in hospitals and outpatient clinics have been topic of interest for several scientific works in the last decades [20-24].

The *Australian Press Ganey 2005 health care satisfaction report* states waiting times within the waiting room, at the registration process as well as at the design of waiting area itself concerning arrangement and furnishing, as one of the key factors for patient satisfaction [25]. Dansky and Miles even state, that the waiting time for seeing a clinician is the most significant predictor for patient satisfaction [23]. Taylor analyses that during the waiting time two kind of psychological and physiological responses are shown: (1) uncertainty including annoyance, irritability, stress and (2) anger [26]. Becker claims that the frustrating part of waiting times in general is that there is no control over how long the wait will be [22]. From the perspective of the patient it is incomprehensible, why long waiting times occur, whereas the medical treatment or the dialog with the doctor only takes a few minutes [21].

It can therefore be concluded that waiting times are a psychological burden and influence our health condition negatively, what leads us to the paradox situation that waiting for health care services influences our health negatively.

Waiting times are not only a quality characteristic and a distinguishing feature in a marked based healthcare system, but can also be a competitive advantage for healthcare providers with short waiting times. Because of that a few strategies to shorten waiting times already exist. In the United States for example hospitals are trying to attract more patients with non-medical

services due to a struggle for patients. The *Jersey City Medical Centre* advertises with its short waiting times [27]. Another service is *InQuicker* (https://inquicker.com/), which is an outsourced online self-scheduling tool for hospitals. With this tool patients can select an appointment by themselves via internet and make sure they don't have to wait for a long time at the hospital.

In Austria the public health care market is not that embattled. However, the system *mednanny.com* offers the same kind of functionality that *InQuicker* offers for the Austrian resident physicians. It is mostly used for appointments for treatments for the private health care sector. Both, the American and the Austrian online system try to decrease waiting times and increase perceived quality by following the idea of giving the patient information concerning the next available and nearest physician or hospital.

But also in government based healthcare systems, long waiting times are seen negatively. The government of the state of Saskatchewan in Canada publishes survey results on the satisfaction with the waiting times in specific institutions in the course of its program to increase quality in healthcare [28]. It is expected that patients try to find institutions with less waiting time if they have the possibility to do so.

As shown, waiting times have effects on different levels. First, on the level of patients, short waiting times are, due to psychologically and physically burdens, an indication of quality. Second, on the level of the health care system, short waiting times can be a competitive advantage for healthcare providers. And also on the third level, the level of society/state, short waiting times can contribute to a more effective system. Patients, but also persons accompanying them, waiting in a waiting room, lose time. Time, they can use either to get well, to have more spare time or to go to work.

This master theses analysis the impact of waiting times on all three levels. The situation of the patients will be shown, strategies to reduce waiting times will presented and the loss of potential working power due to long waiting times will be calculated.

After this introduction and the presentation of the objectives, chapter 2 "Related work" provides an overview of the current state of research. Therefore the available scientific literature is divided into several parts: In a general part, queueing theory and a definition of waiting time are presented. In a second part the general theory of waiting times is applied to the health care sector and a deeper look into waiting times at miscellaneous health care facilities is taken. Third, a brief summary of the scientific work concerning the evaluation of processes in health care institutions is given. The fourth part sums up the current state of research concerning the impact of waiting times on patient satisfaction, which plays a crucial role when it comes to waiting times. After that, scientific work dealing with the loss of working time due to waiting is provided. Besides the health care sector, the phenomenon of traffic jams is analysed there. The final part of the chapter "Related work" takes a look on how validity of interviews and surveys can be measured and ascertained.

Chapter 3 "Methodology and approach" gives detail information about the methodology used in this thesis. First, the grounded theory is presented. This theory represents the general

approach or general style of the methods used in this thesis. After that, the methods of qualitative and quantitative data collection including their field of application within this thesis are shown. The grounded theory allows using both research approaches for their specific purpose. Due to the combination of them more comprehensive results can be found. Finally this chapter deals with the calculation of quantifying waiting times.

The "Results"-chapter presents the results of the thesis straightforward. The results of the qualitative expert interviews and the validation interviews are shown by providing s set of the most important quotes. The results of the questionnaire are mostly presented by showing statistics.

Within chapter 5 "Analysis and discussion" the results are grouped according to their relevance for specific objectives. It provides answers using a combination of the results from the qualitative interviews as well as the questionnaire and related work from current state of research.

Chapter 6 "Conclusion" sums up the main findings clustered by the objectives. Finally chapter 7 "Limitation and further research" shows the limitation of the present study and gives suggestions for further research.

1.1 Objectives

Waiting times are often stated as necessary to decrease idle time of physicians which is wasted time in the eye of the physician. This leads to the claim that the physician's time is more important and more worthy than the patient's time [21]. A study calculated physician's and patient's time and came to the result that the consultant's time was 37.5 times more valuable than patients' time. The different rating of time and its value leads more and more to incomprehension, especially for those whose time is lower rated.

To date, waiting times have been subject to little public attention in Austria. There may be internal evaluations about waiting times in certain institutions, but there is no coordinated national initiative so far. A questionnaire published in 2009 showed, that the average waiting time at the general practitioner is 34 minutes and at the specialist 28 minutes [29]. The question, if appointment systems lower waiting times was not part of the study.

There is no scientific study which tries to examine waiting times from an inter-institutional perspective in Austria. But as the minister of health lately tried to get momentum within this certain field [30], and waiting times are mentioned within the current healthcare reform paper [31] waiting times might get more (scientific) attention in near future.

This master thesis aims to evaluate and analyse waiting times on an organizational and structural level and tries to find solutions to decrease waiting times as they have negative impact on mind and body [21], support infections [32] and are a financial burden for patients, clinics and the Austrian healthcare and economy system in general [27].

Certain scientific questions are grouped concerning their issue and are partially independent and partially depended on each other:

1.1.1 Process oriented evaluation of the origin of waiting times

The first question concentrates on the origin of waiting times. It examines the reasons for waiting times and analyses processes at resident physicians and at hospital ambulances.

Within the scientific literature there are several explanations for the emergence of waiting times. A study from Norman Bailey says that long waiting times are intended to prevent possible idle status [21]. Another study says that the incalculable medical everyday life, for instance a call from another institution concerning a patient, leads to longer waiting times [33]. Within the first question those explanations are topics to be discussed:

1. **What are the reasons and causes of waiting times in outpatient clinics and at general practitioners?**

Due to the incomparable structures of resident doctors and hospitals, both areas are evaluated separately.

1.1.2 Evaluation of duration of waiting times

This issue of the evaluation of the duration of waiting times contains three questions and concentrates on the concrete length and perception of waiting times at hospital ambulances and resident physicians.

2. **How long is the average waiting time for patients**
    a. **at resident physicians?**
    b. **in hospital ambulances?**
3. **How are waiting times perceived?**
4. **Are there, from the patient's view, any convincible improvements to decrease the burden of waiting times and make waiting more comfortable?**

1.1.3 Electronic appointment systems

Within the third package electronic appointment systems and their impact on waiting times will be analysed. It examines whether waiting times are shorter if the institution uses an organisational and technical well implemented appointment system.

5. **Are there differences in waiting times at institutions with and without electronic appointment systems?**

1.1.4 Solutions for reducing waiting times

The fourth issue tries to find (IT-based) solutions to reduce waiting times. A special focus should be given to online solutions as a new kind of communication strategy.

6. **Which – IT-based – solutions can be found to decrease waiting times and also represent a viable and realistic solution?**

1.1.5 Loss of gross domestic product

Using the extrapolated nationwide waiting time from data from previous questions, the loss of national added value (GDP) due to waiting times will be calculated.

7. **Based on data for waiting times, what is the loss of national added value due to waiting times?**

   The calculation will be based on the assumption that a certain percentage of the patients would be able to work instead of sitting in the waiting room [21].

8. **How much national added value could be generated from using electronic appointment solutions that decrease waiting times?**

Both questions deliver an approximate numerical result, which represents the loss of GDP due to waiting times and the increase of GDP due to a nationwide usage of appointment systems. Due to the small data that can be generated within a master thesis, the numerical result can only be understood as an approximation and does not purport to be exact.

2 Related work

There have been little scientific investigations on the topic of waiting times in the health care sector in Austria. But there have been international initiatives to analyse this field of interest. Those will be summarized within this chapter. In the matter of this master thesis general literature about the queueing theory is relevant as well as specific literature about waiting times in healthcare.

2.1 Definition of queueing and waiting time

The basic principle of the queueing theory is that customers on the one hand consume a specific service at any time in any quantity (arrival rate). The supplier, on the other hand, offers a service to the customer at a specific time in a specific quantity (service rate). If there are more customers asking for service than suppliers can supply, a queue occurs (service rate < arrival rate) [34]. This means, e.g. for traffic jams that the road capacity is smaller than the demanded space for cars. Individual incidents are then able to cause a cascade of effects ("butterfly effects") and finally a traffic jam. To work with jams scientifically, cars are often replaced by supercooled fluid. Nevertheless, the theoretical models correspond quite poor to the observed traffic flows which foster the use of empirical models.

Looking at the economy theories concerning queues, there are two ways to allocate resources: First, by pricing (ability to buy), and second, by queueing (first come first serve). A traffic jam is an example for the latter. Instead of making roads bigger and bigger to avoid traffic jams, governments try to price the road and get people into public transportation systems. An interesting phenomenon is that the more roadways exist, the more the numbers of vehicle-kilometres will increase. This phenomenon is called supply-induced demand.

There are several negative impacts of traffic jams which can be assigned to any other queues:

- Wasting time: increase non-productive activity for most people in the jam
- Delays: late arrival of employers, missing of appointments, meetings etc.
- Stressed and frustrated people
- Traffic jam blocks traffic for emergencies
- Spillover effect: instead of using main roads, "smaller" and side streets are used

Especially the wasted time including a delay and late arrivals for employers becomes a big problem. An US-American commuter spends 38 hours in traffic jams in average per year. In cities such as LA or Washington DC people spend more than 60 hours in traffic jams in average per year [35]. This numbers show, how important a scientific look on queues is; not only to see the impact and implications on society and economy, but also to help to reduce and minimalize those "lost" waiting times.

Agner Krarup Erlang designed the first theory of queueing systems, that is still valid [36]. Originally created for the distribution of telephone lines, the theory was developed and applied

to other business areas. Based on the theory of these findings, David George Kendall created a generally valid queueing notation [37]. In this master thesis an adopted notation for the healthcare will be used [21, 37, 38]:

- **Input-Process**: Within healthcare environment, patients represent the input process. The input process follows a Poisson distribution.
- **Queue-discipline**: The common known queueing methods are FIFO, LIFO, SJN, SRFT and PS[1]. Within the healthcare sector the queueing discipline (or the sequence of patients) is based on several factors. For instance the severity of the injury or whether the patient made an appointment in advance. Furthermore, medical processes can run parallel.
- **Service mechanism/Consultation times**: This factor shows the temporal duration of a certain service. For instance, the administrative registration or the medical consultations. It is assumed that the durations are independent.
- **Number of services:** Number of parallel running service paths. In the health care sector this could be parallel treatment rooms within a hospital.
- **Number of places**: Maximal number of patients in the waiting room.
- **Calling population**: Represents the number of all possible patients.

Queues can be characterized by three kind of categories: (1) server which represents the number of services, (2) phase which represents the process chain and (3) line which characterises the waiting line [34]. Figure 1 visualizes different kinds of queueing systems.

[1] FIFO (first in, first out): Customers who waits the longest is served first.
LIFO (last in, first out): Customer who waits the shortest is served first.
PS (process sharing): capacity is shared equally.
SJN (shortest job first): The customer with the smallest processing requirement is served first.
SRTF (shortest time remaining): The customer with the smallest processing requirement remaining is served first.

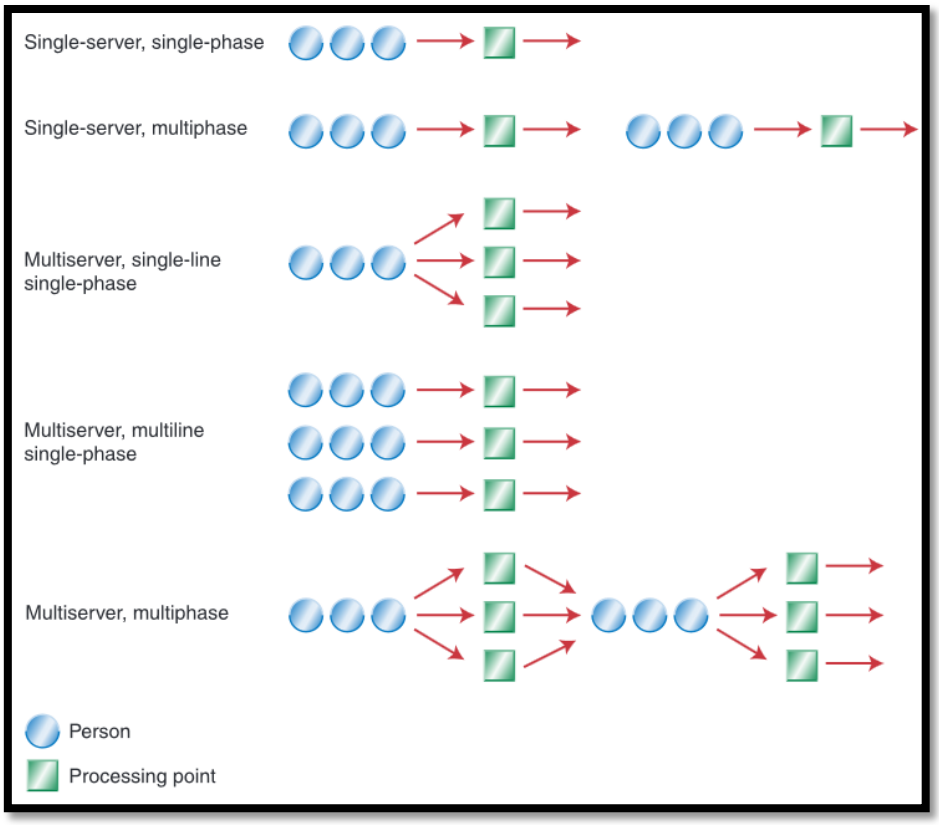

Figure 1: Categorization of queueing systems [34]

Within this work, only single-phase queues are considered to reduce the complexity and get valid results. Two kinds of queues are involved: First, single-line, multi-server, single-phase queues are used in hospitals, where several treatment rooms are available. It is imaginable that a hospital provides also a multi-phase queue as a patient for example passes several stations such as X-rays, treatment rooms and plaster room. This process will not be covered within this work. Single-server, single-phase queues are used within the residential area where one physician takes care of his or her patients.

2.2 Waiting times in health care

A peculiarity of the waiting times in healthcare is that the customer (patient) can change the service provider, unlike to other industries, only under considerable expense. The customer has in general no access to information about waiting times at other healthcare providers when he or she goes to the hospital. Especially in hospitals and clinics, it can be psychologically difficult to change the physician, once a patient is in treatment or alternatives to change the service provider (which means to go to the next hospital) are not available. Even the change of the family doctor is associated with effort as, for instance, the new doctor doesn't have access to necessary historical health care data.

Norman and Bailey took a closer look on the waiting times and the appointment systems at out-patient clinics based on data from the Nuffield Provincial Hospital [21]. Due to the use of mathematical models, they examined a series of 50 hypothetical clinics, each with 25 patients. Figure 1 shows that the best appointment interval is between five and five and a half minutes as the average waiting time and the consultant's time wasted is about seven to eight minutes.

However, they also showed that the increase of patient's waiting time clearly decreases the consultant's average wasted time. When patients wait about 17 minutes, the consultant's wasted idle time is reduced between one to two minutes.

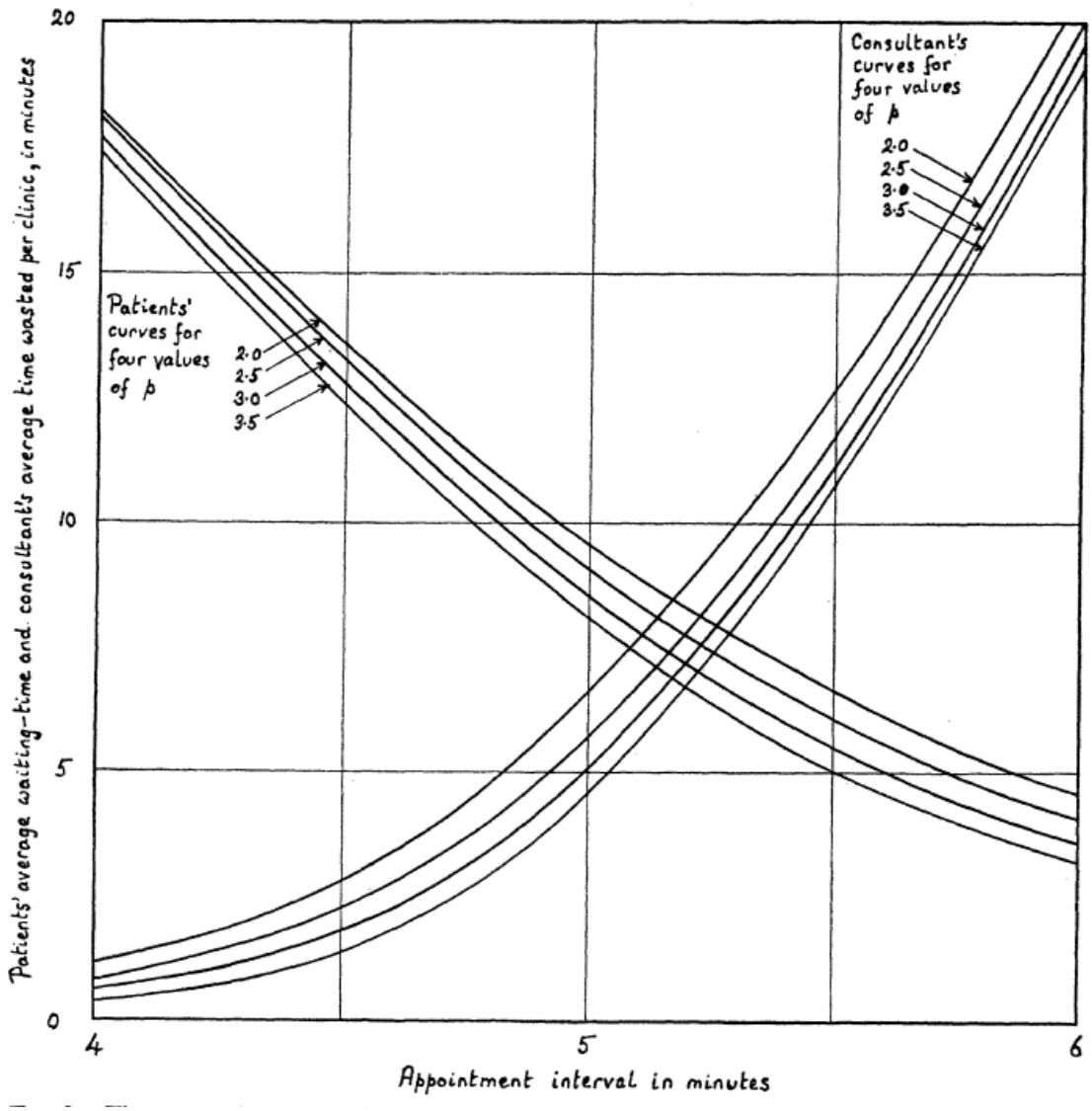

Figure 2: Contrast of appointment intervals, patients average waiting time and consultant's average idle time [21] (p is a mathematical parameter which shows the intrinsic measure of the shape of the curve)

Furthermore, they showed that the waiting times of patients have a positive skew. Figure 3 shows that within the mentioned study 30% of the patients were waiting up to five minutes, 25% between five and ten minutes, 15% between ten and 15 minutes, 12% had no waiting times and the rest more than 15 minutes.

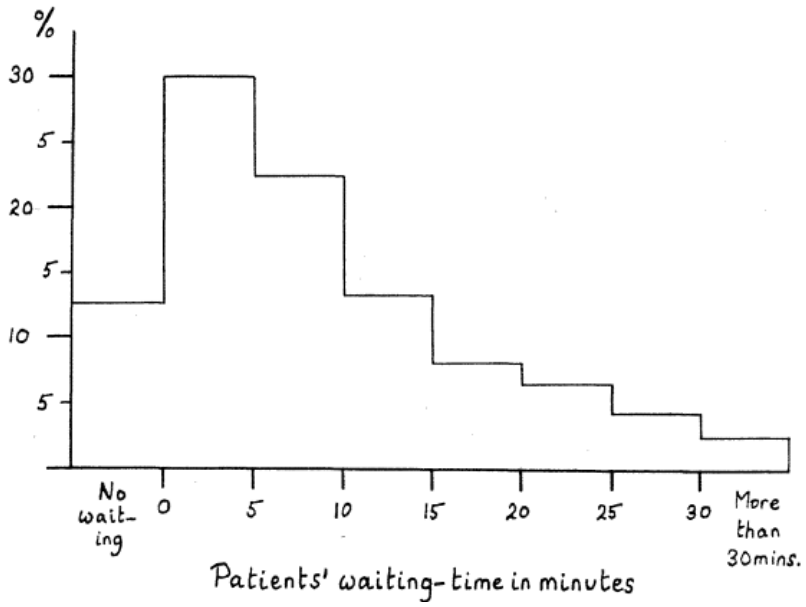

Figure 3: Average waiting times of patients [21]

They concluded that a suitable appointment system decreases waiting times without increasing idle time for the physicians. The optimum system is where the appointments at regular intervals are equal to the average consultation time and the arrival of the physician is at the same time as the second patient.

In comparison to the work of Norman and Bailey, this master thesis is based on data observed within the hospital and resident physicians' offices. This approach gives a more realistic picture of the waiting situation, but also lacks sufficient number of cases to provide generally valid results.

Miceli and Wolosin found out, that longer waiting times correlate negatively with satisfaction with health care services [24]. But they also showed that good communication and a strong relationship between the health care provider and the patient is able to reduce those negative effects. Due to these findings, the topic of transparency and publishing of waiting times including the origin of waiting times play a crucial role within this thesis.

To analyse waiting times and the causes of waiting times within the health care sector, it is necessary to have a theoretical fundament. Therefore, Becker and Douglass categorize the waiting process in an ambulatory waiting room into three steps [22]:

1. Pre-process: arrival time of the patient till the patient is taken into the exam room
2. In-process: time between entering and leaving the exam room
3. Post-process: remaining time from leaving the exam room till exit the building.

Within this thesis those categories will be modified to reach the objectives as follows:

1. Administrative waiting: waiting time at the administrative desk
2. Waiting time: waiting time at the waiting area (the sum of the "administrative waiting" and the "waiting time" is equal to the "Pre-process" category)
3. Duration of treatment: starts when the patient enters the exam room and stops when the patient leaves the exam room; equivalent to "In-process")

A major topic when it comes to waiting times is the patient's adherence to schedules. The Hartmannbund, an association of physicians in Germany, published results of a survey which aims to check the adherence to schedules of patients [39]. More than 7,000 questionnaires were sent out to physicians via email and fax. They subjectively estimated the number of patients who were not coming to their appointment. Within an appointment system those "non patients" can create idle time, which is very costly for the physicians. In sum 532 physicians answered the survey. They said that one in ten appointments at the general practitioner and one in seven appointments at specialist are missed without notification. However, this study illustrates subjective opinions from concerned physicians and does not cover a representative sample.

2.2.1 Perception of waiting times in health care facilities

The perception of the waiting times plays a crucial role within this thesis. There has only been little research about the correlation of waiting times, perceived waiting times and attractiveness of the waiting area. De Man et al. showed that the perceived waiting time correlates with the perception of the service quality in nuclear medicine [40]. He concludes that waiting time was overestimated as the perceived waiting time was higher than the actual waiting time. On the contrary, the time inside the exam room was underestimated. Furthermore, he found out that providing information about the reasons for the waiting times reduces the gap between perceived waiting time and actual waiting time.

Arneil and Devlin confirm de Man's results and detected a relationship between quality of care, perceived waiting times, anxiety, staff-patient interaction and attractiveness of the physical setting for patients in an out-patient facility [20].

Finally, Becker and Douglass studied the difference between perceived and actual waiting time in urgent care departments [22]. Figure 4 shows that, within the study, patients tend to overestimate shorter waiting times and underestimate longer waiting times. 23% of the patients thought, that they waited 0-5 minutes. In fact only 15% of the patients waited 0-5 minutes. On the contrary, 11% of the patients thought they waited over 30 minutes. Actually, 25% of the patients waited over 30 minutes. Furthermore, they found out that in more attractive environments patients perceived a larger difference between actual and perceived times.

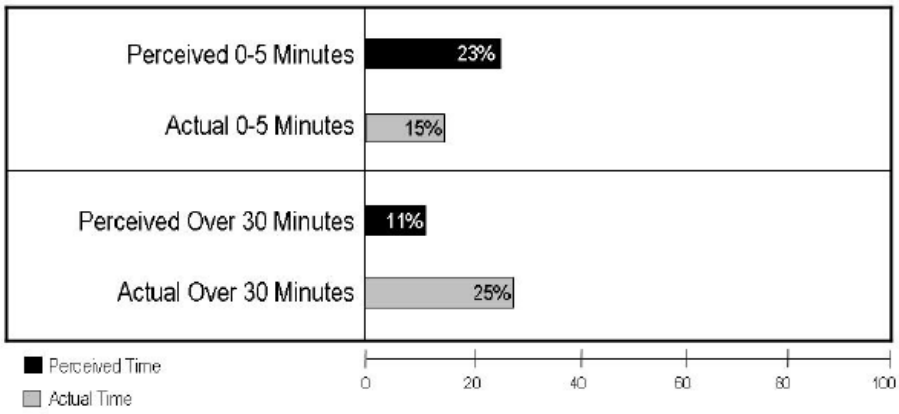

Figure 4: Actual vs. perceived time in waiting areas [22]

This thesis takes up this point within the questionnaire (see chapter "Evaluation of duration of waiting times" on page 14) by asking the waiting patients how the waiting times within the certain institution in general are perceived (answers are: "long", "ok" and "short"), but also by asking how one feels about the waiting time (possible answers are: "comfortable", "neutral" and "uncomfortable"). This distinction enables to search for a correlation between those two factors.

2.2.2 Waiting times at resident physicians

A 2009 published survey showed that the average waiting time at general practitioners in Austria is 34 minutes and at specialists 28 minutes [29]. Fischer and colleagues asked 4,000 Austrian citizens over the age of 14 about the supply of health care services from resident physicians. Fischer showed, that within the Austrian health care system, patients tend to visit doctors quite often compared to other countries [29] which concerns waiting times at waiting areas but also for an appointment dramatically. Waiting times for an appointment, especially for specialists, are an indication for over- and undersupply of health care services. According to the study, long waiting times for an appointment indicates an undersupply and short waiting times for an appointment indicates an oversupply [29]. Fischer examined waiting times for an appointment at specialists in Austria divided into federal states (Bundesländer) as is shown in Figure 5.

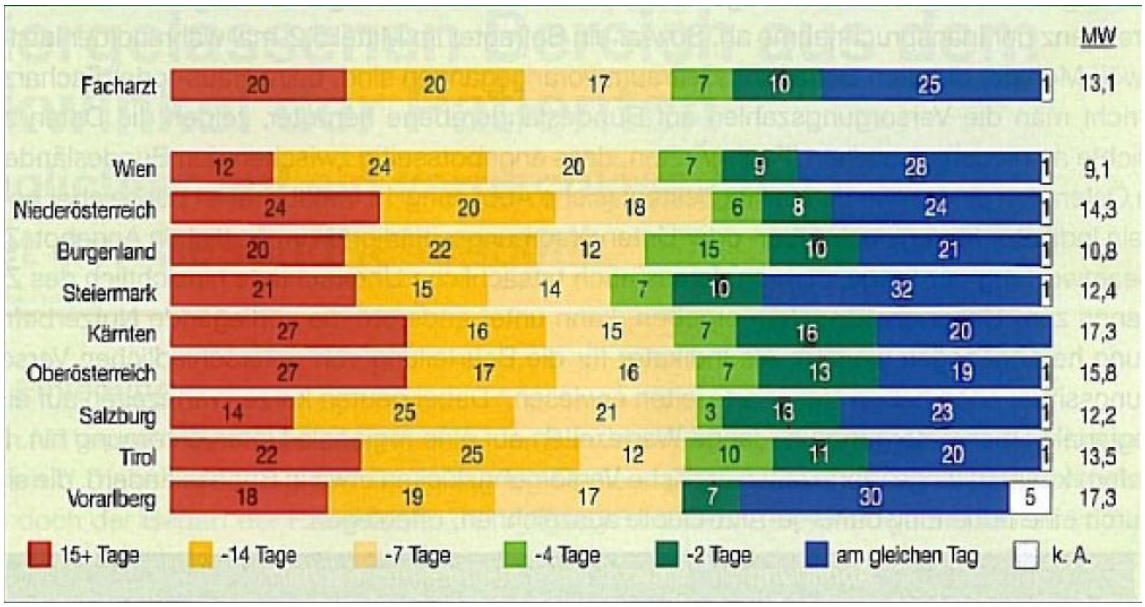

Figure 5: Comparison of the waiting times for appointments in Austria [29] (in German)

Fischer also considered waiting times within the waiting area of resident physicians. Figure 6 shows that 50% of the patients of general practitioners within this study waited more than 30 minutes (mean 33.8 minutes). At specialists 40% of the patients are waiting more than 30 minutes (mean 28.3 minutes). The study also concluded, that patient's wilfully accept waiting times if the certain physician has a good reputation [29].

Figure 6: Waiting times at resident physicians – general practitioners and specialists (in German)

A study of the University of Erlangen-Nürnberg examines the most important concerns for patients at resident physicians [41]. Within a qualitative study more than 3,000 comments from the doctor rating online portal *jameda.de* were evaluated. Figure 7 shows the top ten concerns. Subjective perceived professional expertise, empathy of the physician and the time for the medical treatment are the most used terms for rating a doctor. Waiting times in the waiting area of the doctor's office is ranked at number six (one in every five comments concerns waiting times). However, almost half of the comments concerning those waiting times are negative. No other issue is associated with more negative comments. This shows how

important waiting times for patients are, but it also shows that waiting times are often negatively associated.

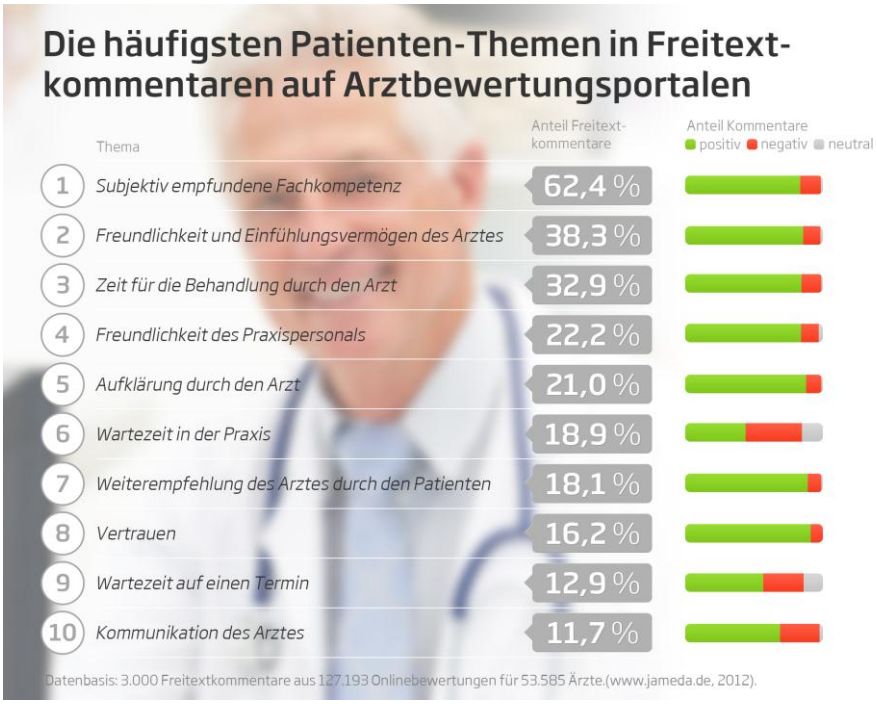

Figure 7: Most important issues for rating a doctor on jameda.de (in German)

Within a study of *statista.de* patients were asked to give statements concerning their last medical visits at resident physicians [42]. Figure 8 shows that two thirds of all patients found the waiting times acceptable, but one third considers the waiting time too long. This corresponds with the results from [29] as the majority of the patients is willing to wait as long as it gets good health care.

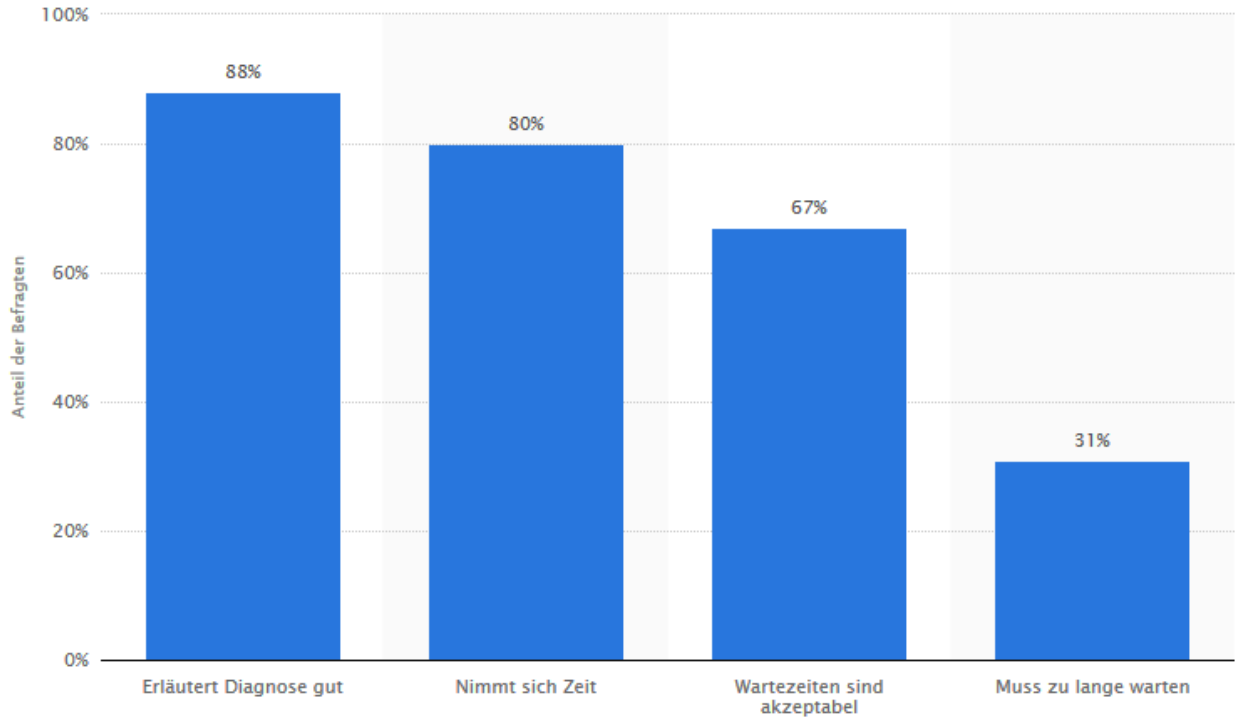

Figure 8: Statements concerning the patients visit at a resident physician (in German)

The Techniker Krankenkasse, a major health insurance in Germany, published a report about the satisfaction with the health care system [43]. It concluded that about 50% of the patients were not satisfied with the waiting times.

Within this master thesis, the connection between length of waiting times and quality of care is questioned. It will be shown that physicians with longer waiting times are not providing better care and the other way around.

2.2.3 Waiting times at hospitals

Dansky and Miles found out, that there is a relationship between perceived and actual waiting times and how patients sense service satisfaction at hospitals [23]. Concerning the waiting times itself, they showed that patients waited 55 minutes in the waiting area on average before entering the exam room. After that, they waited 17 minutes on average for the doctor within the exam room. Finally, they spend 107 minutes overall in the facility.

Becker and Douglass examined the patient's visit at seven out-patient clinics [22]. Besides the time in the waiting room they include different kinds of waiting times such as total time in clinic, time spent with doctor and time in the examination room. With an average of 63 minutes total time in clinic, 48 minutes of total waiting time and 13 minutes time spent with a physician the numbers match quite good with the previous study .

Both studies examined the waiting times at hospitals and out-patient clinics and came to roughly the same numbers. Within this study, waiting times of a follow-up ambulance at an accident hospital will be analysed. However, the focus lies on the waiting time inside the

waiting room and the administrative desk. It is not part of the objectives to examine the waiting within the exam room till the doctor arrives.

Preventing long waiting times, several hospitals in Vancouver, Canada, offer their waiting times online to enable patients to choose either the time when to visit the hospital or to choose another hospital itself [44]. It is an attempt to increase the efficiency of the regions health care resources and improve patient flow (http://www.edwaittimes.ca/). There has been several interesting numbers extracted out of the data:

- Most patients come from 10:00 to 22:00 to the emergency department.
- There is no first come, first serve at emergency departments.
- The waiting time does not decrease if patients come with an ambulance.
- The length of the stay depends on how many tests are needed for the physician to treat the patient.

Details about this system are provided in the results chapter of this work.

2.3 Evaluation of the process at health care institutions

The evaluation of the process in hospital ambulances and at resident physician offices is one major point within this thesis as the process is seen as the base for waiting times. A related topic is discussed in Goncalves's paper concerning the orientation on hospital processes [45]. The objective was to develop and test a new measurement tool for the determination of the process orientation of a certain hospital from the operations management perspective. Goncalves points out that operations management is able to design healthcare services which meet the needs of patients such as low waiting times. Visses and Beech [46] pointed out, that the healthcare chain is "the chain of operations that need to be performed to produce a particular health service". Defining such a healthcare chain enables the creation of strategic management tools to allocate resources to increase operational effectiveness and linking organizational objectives with operational processes to increase patients' satisfaction[47].

In the last decades, healthcare organizations and hospitals became interdisciplinary organizations with cross-functional teams offering highly complex health services with overlapping responsibilities across several departments. Distributed medical skills and knowledge needs to gather together, which is a challenge for the entire organisation [48]. Therefore, process orientation becomes an international trend to provide a holistic and systematic view of healthcare services [45]. Thus, McCormack presented five dimensions of the process orientation to describe all necessary influences [49]:

- Process view which views individual actions as chain of events.
- Process structure as "a perspective as an organizational structure to coordinate, manage and improve patient care processes".
- Process jobs as the management of skills and information of employees.

- Process measurement and management for measuring the patient's care process.
- Customer-focused process values and beliefs which represent an organizational culture.

2.4 Impact of waiting times on patient satisfaction

Waiting times are often seen necessary to reduce idle time for physicians. Patients missing an appointment derange the physician's day schedule and lead to financial losses. As a result physicians overbook as they assume that some patients might not come. But often it appears that all patients come to their planned appointment and probably some emergency patients come as well. A queue forms and makes the patients with appointments waiting. This increases the frustration of patients as they have an appointment, but have to wait anyhow. This leads to the situation, that patients come whenever they think the expected waiting time is short. Within this circle, all participants (physicians and patients) loose and frustration on both sides increases [19]. Within this circle of losses, there are several ways to decrease the psychological burden of waiting times.

Taylor states that during the waiting time two kinds of psychological and physiological responses are shown: (1) uncertainty including annoyance, irritability, stress, and (2) anger [26]. Entertainment programs such as providing TV or magazines, outdoor views, refreshments and patient education as well as giving the patients a choice what they can do during the waiting time could dramatically reduce those negative implications [50].

Becker and Douglass found a strong significant correlation between the level of anxiety and the attractiveness of a clinic [22]. Furthermore, according to their study, patients felt better preserved in clinics with a higher attractiveness ranking. This indicates that a well-designed environment is able to reduce stress and psychological harm of waiting patients.

Arneil and Devlin emphasise how the design of outpatient waiting rooms influences the perception of the quality of health care services [20]. More comfortable designed waiting areas are associated with greater perception of provided health care [51]. Furthermore, the performance of health care stuff can also be influenced positively by small changes of the design of the environment [52]. These results show the dependencies between the design of the environment, performance and attitude of health care stuff, and the satisfaction of the patients with the health care services.

Waiting times are a major issue for patient satisfaction. Dansky and Miles postulate, that waiting time for seeing a clinician is even the most significant predictor for patient satisfaction [23]. Informing the patient had also positive influence on patient satisfaction.

This thesis will take up this issue and ask the patients how the environment could be changed to make the waiting time more comfortable. However, this question includes only comparable small changes like a water dispenser or more magazines. It does not include general redesigns of buildings as this would often be impossible. Resident physicians are often located within residential buildings and the costs for redesigning hospitals are extremely high. Due to the results of Danksy and Miles, the questionnaire also deals with the question, if information

about the individual waiting time would help to increase the patient satisfaction ("I want to know how much longer I have to wait").

2.5 Loss of working time

Patients in Austria and Germany seem to accept long waiting times because they consider them as part of the game. As long as they get good health care, most of the patients are willing to accept waiting times [29] [42]. A reason for that stoic calm might be the fact that according to the Austrian law, visits at physicians during working hours is being borne by the employers. It says that if a visit to the doctor is necessary but not possible outside the working hours, it is legal to visit the doctor during the working hours [53].

Waiting times have also found their way into the German law. A court in Germany ruled that physicians have to inform self-employed patients clearly and sufficiently concerning expected long waiting times. Otherwise, this is seen as an organisational fault and the physician is liable for that. In other words, physicians have to pay compensations to the patients if they don't inform self-employed patients about long waiting times [54].

Therefore, Norman and Bailey point out, that the disproportionately long waiting time in hospital out-patient clinics compared to the average length of the medical examination leads to a loss of working time and a shortage of manpower [21].

A loss of working time is also a big issue concerning other situations, like traffic jams. In cities such as LA or Washington DC people spend more than 60 hours in traffic jams in average per year [35]. The costs are at about 800 Dollar per driver due to the wasted time. The sum of money lost due to traffic jams is tremendous: "Today's congestion bill of $ 121 billion dwarfs the GDP of all but 60 of the countries in the world". The article also says that there is no quick solution for cutting traffic jams which is probably true for all kinds of waiting lines. To fix those kinds of queues structural, organizational and societal changes need to be done.

Within this master thesis, the loss of GDP due to waiting times will be calculated. The approximatively calculation makes it possible to estimate the impact of "lost" waiting time on the economy.

2.6 Validity of interviews and surveys

The question of a valid survey, which reflects the feelings and ideas of the participants have been subject to discussion for a long time. Cohen, Forbes and Garraway took a closer look on consistency of surveys concerning patient satisfaction and compared three independent population surveys [55]. The topic included questions concerning waiting times, information given to patients and involvement of patients in decisions concerning treatment. Besides the confirmation of the well-documented phenomenon that wording and presentation of questions are able to influence responses [56], the study produced the following results:

> "Asking patients if they agree with a negative description of their hospital experience tends to produce greater apparent satisfaction than asking if they agree with a positive description".

Another topic is the relevant number of observations needed to get valid information. Norman and Bailey suggest that more than 400 observations are necessary to estimate the average consultation time with a fair degree of accuracy [21]. As this number of observation is not reached within this thesis, the results cannot be seen as completely valid.

Within their study about the influence of physical attractiveness of the waiting area on the perception of waiting times, Becker and Douglass used a multi-method data collection at seven clinical outpatient practices which differ in attractiveness significantly [22]. This thesis follows this path. Instead of having data from several equal places, different kinds of places were selected. Each resident doctor's office within this study has certain characteristics, what allows getting a broad spectrum of answers to the study objectives.

Experts interviews, according to Gläser and Laudel, are used to construct and analyse social processes to find an explanation using methods from the social sciences [57]. They enable to exploit expert knowledge from people with special knowledge. Furthermore, they argue that qualitative methods like the expert interview should be used when it comes to case based explanation of certain phenomena as well as for reconstructing investigations. In that case guideline-based interviews with single experts are the method of choice.

The use of a multi-method data collection allowed Becker and Douglass a different look on the objectives [22]. Due to the use of a systematic observation procedure the waiting times and the range of activities during the waiting time were captured. The data was recorded from Monday to Friday at morning and afternoon sessions. Two research assistants with synchronized watches hand over data collection sheets (questionnaires) to the waiting patients.

The methodology of this thesis is closely related to this approach. Due to the lack of human resources only one research assistant (the author of the thesis) was present at the resident doctor's office and the hospital ambulance for only one day each. However, it was possible to track patients concerning their waiting time and time in the exam room and let them fill out questionnaires.

In the study of Becker and Douglass, the surveys were distributed by designated staff members who ask the patient if they are willing to fill them out. Participation was completely anonymous and voluntary. Patient could either fill them out before they leave the clinic or taking the survey home and mailing them back. All in all 205 surveys were collected within seven practices [22].

The present study uses the same approach for distributing surveys although it differentiates in details. Patient normally filled out the survey during the waiting time, not at home or after the visit. This would decrease the motivation to fill them out drastically. In sum 63 surveys from patients at resident physicians and 60 surveys from patients from the hospital ambulance have been filled out.

3 Methodology and approach

There are two research traditions which differ in regard to the approach, data, aim and usage [58]. The objective tradition (1) on the one hand aims to verify correlations. Following a positivistic, quantitative and rational approach, it tries to check hypothesis for explorative empirical science. The subjective tradition (2) on the other hand, aims to find new correlations. It follows an interpretative and qualitative approach using qualitative data to generate hypothesis. Both research traditions have their place in the scientific community and also in this thesis.

3.1 Grounded theory

The grounded theory can rather be understood as a general approach or general style to analyse qualitative data than a specific method [59]. It helps to detect the complexity of the collected data and classify the issues, which arise during the research process. It is the basis to conclude results out of empirical data, using a systematic and iterative analysing method. The raw material is conceptualized by constant comparison between raw material and results [59].

The grounded theory is not limited to certain survey methods. On the contrary, it particularly supports a well suited mix of methods as used in this thesis [60]. Therefore, the focus of the grounded theory does not lie entirely on the specific method itself but on the principal of theoretical sampling, which can be understood as an interwoven process of sampling and generating results, as shown in Figure 9. The major characteristic of the grounded theory is, that generated results are not taken for granted but rather tested again and again against new material.

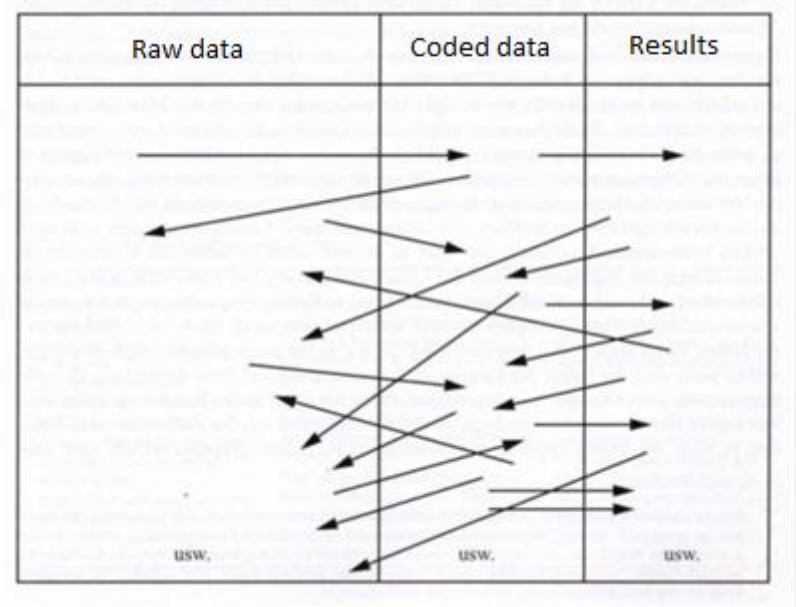

Figure 9: Functionality of the grounded theory [59]

Within this thesis a pool of methods is used. Using qualitative methods, semi-structured expert interviews are done with physicians to get a first impression of the problems and answer the thesis' objectives. After that, quantitative surveys in combination with participant

observations are done to answer the thesis' objectives. To verify and validate the results, they are presented to the physicians themselves so they can comment them. Figure 10 summarizes all used methodological activities and their respective results.

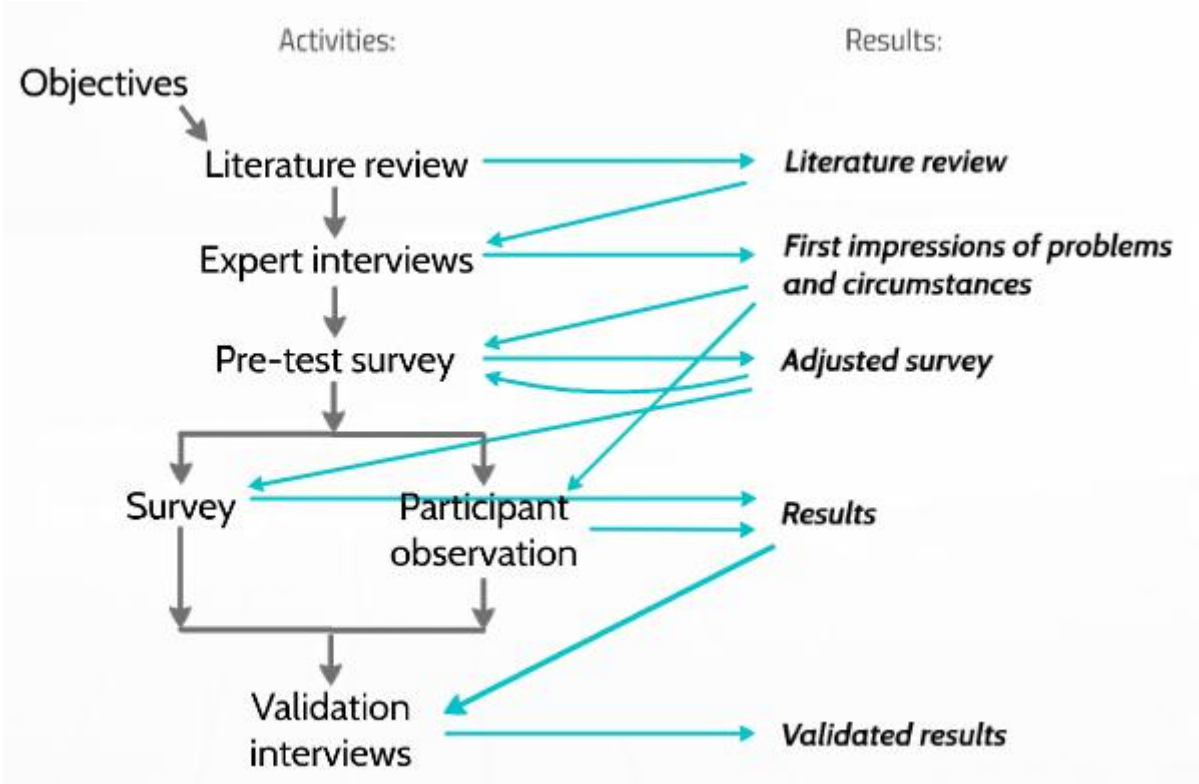

Figure 10: Process flow shows activities and results stepwise and its recursive influences.

Figure 10 points out that the grounded theory is used. Each step depends on one or more earlier steps:

1. **Objectives**: Within the first step the objectives are defined. The objectives can be found on page 13. There are eight scientific questions defined answering the objectives.

2. **Literature review**: After the definition of the objectives, the literature was used firstly to get an insight into the working area and secondly to define a proper methodology.

3. **Expert interviews**: Based on the results from the literature review, semi-structured, guideline-based, problem-centred expert interviews were used to get detailed insight and knowledge concerning the topic of waiting times at the chosen physicians and the hospital ambulances. More details concerning the methodology of the expert interviews can be found in the chapter "Semi-structured experts interviews" on page 33.

4. **Pre-Test survey**: After the expert interviews, the questionnaire for the patients was designed based on the results of the expert interviews. Before handing out, it was pre-tested several times till the questions were comprehensible and understandable. More details concerning the methodology of the questionnaire and its pre-test can be found in the chapter "Quantitative methods" on page 34.

5. **Survey**: After the pre-tests, the questionnaire was handed out to the patients at the waiting rooms of the hospital ambulance and the resident physician's offices. More details concerning the methodology of the questionnaire can be found in the chapter "Quantitative methods" on page 34.

6. **Participant observation**: Parallel to the survey phase, participant observation took place to examine the processes which lead to waiting times, the environment of the waiting areas and how the patients act during the waiting time. More details concerning the methodology of the participant observation can be found in the chapter "Participant observation" on page 32.

7. **Validation interviews**: Finally, the results were discussed with and validated through a subset of the concerned resident physicians to present the data, but also to give them an opportunity to comment and relativize them. The method is again a semi-structured, guideline-based, problem-centred expert interview. More details concerning the methodology of the expert interview can be found in the chapter "Semi-structured experts interviews" on page 33.

3.2 Data Collection

As described in the previous chapter, several methods are used in this thesis. On the one hand the qualitative methods used were the participant observation to get insights into the situation of waiting from an observer point of view and the expert interview to get insights from the physician's point of view. On the other hand quantitative methods were used to get information from the patient's point of view. Both kinds of methods are described within this chapter.

3.2.1 Qualitative methods

Two particular qualitative methods are used to get insights into the waiting process from the viewpoint of the patient and the physician. Qualitative methods in general produce descriptive data according to spoken or written word and observable behaviour [61]. It is the aim to show the study subject holistically and not reduced to a single variable, but viewed as a part of a whole. Especially, when it comes to emotions, qualitative methods are able to handle concepts such as frustration or suffering and pain. Those are emotions that occur while waiting.

3.2.1.1 Participant observation

Participation observation is a method coming from the social sciences and allowing to capture perceivable action, seeing the observer as part of the observed action [62]. Girtler defines two useful kinds of participant observation: (1) the structured participant observation and (2) the unstructured participant observation.

Within structured participant observation the observer standardizes the research activities in form of a guidelines which he or she follows during the observation. Using the method of the unstructured participant observation gives the observer more freedom, because the observation can be done without any restrictions. Newly emerging situations or very complex situations can therefore be easier integrated into the results. Girtler says that unstructured

participant observation enables the observer him or herself to avoid distortion easier than structured participant observations [62].

Within this thesis participant observation took place in the waiting areas of the doctor's offices as well as in the waiting area of an ambulance. Examining a complex topic such as waiting times, especially when it comes to emotions and feelings arising due to waiting, unstructured participant observations seem to be the right choice. Unexpected and unforeseeable events are the main focus of the observation.

3.2.1.2 Semi-structured experts interviews

Gläser and Laudel suggest using the method of the guideline-based interview with a single expert when it comes to fall based explanation of certain phenomena as well as for reconstructing investigations [57]. The interview can be seen as a communication process. On the contrary to an ordinary conversation there are fixed communication rules, fixed roles and directed dialogic structures.

The method of the semi-structured, guideline-based, problem-centred interview is based on Mayring [63] and for this thesis extensions of Gläser and Laudel were used [64]. They state that semi-structured interviews are in the first line useful if different topics are part of the interviews, which follow specific research questions [57].

The distinction between experts and "normal" people in terms of the interview-situation is discussed by Gläser and Laudel in their book about expert interviews and qualitative content analysis [57]. They say that experts are people with special knowledge concerning a social issue, and expert interviews are a method to exploit this knowledge.

Four resident physicians who are experts in this field – because they have to deal with it every day – were interviewed. The selection of the person at the hospital ambulance is based on his or her knowledge in the topic of waiting times in general as well as in inter and intra-organizational process understanding in the certain healthcare institutions [65].

It is recommended to do a precedent preparation for the expert interviews concerning formulation of the objectives and theoretical preliminary considerations [57]. Within this thesis all interviews were planned and not spontaneous. It was aimed to learn about the opinion of the physicians about the topic of waiting times, whether they think long waiting times are a problem or not and how to decrease them. During an appointment that lasted between ten and 15 minutes, the interview guideline was asked and discussed point to point. It was not desired to enter a discussion concerning the studies' objectives, but if the interview partner started a discussion, the interviewer joined without contributing his or her own opinion.

All interviews were recorded via audio, which enabled the interviewer to concentrate on the content. Despite the fact that the process of recording might influence the content, recording is far more efficient for the analysis [57, 64].

The interview- as well as the analysis-language was German. The data was pseudonymised to disable the opportunity to track the results back to the physician. Nevertheless it was possible to analyse the content separately for every participant.

To ensure the quality of the results and acquire the reaction to the results, validation interviews with the physicians took place. Therefore the method of communicative validation was used, which aims to discuss the results with a subgroup of the participants [66].

3.2.2 Quantitative methods

Quantitative methods combine all approaches which are able to be expressed in numbers such as the standardized questionnaire, counting, observation, physiological measurements and much more [67]. Kromrey would even go so far as to say that all interesting issues and circumstances can be measured with standardized questionnaires [68].

3.2.2.1 Questionnaires

Questionnaires can be seen as a remote conversation between the researcher and the respondent. The main difference to qualitative methods is that the researcher is not physically present which indicates the need for a well-designed questionnaire and gives the ability to understand the questions [69].

Questionnaires can be categorized concerning the degree of standardization (1), reference of standardization (2) and way of communication (3) [67]:

1. Degree of standardization:
    - Fully standardized (rigid process)
    - Partial standardized
    - Not standardized
2. Reference of standardization:
    - Standardization concerning answers
    - Standardization concerning the order of questions
    - Standardization concerning the environment
    - Standardization concerning the wording of the questions
3. Way of communication:
    - Personal, face to face
    - Written
    - Via telephone
    - Electronic

Within this thesis a fully standardized questionnaire is used with the standardization concerning the answers, order of questions, environment and wording in a written form.

The design of the questionnaire needs to be done carefully and needs to consider the research question on the one hand and the analyses on the other hand [67]. First of all there is the fundamental question whether open or closed questions should be used. Open-ended questions offer the opportunity to write down issues in the respondent own words. Using

closed-ended questions gives the respondent the opportunity to choose the answer out of a given list of possible answers. A combination of both is also possible.

There always needs to be an introduction including instructions how to fill out the survey and direct and personal form of appeal. After reading the short text the person who answers the questionnaire should be able to know how to do it, which kind of questions are used, what the survey is about and what will happen with the results. A final sentence should ask for correct answers which expresses real opinions and give thanks to the respondent [17].

Constructing the questions, several aspects need to be considered [70]. The most important issues are listed in the following:

- The wording needs to be adjusted to the respondent, especially when elderly people or children are included.
- The questionnaire needs to have an overall design and layout. Details such as the line distance or the font size could play a crucial role.
- The length of the questionnaire should be limited as well as the length of each question. Too much text could probably scare the respondent.
- Unrealistic formulations such as “never”, “none” or “always” as well as quantified formulations such as “almost” or “nearly” should be used very carefully.
- Only one issue per question. Asking more than one issue within a single question could confuse the respondent.

When constructing a questionnaire, a mayor issue is also the kind of answer options. Within this thesis the most used answer option is the multiple choice answer. It allows the respondent to select one or more items out of a given list.

The process pre-test survey followed an iterative and deductive approach. Within two circles, five people who had been to the doctor lately were asked to fill out the questionnaire. It was important that the questions were comprehensible, understandable but also answering the research questions. After two improvements and redesigns the questionnaire design, content and structure was completed. The questionnaire for the hospital ambulance and resident physicians was based on the same principles (structure and design), but had little deviance concerning the formulation and answer options. The final questionnaire can be found in the appendix.

3.3 Analysis

The analysis phase contains the qualitative analysis of the qualitative content, mainly the expert interviews, as well as the quantitate content of the questionnaires. For the qualitative analysis the content analysis of Mayring was the method of choice [71]. Mayring is a scientific heavyweight when it comes to qualitative methods over the last years.

The analysis of the quantitative part used methods from the descriptive statistics.

3.3.1 Analysis of qualitative content

Within this thesis the methods of Mayring are used for the analysis of qualitative content [71]. Within his models, Mayring points out that the researcher has to be aware of the smallest and largest size of text block to be able to analyse it. During the analysis those text blocks are subject to categorization. The categories used within this method are either deductively given or inductively reasoned. The latter makes it possible to form new categories and enlarge existing categories to illustrate the research object more reasonable [57]. However, a mixture of a deductive and inductive methodology is also possible. After extracting those categorized text boxes, the method of generalization is used to sharp the statements and issues. The analysis process itself is shown in Figure 12. Figure 11 provides an example of the analysis of qualitative content within this thesis.

e.g.: „You have to decide whether the patient has acute problems or problems which could wait until the next appointment."

↓

Categorization: „Predictability of health care"

↓

Generalization: Assessment of a patient concerning the urgency of the health issue

↓

Issue: „Predictable vs. unpredictable (acute) visits"

Figure 11: Example of the analysis of qualitative content.

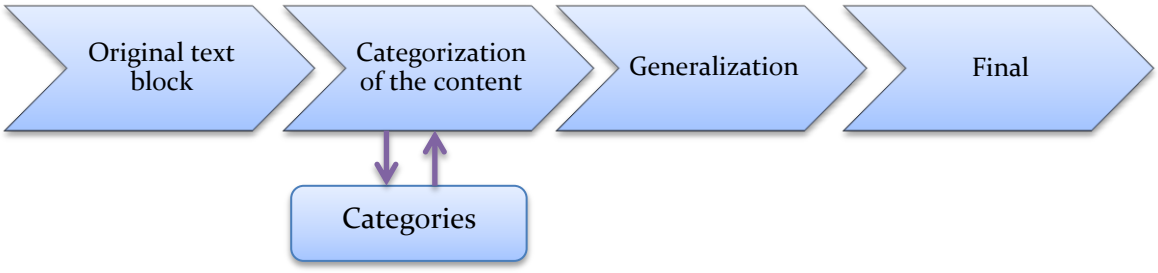

Figure 12: Analysis of qualitative content according to [71]

The aim of the analysis, according to Mayring, is to reduce the data to a minimum without losing essential content [71]. The result, he further says, is the abstract reflection which still is an image of the raw material. Furthermore, Glaser and Laudel suggest that within the phase of extraction, it is important to separate content which is necessary for the objectives and delete content which is unimportant [57].

For the analysis of the comparable large amount of data the software tool ATLAS.ti allowed an efficient analysis. ATLAS.ti is a software focusing on the analysis of qualitative data such as text, pictures, videos and audio. It is bases on a "code-and-retrieve-procedure", namely the categorization/coding of content and the retrieving and finding of coded content. Within this thesis the main data consists of audio files from the expert interviews and therefore, the analysis of audio files was emphasised.

The expert interview followed a guideline with five issues A1-A5 and 13 questions (the guideline can be found in the appendix). That structure was supposed to help with the analysis part of

the work as the questions could not be seen independently from each other. Some questions were excluded due to the concrete setting of the doctor's office. Therefore, not every interview consisted of all questions. Within the analysis software, questions are represented in the categorization and codes. Figure 13 shows an example of used codes for the expert interview with Dr. P.

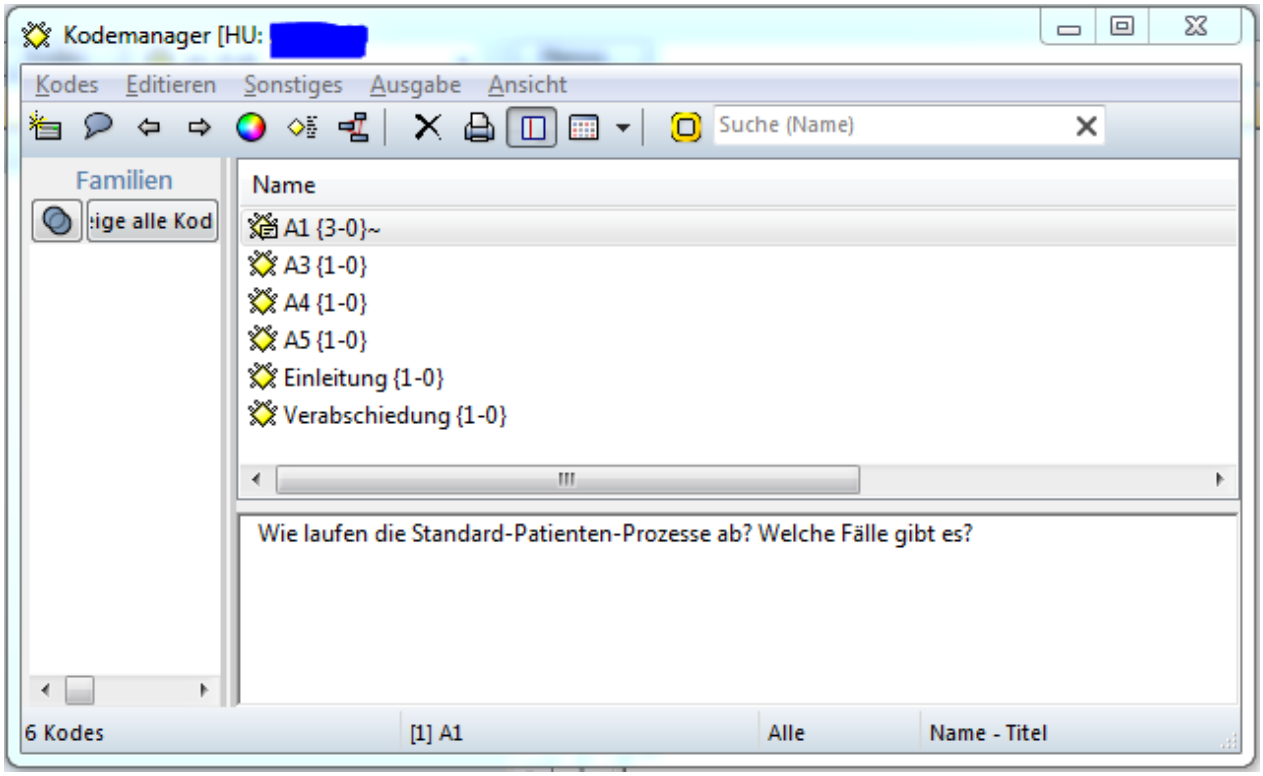

Figure 13: Screenshot of the code manager for the interview with Dr. P. (in German)

The audio file from the expert interview was imported into the software tool and analysed concerning the given codes. Figure 14 shows the graphical user interface of ATLAS.ti. On the right hand side the assigned codes according to the time period can be seen. The interaction between several questions can be seen clearly at the first minutes of the interview, where a mixture of issue A1 and A5 occurred.

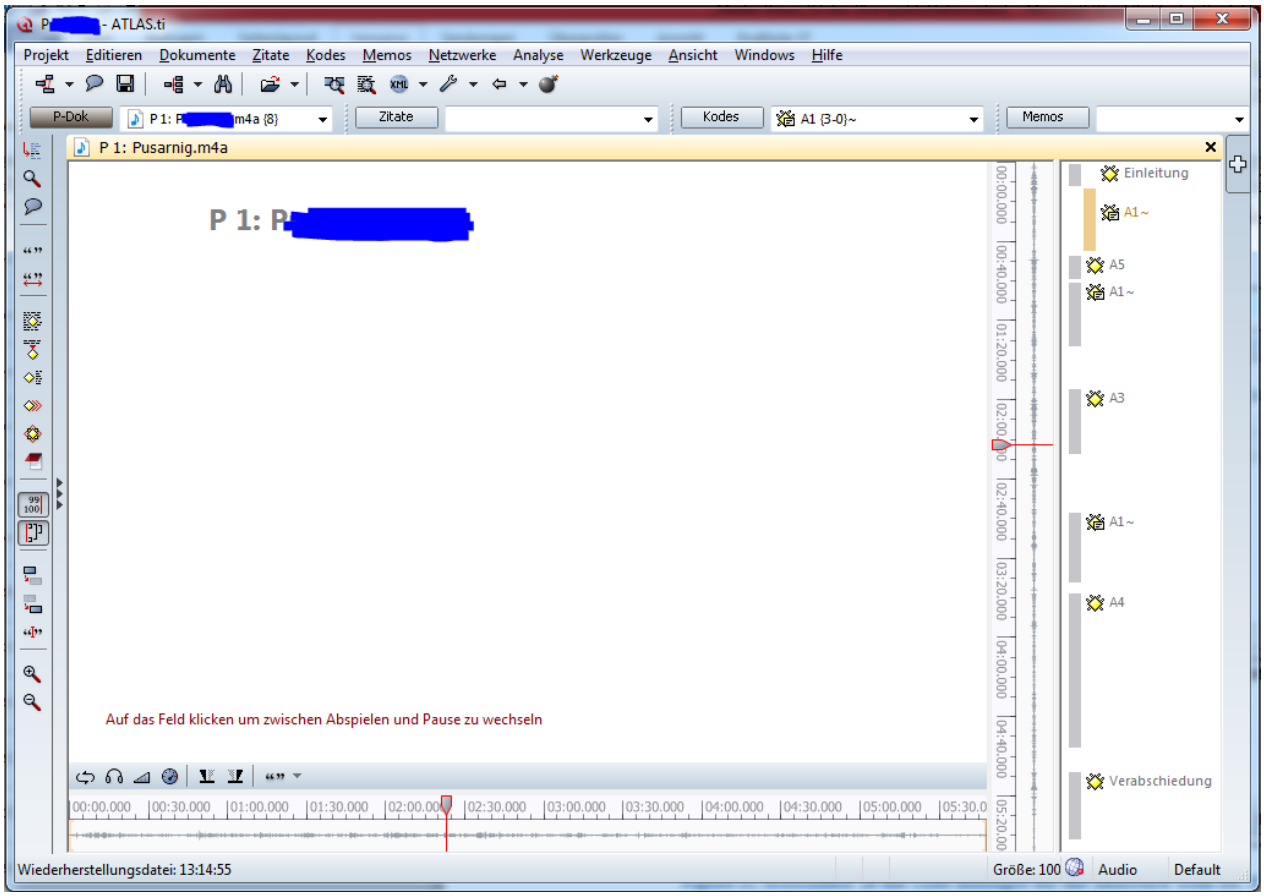

Figure 14: Screenshot of the GUI of ATLAS.ti.

After the categorization and coding of the content, the content of the codes was analysed and generalized. After the generalization, identical audio fragments with the same meaning were merged. The results are displayed in the results chapter of this work.

3.3.2 Analysis of quantitative content

Having collected all data from the chosen sample, the tools of the descriptive statistics allow describing their characteristics. The main tasks are [72]:

- Data cleaning
    - **Standardizing the data**: the data need to be structured equal
    - **Cleaning the data**:
        - Delete false data: once data is flawed, false or not reasonable, it should be deleted
        - Substitute data: substitute flawed data with already verified data
        - Using default values: substitute flawed data with default values
        - Delete duplicates: Once duplicates are identified, they need to be deleted. Otherwise redundant data could skew the results.

- Summarize and order data into tables

    - **Creation of an original list**: A simple check list in which the cleaned data is entered per entity (questionnaire)

    - **Frequency distribution**: Creation of a frequency distribution concerning the most characteristic properties. Bortz says in his book about methods at biostatistics that the samples of quantitative (and qualitative) observations should be described to make a communication with the scientific community possible [73]. He further points out, that the most complete and clearest description is done graphically or via tables of frequency distributions. An example is a frequency table as shown in Table 1, which represents the number of questionnaires filled out by the patients.

Location	Number of Questionnaires	Sub amount (%)	Amount (%)
Dr. N	21	33%	
Dr. P	18	28.6%	
Dr. M	10	15.9%	
Dr. H	14	22.5%	
Resident physicians	63	100%	51.3%
Hospital	60		48.7%
Sum	123		100%

Table 1: Example of frequency table

- Summarize data into graphics: Graphics and figures offer the possibility to simplify complex facts in a compact way. The following properties constitute such a graphic or figure:

    - **Position**: area where the values occur

    - **Deviation**: gives information about the distance from the mean or median value to certain observations; it also includes information about outliers

    - **Form of the distribution**

  The most important representatives are:

    - **Bar charts/histogram**: Bar charts show the frequency in form of bars; the sizes are proportional to the frequency. Figure 15 shows an example of a bar chart, showing the percentage of patients and their length of waiting times at resident physicians and hospital ambulances.

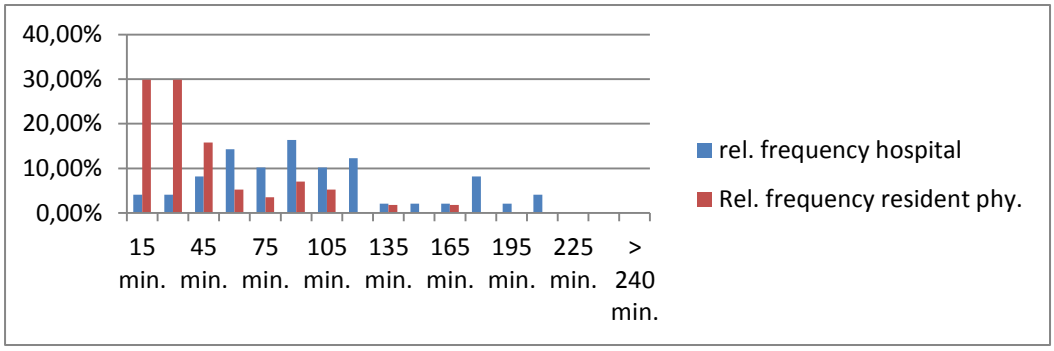

Figure 15: Example of a bar chart

- **Pie charts**: A pie chart is divided into pieces of a pie corresponding to the relative percentage or absolute number. Figure 16 shows an example of a pie chart visualizing the waiting times at hospital ambulances.

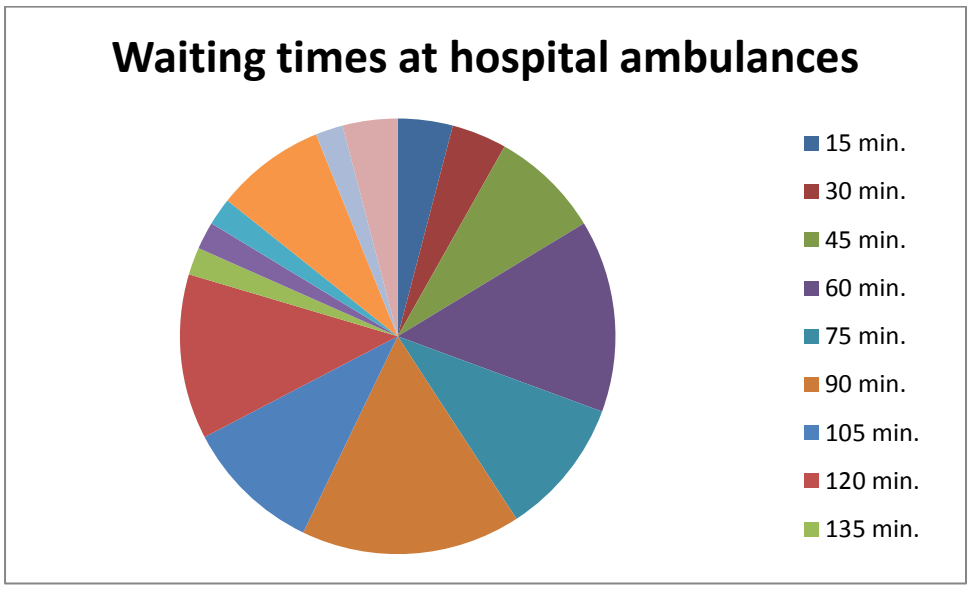

Figure 16: Example of a pie chart

- **Box plots**: A box plot combines several kinds of results in one figure. Normally, five measures are displayed within a boxplot, giving information such as the variations of the sample including the statistical distribution, the degree of dispersion (spread), skewedness and outliers. It consists of boxes and whiskers. Boxes normally represent the 25% to 75% quartile, while the whiskers show the 2% and 98% quartile. A star normally represents outliers. Figure 17 shows an example of the distribution of waiting times at certain physicians.

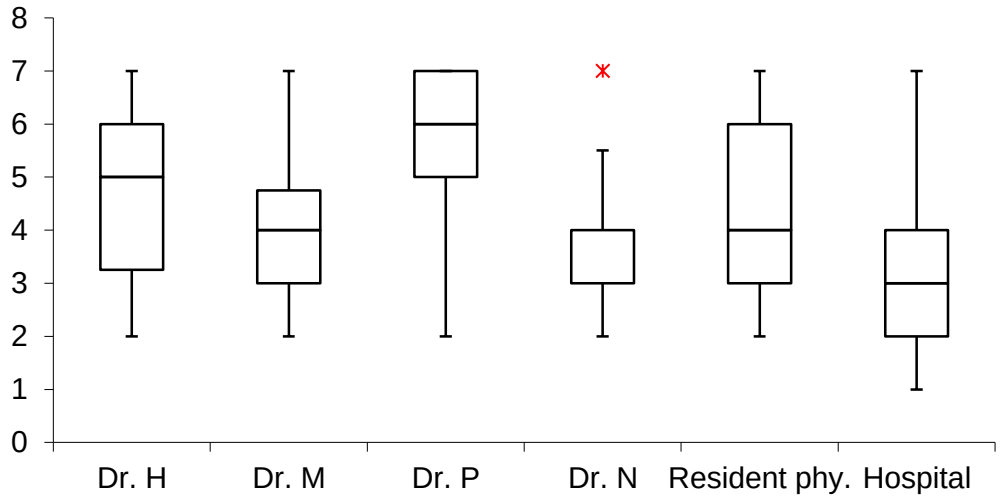

Figure 17: Example of a box plot

The following information can be found within a box plot:

- Minimum: The minimum may be the minimum outlier or a whisker
- Lower quartile: The lower quartile consists of all values of the 25% quartile.
- Median (50% quartile): Line between the 25% and the 75% quartile; divides the box.
- Upper quartile: The upper quartile consists of all values of the 75% quartile.
- Maximum: The maximum may be the maximum outlier or a whisker

3.4 Study design

The present thesis covers two kinds of environments: first, the residential physician and second, the hospital ambulance. Four resident physicians were willing to participate in the study. After approving to participate in the study, a date for the expert interview was selected. The expert interview took place inside the physician's office. Most of the interviews took place right before the start of the business hours. The expert interview started with an explanation of the thesis, the objectives and the procedure. After the physician declared himself or herself ready to participate, the guideline for the expert interview was processed point by point. The interview was recorded on a dictating machine to be able to assess the content afterwards and to give the interviewer the possibility to concentrate on the interview and the interviewee. After the end of the interview, a date for the participant observation and the handing out of the questionnaires at the resident physician's waiting room was settled. Most of the patients addressed in the waiting rooms of the resident physicians were willing to fill out the questionnaire, probably as they had to wait anyhow. In sum 63 questionnaires were gained in this way.

At the beginning of the study it was not easy to find hospital ambulances that were willing to participate in the study. The contact took place via telephone and email as most of the hospitals needed an official project description. At a conference concerning safety of employees at hospitals and other health care institutions it was possible to establish contact to a hospital in Vienna which was willing to support the study. After sending the official project description to the head of the hospital, he confirmed the participation of the hospital in the project officially.

The interview partner for the expert interview in the hospital was the head of the occupational medicine, who also led a tour through the hospital, having a closer look on the causes of waiting times. The interview was again recorded on a dictating machine. The author of the thesis spent a whole day at the hospital follow-up ambulance. This particular ambulance was chosen because the patients were mostly not severe injured, had time and the ability to fill out the questionnaire was given. Additionally most of the visits could have been theoretically planned before as an appointment, because of the follow-up situation. 60 patients were willing to fill out the questionnaire in this setting. Again, most of the patients were willing to fill out the questionnaire and some of them even started a discussion including other patients around concerning waiting times and the health care sector in general.

Table 2 summarizes the number of collected questionnaires in both settings:

Location	Number of Questionnaires	Amount (%)
Resident physicians	63	51.3%
Hospital ambulance	60	48.7%
Sum	123	100%

Table 2: Number of surveyed patients at resident physicians and the hospital ambulances

3.5 Analysis of loss of gross domestic product

The calculation of the loss of gross domestic product due to waiting for medical treatment is a major objective of this thesis. Data gained from the questionnaire and from the Statistik Austria is the basis for the calculation [74]. Due to a relative small sample and limited resources to consider all the variables causing waiting times and loss of GDP, this calculation must be understand as an approximate value to give a roughly estimation.

The calculation took several steps, which are described in the following:

1. Loss of time due to waiting:

   The median of the waiting times forms the base of the calculation. The median is a unit, which is more independent from outliers than the mean. Using the mean value could skew the results [75].

   The median is calculated from the numbers about waiting times gained of the questionnaire surveys. The two settings, hospital ambulance and resident physician,

are calculated separately. The data gained from the questionnaire survey at one resident physician, Dr. N, is ignored, because he or she is a paediatric and in that case not comparable to others.

$$x_{med} = x_{[(n+1)/2]} \text{ ... for uneven n}$$
$$x_{med} = x_{[n/2]} \text{ ... for even n} \quad (1)$$

Formula 1: Median for uneven and even n

Within the illustrated Formula 1 x_i represents the calculated waiting times. Those are calculated by subtracting the arrival time at the doctor's office or the hospital ambulance from the time when the patient enters the treatment room.

The results of this step are shown in Table 3. The numbers represent the median of the waiting times at the general practitioner and the hospital ambulance. Furthermore, the waiting times at general practitioners are also calculated for offices with and without appointment systems.

Median waiting time	Hospital ambulance	General practitioner (GP)	GP with appointment system	GP without appointment system
People who would work	$x_{w,h}$	$x_{w,gp}$	$x_{w,gpw}$	$x_{w,gpo}$
People who would not work	$x_{n,h}$	$x_{n,gp}$	$x_{n,gpw}$	$x_{n,gpo}$

Table 3: Definition of the median of people who would/would not work at hospital and GP's

2. Gross domestic product (GDP)

Within this thesis the following definition of the GDP will be used: "The gross domestic product is the monetary value of all goods and services produced in a nation during a given time period, usually a year." [76]

The assumption is that a certain amount of people waiting in the doctor's office or in the hospital ambulance would be willing and able to work instead of the waiting. Since they have to wait, they cannot produce goods or services which lowers the GDP.

The GDP in Austria is calculated by the Statistik Austria which is also the source of the data within this thesis concerning the GDP [74].

To get a more accurate value, the GDP will be separated between GDP of the working population and the average population as shown in Formula 2. Due to limited availability of data, the GDP at current prices will be used. The difference to the GDP at constant prices is used to compare the GDP concerning another year. To do so the inflation is subtracted. The GDP at current prices includes the inflation, which doesn't

cause a disadvantage for this calculation. The data was extracted from a document from the *Statistik Austria*[2]. The numbers are based on full-time equivalents.

$$g_1 \ldots \text{average GDP per person per hour}$$
$$g_2 \ldots \text{average GDP per person per hour at the working population} \quad (2)$$

Formula 2: Definition of avg. GDP per person per hour

Following the data of Statistik Austria, in 2013 each person (in average) produced a GDP of € 36,930 which is € 6.32 per hour. Each person who is part of the working population produced € 86,780 which is € 14.86 per hour. The values per hour will help to calculate the GDP per waiting hour.

3. Average loss of GDP per visit per person

In the third step, two groups are defined. The first group consists of persons who would work, if they had not to wait for medical treatment. The second group consists of persons who would not be able to work instead of waiting, either because they are not part of the working population or they are too ill to work. Table 4 provides the definition of the average loss of GDP per visit per person who would or would not work.

The amount of people in group one, people who would work, is retrieved from the questionnaire, question A8. Ticking the forth answer indicates that the person would be able to work instead of waiting in the waiting room.

The waiting time of both groups, people who would and who would not work, are multiplied with the GDP per hour of the respective group.

This numbers show the loss of GDP per visit per person in average, separated for people who would work and therefore produce goods or services, and people who would not work instead of waiting.

Loss of GDP (per visit)	Hospital ambulance	General practitioner (GP)	GP with appointment system	GP without appointment system
People who would work	$h_{w,h} = x_{w,h} * g_1$	$h_{w,gp} = x_{w,gp} * g_1$	$h_{w,gpw} = x_{w,gpw} * g_1$	$h_{w,gpo} = x_{w,gpo} * g_1$
People who would not work	$h_{n,h} = x_{n,h} * g_2$	$h_{n,gp} = x_{n,gp} * g_2$	$h_{n,gpw} = x_{n,gpw} * g_2$	$h_{n,gpo} = x_{n,gpo} * g_2$

Table 4: Definition of the average loss of GDP per visit per person who would/wouldn't work

[2] http://www.statistik.at/web_de/static/volkswirtschaftliche_gesamtrechnung_hauptgroessen_019505.xlsx (in German, accessed 8.12.2014)

4. Average loss of GDP per person per year

The fourth step extrapolates the numbers for the loss per visit to the whole year. To do so, the average number of visits at hospital ambulances and general practitioners are taken. Those numbers were published by the Statistik Austria [77]. They were retrieved through a questionnaire in 2007. They asked how often the person visited a hospital ambulance in the last four weeks. The answer was 1.6. The same question was raised for general practitioners. The answer was 1.5. Extrapolating this numbers from four weeks to the whole year, an average person visits the hospital ambulance 21.19 times per year and the general practitioner 19.76 times per year. Formula 3 shows the calculation of the frequency of hospital and physicians visit per year.

$$f_h = 1.6 * 52 / 4 \text{ ... frequency of hospital ambulance visits per year}$$
$$f_d = 1.5 * 52 / 4 \text{ ... frequency of general practitioner (doctors) visits per year} \quad (3)$$

Formula 3: Definition of frequency of hospital and physicians visits per year

Using the average number of visits at doctors and ambulances, the average loss of GDP per person per year can be calculated.

The calculations concerning the advantage of appointment systems are calculated as if all doctors would use an appointment system or all doctors would not use any. Table 5 provides the definition of average loss of GDP per person for one year for hospital ambulances and general practitioners distinguishing between general practitioners with and without appointment systems.

Loss of GDP per person (yearly)	Hospital ambulance	General practitioner (GP)	GP with appointment system	GP without appointment system
People who would work	$i_{w,h} = h_{w,h} * f_h$	$i_{w,gp} = h_{w,gp} * f_d$	$i_{w,gpw} = h_{w,gpw} * f_d$	$i_{w,gpo} = h_{w,gpo} * f_d$
People who would not work	$i_{n,h} = h_{n,h} * f_h$	$i_{n,gp} = h_{n,gp} * f_d$	$i_{n,gpw} = h_{n,gpw} * f_d$	$i_{n,gpo} = h_{n,gpo} * f_d$

Table 5: Definition of the average loss of GDP per person for one year

5. Loss of GDP in general

The last step extrapolates the average loss of GDP per person per year (Formula 3) to the whole country.

Formula 4 shows the separation of the number of people who would work instead of waiting is needed and those who would not. This is not equal to the number of the working population as not all of them would be able to work due to their illness. To get the number, the results of the questionnaire will be extrapolated nationwide which results in a percentage of people who would work. Multiplying this percentage with the population of Austria provides the needed number. To exclude children, the

population will be reduced to people who are 15 years and older. Before that, people are not allowed to work.

p_1 … people nationwide who would work
p_2 … people nationwide who wouldn't work (4)

Formula 4: Number of people who would work and who would not work

One of the objectives of this thesis is to compare the waiting times and the corresponding loss of GDP at doctor's offices with appointment systems to waiting times and the corresponding loss of GDP at doctor's offices without appointment systems. Thus, the calculation will be realized for waiting times at doctor's offices with and without appointment systems. Table 6 sums up the last step of the calculation.

Loss of GDP nationwide	Hospital ambulance	General practitioner (GP)	GP with appointment system	GP without appointment system
People who would work	$loss\_gdp_{w,h} = i_{w,h} * p_1$	$loss\_gdp_{w,gp} = i_{w,gp} * p_1$	$loss\_gdp_{w,gpw} = i_{w,gpw} * p_1$	$loss\_gdp_{w,gpo} = i_{w,gpo} * p_1$
People who would not work	$loss\_gdp_{n,h} = i_{n,h} * p_2$	$loss\_gdp_{n,gp} = i_{n,gp} * p_2$	$loss\_gdp_{n,gpw} = i_{n,gpw} * p_2$	$loss\_gdp_{n,gpo} = i_{n,gpo} * p_2$

Table 6: Calculation of loss of GDP per year due to waiting times

Finally, the loss of GDP is calculated in the categories hospital ambulance and general practitioner as well as general practitioner with and without appointment systems.

4 Results

Within this master thesis several scientific research questions are discussed. This chapter provides details about the results of the quantitative and qualitative survey. Then conclusions to the questions concerning the origin of waiting times, electronic appointment systems and solutions for reducing waiting times are drawn. Furthermore, the result of the calculation of the loss of gross domestic product is presented.

4.1 Pre questionnaire expert interviews

Prior to the questionnaire survey, interviews were done with physicians to check the daily routine within the doctor's office. The results of those interviews are shown in Table 7. It contains paraphrased statements joined to issues. The column "quoted by" shows whether the statement is coming from a doctor with an appointment system (DRW) or a doctor without an appointment system (DRWO). The third column contains examples of quotes of the physicians.

No	Issues	Quoted by	Quotation
1	Predictable vs. unpredictable (acute) visits	DRWO DRW	„You have to decide whether the patient has acute problems or problems which could wait until the next appointment." (Interview Dr. H, 14.03.2014)[3] „A patient with acute problems can only be treated concerning the acute medical issue. Concerning the rest, which can wait until the next appointment, the patient has to wait till then" (Interview Dr. N, 13.03.2014)[4]
2	There is no medical process	DRWO	„For colds or any other small diagnoses there is no big medical process necessary" (Dr. H, 14.03.2014)[5]
3	Difficult to standardise the medical process	DRWO DRW	„Taking blood samples is only a small part of the whole process. It also indicates a diagnoses before and probably several actions afterwards" (Interview Dr. H, 14.03.2014)[6] „Unexpected long treatments occur" (Interview Dr. N, 13.03.2013)[7]
4	Parallel treatment rooms	DRWO DRW	„There is a second treatment room where patients can prepare for the treatment (e.g. dressing and undressing). The doctor changes the rooms" (Interview Dr. H, 14.03.2014)[8]
5	Reserve slots (several	HSP DRW	„Patient management concerning appointments is done in handwriting. I also have an appointment book – it's a simple

[3] Original quotation: „Man muss unterscheiden zwischen akuten Beschwerden, die er (Anm. der Patient) schon länger hat und jetzt mal abgeklärt haben möchte, Kontrollen, da war irgendwas und das gehört sich angeschaut und das könnte man weiter aufdröseln in wirklich dringende Beschwerden oder Beschwerden für Krankenstand."

[4] Original quotation: „Akut-Patienten können auch nur das besprechen, was akut notwendig ist. Was anderes geht dann nicht."

[5] Original quotation: „Bei Verkühlung oder Ähnlichem ist kein großer Behandlungsprozess notwendig"

[6] Original quotation: „Eine Blutabnahme ist ja an sich nur ein kleiner Teil des gesamten Prozesses. Zu einer Blutabnahme muss eine Indikation gestellt werden. Dann muss jeder Wert einzeln angegeben werden."

[7] Original quotation: „Unerwartet lange Gesprächs- oder Behandlungszeiten, die sich ergeben."

[8] Original quotation: "Es gibt ein zweites Behandlungszimmer in dem sich die Patienten auf die medizinische Behandlung vorbereiten (z.B. aus- und anziehen). Der Arzt wechselt das Zimmer dann."

	minutes) per patient per appointment		excel file that gives ten minutes slots for patients. A patient can get more than one slot.“ (Interview Dr. H, 14.03.2014)[9] „The Computer gives appointments. It doesn’t calculate any treatment time“ (Interview HSP, 16.05.2014)[10] „The problem is to calculate the time slot. A consultation concerning a lab result could need 30 seconds or up to ten or 15 minutes. The difficulty lies in knowing before how long a patient will need.“ (Interview Dr. M, 24.03.2014)[11]
6	Telephonic booking with estimated treatment time necessary	DRW DRWO	„The problem is, that patients did not call before coming to my office. They should call before“ (Interview Dr. N, 13.03.2014)[12] „In my opinion it is nearly impossible to estimate a treatment time prior to the treatment. Patients have difficulties in saying how much time they will need via telephone. “ (Interview Dr. H, 14.03.2014)[13]
7	Administrative staff is responsible for the appointment system	DRWO DRW	„My receptionists filter right at the phone call according to temperature, diarrhoea, etc. Organisational the are really good, friendly but determined“ (Interview Dr. N, 13.03.2014)[14] „I would like the patient to say how long he or she is going to need before he or she enters the office. Then he or she would know how much time he/she has. But Elizabeth (the receptionists) has to play along. This is a learning process (Note: for the patients)“ (Interview Dr. M, 24.03.2014)[15]
8	Not meeting the appointment is a problem	DRW HSP	„If a patient comes late, this disorganizes a lot“ (Interview Dr. P, 24.03.2013)[16] „Patients come whenever they want“ (Interview HSP, 16.05.2014)[17]
9	Patients ranking/order	DRW	„According to the patient and his or her needs I am ranking the patients differently“ (Interview Dr. P, 24.03.2014)[18] „First come, first serve“ (Interview HSP, 16.05.2014)[19]
10	Too many treatments indicate longer	DRWO	„At the beginning of the day blood samples are taken. If this takes too long, the ‚normal’ patients have to wait“ (Interview Dr. H, 14.03.2014)[20]

[9] Original quotation: „Patientenmanagement was Terminvergabe betrifft wird handschriftlich gemacht. Ich habe auch ein eigenes Terminbuch entworfen – ganz simple Excel Files mit zehn Minuten Slots. Ein Patient kann mehrere Slots bekommen.”

[10] Original quotation: „Der Computer vergibt die Termine. Behandlungszeit rechnet er nicht ein.”

[11] Original quotation: „Das Problem ist, dass man nicht abschätzen kann, wie lang der Termin dauern kann. Eine Laborbefundbesprechung kann dauern eine halbe Minute aber auch 10-15 Minuten. Die Kunst ist es vorab herauszufinden, wie lange der Patienten braucht.”

[12] Original quotation: „Das Problem ist, wenn Leute unangemeldet kommen. Die Leute sollen vorher anrufen.”

[13] Original quotation: „Es ist aus meiner Sicht kaum möglich, leicht abzuschätzen wie lange ein Problem brauchen wird. Patienten können telefonisch nicht einschätzen, wie lange sie brauchen werden.”

[14] Original quotation: “Mitarbeiterinnen filtern schon bei Anruf nach Fieber, Durchfall usw. Organisatorisch sind sie echt gut. Freundlich aber bestimmt.“

[15] Original quotation: “Was ich versuchen möchte ist, dass der Patient im Vorfeld schon sagt, wie lange er brauchen wird, weil dann weiß er genau, wie viel Zeit er hat. Da muss die Elizabeth (Anm. Sprechstundenhilfe) aber mitspielen. Das ist ein Lernprozess (Anm. für Patienten).”

[16] Original quotation: ”Auch kann jemand zu spät kommen, da bringt es viel mehr durcheinander.”

[17] Original quotation: „Die Leute kommen wann sie wollen“

[18] Original quotation: „Entsprechend der Behandlung werden Patienten vorgereiht ”

[19] Original quotation: „Wer zuerst kommt malt zuerst.”

	waiting times		
11	Using an appointment system is part of a general approach	DRWO	„There are physicians who accomplished it, I have not (remark: establish an appointment system) It is a general approach of the physician.“ (Interview Dr. H, 14.03.2014)[21]
12	Waiting time needs transparency	DRW	„Patients who have an appointment will be taken first, which often causes disturbance in the waiting area. There must be clear and transparent communication that patients with an appointment are treated first. “ (Interview Dr. M, 24.03.2014)[22]
13	Organisational procedure	DRWO HSP	„People don’t know how complex it is to run a physician office. But there are also some offices which aren’t well organised“ (Interview Dr. N, 13.03.2014)[23] „There have four teams of physicians. We take care that each patient is treated by one of those four teams during the whole procedure. “ (Interview HSP, 16.05.2014)[24]
14	Why are waiting times a problem?	DRWO	„I don’t know why waiting times are such a big issue“ (Interview Dr. H, 14.03.2014)[25]
15	Time is money	DRWO	„People don’t realize that time is money“ (Interview Dr. H, 14.03.2014)[26]
16	Technical problems with online appointment systems	DRW	„I tried MedNanny a long time ago but it generated a lot of problems. It would only allow loading one day into our system. It would make sense to use it, but technically it is not possible for me. “ (Interview Dr. M, 24.03.2014)[27] „I doubt it that electronic systems are better and is able to suspend the organisational talents of my staff. “ (Interview Dr. N, 13.03.2014)[28]
17	More physicians needed	HSP	„More personnel and more physicians – although we don’t have the facilities. “ (Interview HSP, 16.05.2014)[29]
18	Difficult to install an appointment system	DRW	„It is hard to install an appointment system. “ (Interview Dr. M)[30]

[20] Original quotation: „Es werden zuerst die Blutabnahmen gemacht, dann erst die Patienten behandelt. Wenn zu viele Blutabnahmen kommen/ausgemacht wurden, müssen die „normalen“ Patienten warten.”
[21] Original quotation: „Es gibt Praxen, die haben das geschafft, ich hab das noch nicht geschafft. Das ist aber eine Frage des Ansatzes an die Arzt.”
[22] Original quotation: „Patienten mit Termin werden somit manchmal vorgereiht, was wirklich Turbulenzen im Wartezimmer verursachen kann. Es muss klar gekennzeichnet sein, dass Patienten mit Termin schneller dran kommen.”
[23] Original quotation: „Den Leuten ist auch nicht bewusst, wie viel Aufwand hinter der Organisation einer Arztpraxis steckt. Es gibt aber auch Praxen die nicht gut organisiert sind.“
[24] Original quotation: „Wir haben vier Ärzteteams, jeder Patient sollte möglichst zu seinem Ärzteteam kommen.”
[25] Original quotation: „Ich weiß nicht warum die Wartezeiten immer so ein riesiges Thema sind.”
[26] Original quotation: „Es ist viel zu wenig klar in unserem System, dass Zeit gleich Geld ist.”
[27] Original quotation: „Ich hab dieses MedNanny (Anm. Online Terminvergabe) schon vor ewigen Zeiten gehabt aber das Problem ist, dass man nur den gleichen Tag in unser System reinspielen kann. Das ist zu mühsam. Inhaltlich ist es sinnvoll, technisch ist es nicht möglich.”
[28] Original quotation: „Ich bezweifle ob elektronische Kommunikation wirklich besser ist und das organisatorische Können von Mitarbeitern aufheben kann.”
[29] Original quotation: „Mehr Personal und mehr Ärzte obwohl wir die Räumlichkeiten eh nicht haben.”
[30] Original quotation: “Es ist sehr schwierig das System auf ein Terminsystem umzustellen”

19	Majority of patients could get an appointment (not acute)	DRW	„90% of the patients could have an appointment. " (Interview Dr. M, 24.03.2014)[31]
20	An appointment system doesn't decrease waiting times	HSP	"Do you mean, if, how we appoint patients, decrease waiting times? No!" (Interview HSP, 16.05.2014)[32]
21	Specialists and general practitioner are not comparable	DRWO	„It is easier for specialist to build up an appointment system. The number of predictable technological treatments is higher. " (Interview Dr. H, 14.03.2014)[33]

Table 7: Results of the pre questionnaire interview

4.2 Questionnaire

During the project 123 questionnaires were collected. This number contains questionnaires from both settings, the hospital and the resident physicians. Table 8 provides the distribution of the number of collected questionnaires:

Location	Number of Surveys	Sub amount (%)	Amount (%)
Dr. N	21	33%	
Dr. P	18	28.6%	
Dr. M	10	15.9%	
Dr. H	14	22.5%	
Resident physicians	63	100%	51.3%
Hospital	60		48.7%
Sum	123		100%

Table 8: Number of collected surveys (segmented by location)

As the questionnaire was completely anonymous regarding patients and physicians, the physicians are named here with letters: Dr. M, Dr. H, Dr. N and Dr. P.

The following results are displayed in two ways:

1. Comparison of hospital and all resident physicians: Those numbers allow to take a closer look at the hospital area and the summarized residential area. Furthermore, with this evaluation it is possible to identify differences concerning numbers between the hospital and the primary care (resident physicians).

2. Comparison between resident physicians: Among the resident physicians different attributes occur (e.g. appointment system, work procedure). Those were carried out within the pre questionnaire interviews. Especially the usage of appointment systems requires a deeper look. Dr. M and Dr. H on the one hand both didn't provide a

[31] Original quotation: „Also 90% könnten einen (Anm. Termin) haben"
[32] Original quotation: „Meinen Sie, wie wir die Leute bestellen Ob das die Wartezeit verkürzt? Nein!"
[33] Original quotation: „Ich glaube als Facharzt kannst du viel eher eine Terminpraxis machen weil gerade heute viele Fächer auch als technische Leistungen ausgerichtet sind und da kannst du ja gut sagen, da brauchst du für EKG so und so lange und teilst die Patienten so und so ein."

complete working appointment system. On the other hand, Dr. N and Dr. P were providing a quite strict appointment system.

The results are presented within groups corresponding to the survey on the one hand, but also to the objectives and scientific questions on the other hand. The tables and figures represent relative frequencies of the observations in the interval and histograms. The y axis shows the grouped answers and intervals. The x axis shows the distribution within the intervals. The x axis is divided into two parts: (1) relative frequencies in hospitals and resident physicians, (2) relative frequencies at the resident physicians.

4.2.1 Waiting times

4.2.1.1 Waiting time at the administrative desk

To get data about the waiting times, patients were asked about the time of arrival and the waiting time at the administrative desk. This marks question A2 within the questionnaire. The results of this question are shown in Table 9.

Waiting time	*rel. freq. at hospital*	*rel. freq. at resident phy.*	*rel. freq. Dr. H*	*rel. freq. Dr. M*	*rel. freq. Dr. P*	*rel. freq. Dr. N*
0-1 min.	46.7%	44.8%	18.2%	20.0%	41.2%	75.0%
2-3 min.	20.0%	20.7%	27.3%	30.0%	17.6%	15.0%
4-5 min.	15.6%	19.0%	36.4%	0.0%	29.4%	10.0%
6-7 min.	8.9%	0.0%	0.0%	0.0%	0.0%	0.0%
8-9 min.	0.0%	1.7%	0.0%	0.0%	5.9%	0.0%
10-11 min.	8.9%	6.9%	18.2%	20.0%	0.0%	0.0%
> 11 min.	0.0%	6.9%	0.0%	30.0%	5.9%	0.0%
Sum	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table 9: Distribution of waiting times at the administrative desk

As Table 9 shows, most patients in both settings, hospital and resident physician, were waiting up to one minute at the administrative desk. Furthermore, there was no patient, who was waiting longer than eleven minutes at the administrative desk in the hospital, whereas some patients at the resident physician were waiting longer than eleven minutes.

Figure 18 shows, that there is no substantial difference between the waiting times at the administrative desk in the hospital and the resident physicians.

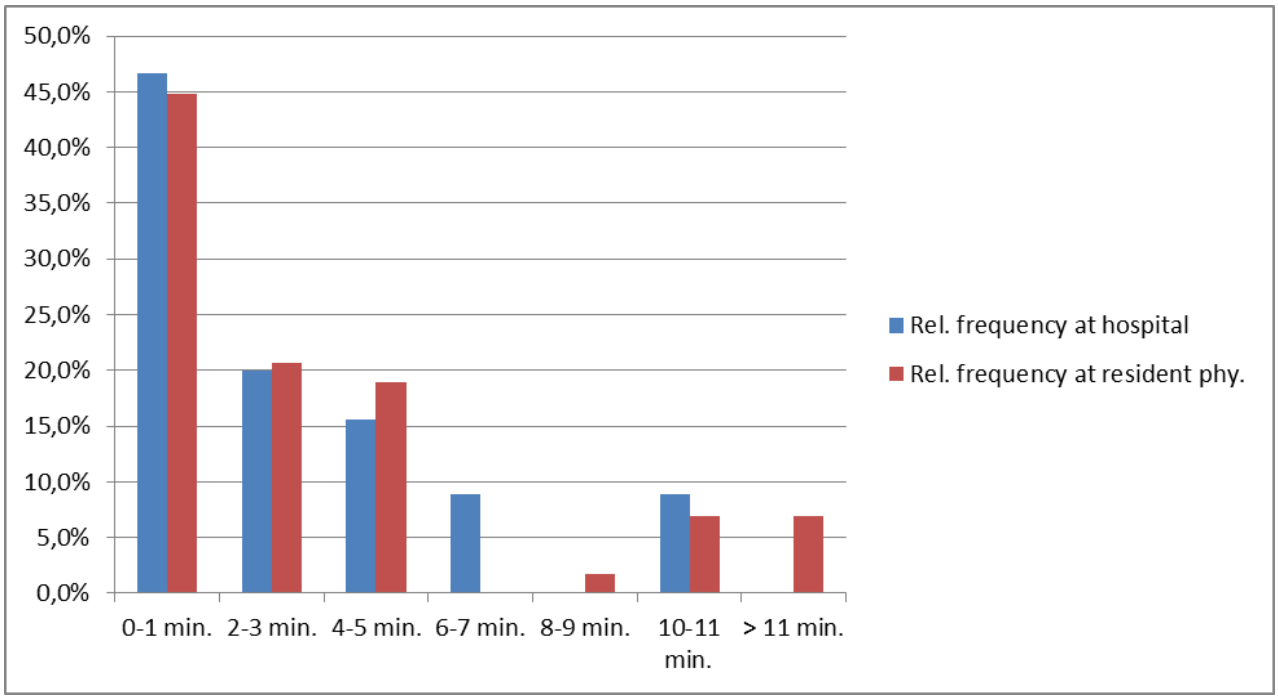

Figure 18: Distribution of waiting times at the administrative desk

On the contrary, there is quite a big difference between the various residential doctors as shown in Figure 19. Most of the patients waiting for 10-11 minutes or longer than eleven minutes were patients from Dr. M. About 50% of all of her patients had to wait more than ten minutes at the administrative desk. Dr. M has no appointment system. Neither has Dr. H, where also more patients had to wait 10-11 minutes than in the other offices. The lack of an appointment system maybe causes that more patients enter the office at the same time and therefore have to wait longer.

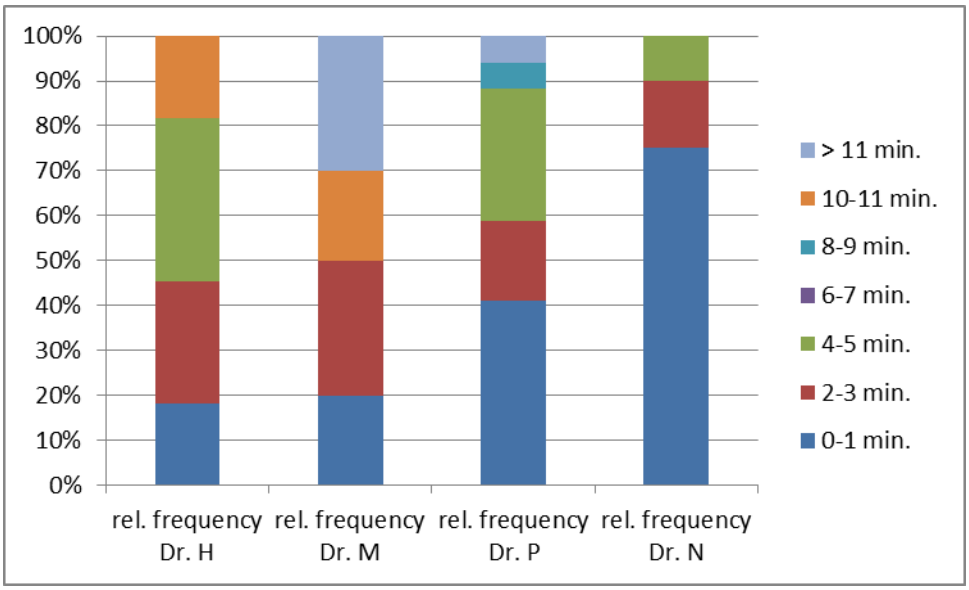

Figure 19: Distribution of waiting times at the administrative desk between residential physicians

Although all together the waiting times at the administrative desk are mostly up to one minute (45%) or between one to five minutes (39%), there is a general problem at the administrative desk that causes waiting times: The administrative desk serves two groups of patients at the same time. The first group consists of patients who only want to conduct administrative procedures such as sick notes or an extension of long-term medications. The second group consists of patients who want to see the doctor and need to register. In all the offices in this study only one person was working at the administrative desk and therefore all the patients – no matter if they wanted to see the doctor or needed to conduct administrative procedure – had to line up in the same queue. The doctors know that this is a problem causing waiting times, but they also said they could not afford to hire a second person for the administrative desk.

4.2.1.2 Waiting time at the waiting area

The patients wrote on the questionnaire their time of arrival. When they were called up to see the doctor, they handed in the questionnaire and the time was written down. As a result Table 10 shows the waiting time of the patients in minutes for the hospital and the resident physicians. This waiting time includes the waiting time at the administrative desk as shown above.

Waiting time	*rel. freq hospital*	*rel. freq. resident phy.*	*rel. freq. Dr. H*	*rel. freq. Dr. M*	*rel. freq. Dr. P*	*rel. freq. Dr. N*
15 min.	4.08%	29.82%	0.00%	20.00%	33.33%	52.94%
30 min.	4.08%	29.82%	0.00%	50.00%	33.33%	35.29%
45 min.	8.16%	15.79%	16.67%	0.00%	27.78%	11.76%
60 min.	14.29%	5.26%	16.67%	0.00%	5.56%	0.00%
75 min.	10.20%	3.51%	16.67%	0.00%	0.00%	0.00%
90 min.	16.33%	7.02%	33.33%	0.00%	0.00%	0.00%
105 min.	10.20%	5.26%	16.67%	10.00%	0.00%	0.00%
120 min.	12.24%	0.00%	0.00%	0.00%	0.00%	0.00%
135 min.	2.04%	1.75%	0.00%	10.00%	0.00%	0.00%
150 min.	2.04%	0.00%	0.00%	0.00%	0.00%	0.00%
165 min.	2.04%	1.75%	0.00%	10.00%	0.00%	0.00%
180 min.	8.16%	0.00%	0.00%	0.00%	0.00%	0.00%
195 min.	2.04%	0.00%	0.00%	0.00%	0.00%	0.00%
210 min.	4.08%	0.00%	0.00%	0.00%	0.00%	0.00%
225 min.	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
240 min.	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
> 240 min.	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Sum	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

Table 10: Distribution of waiting times

Comparing hospitals and resident doctors, the waiting time at resident doctors is clearly lower than in hospitals. While 75% of patients at resident doctors are waiting less than 45 minutes, around the same amount of people is waiting up to 120 minutes in the hospital. Figure 20 visualizes this trend.

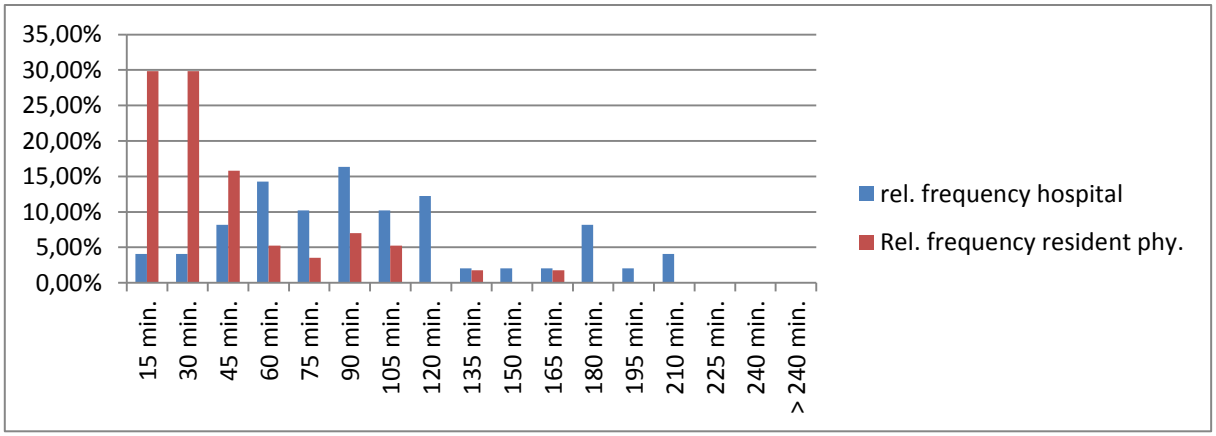

Figure 20: Distribution of waiting times

Looking at resident physicians in detail, a considerable difference can be spotted. The key numbers in Table 11 and the box plot in Figure 21 show that the lowest waiting time was noticed at Dr. N (median = ten minutes, more than 85% of the patients were waiting 30 minutes and less). He was the only specialist in the peer group and also has a strict appointment system. Second best it Dr. P (median = 20, two third of all patients were waiting 30 minutes and less), who is a general practitioner with a strict appointment system. It can be assumed that general practitioners have a higher emergence of emergency cases, which would explain the differences. Dr. M and Dr. H are having longer waiting times. Especially the big area between Q1 and Q3, shown in Table 11, at Dr. M is remarkable.

Labels	*Dr. H*	*Dr. M*	*Dr. P*	*Dr. N*	*Resident phy.*	*Hospital*
Min	38	10	4	1	0	5
Q_1	53.5	17.75	15	6	10	55
Median	77.5	23.5	20	10	20	90
Q_3	88.5	82.75	38.75	20	44.25	110
Max	100	155	60	39	155	200
IQR	35	65	23.75	14	34.25	55
Upper Outliers	0	0	0	0	5	2
Lower Outliers	0	0	0	0	0	0

Table 11: Key numbers concerning the waiting times at resident physicians and hospital

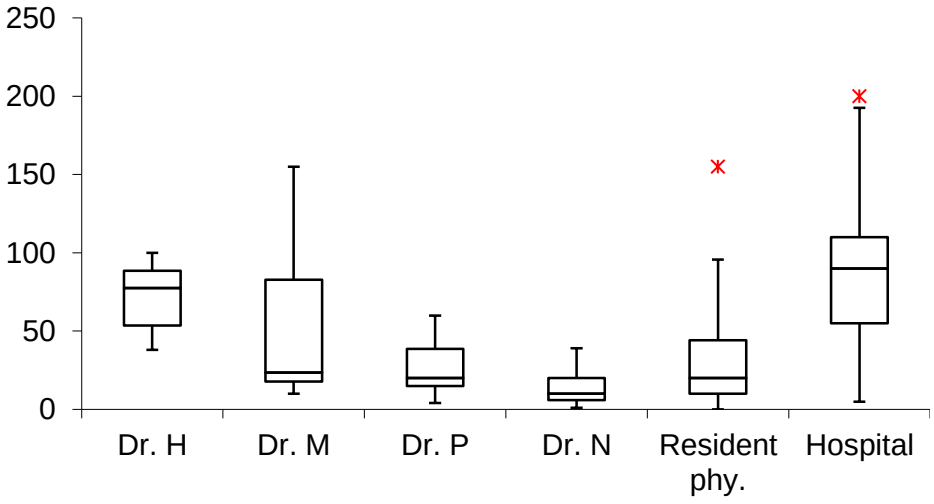

Figure 21: Box plot, shows the distribution of waiting times and outliners

To gather a sense of whether physicians know about the waiting times in their office, part of the pre survey interview was to let the physicians guess the average waiting time in their office. The results of this question are shown in Table 12.

	Dr. H	*Dr. M*	*Dr. P*	*Dr. N*	*Hospital*
Estimated waiting time	30-60 min.	*	10 min. with appointment, 60 min. without appointment	30-60 min.	15 min.

Table 12: Estimated waiting times by the physician

*Dr. M didn't give a clear answer.

Comparing the numbers of estimation from Table 12 with the actual waiting times from Table 11, most of the physicians hit the waiting time quite exactly or even overestimated them. The guess of the representative of the hospital missed the actual waiting times quite high. While based on the appointment system, in which the computer calculates an appointment every 15 minutes, the representative said 15 minutes, the actual waiting time was up to 120 minutes.

4.2.1.3 Appointments

One of the objectives of this master thesis is to check, what factors influence waiting times. One factor could be the existence of an appointment system, which was targeted by question A3 ("Did you make an appointment?") and A3.1 ("When was your appointment?"). Table 13 and Figure 22 show the results of this question.

Appointment	*Rel. freq at hospital*	*Rel. freq at resident phy.*	*rel. freq Dr. H*	*rel. freq Dr. M*	*rel. freq Dr. P*	*rel. freq Dr. N*
Yes	78.0%	49.2%	7.1%	20.0%	38.9%	100.0%
No	22%	50.8%	92.9%	80.0%	61.1%	0.0%
Sum	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table 13: Distribution of appointments

The results show that 22% of the patients at the hospital didn't have an appointment. This is astonishing as there should be no patient without an appointment at the hospital (as it is the follow-up department).

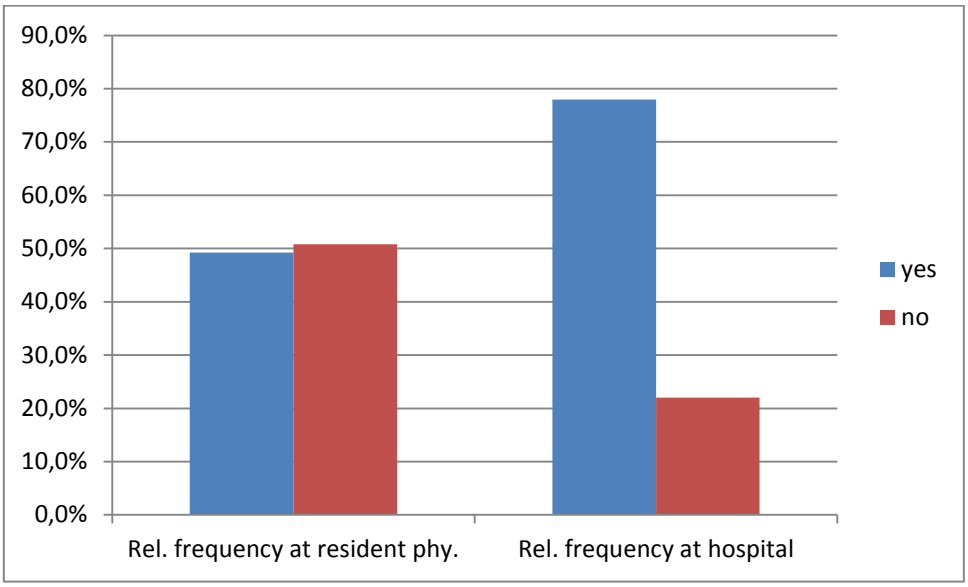

Figure 22: Distribution of appointments

Figure 23 shows several interesting facts. First of all it shows that every single patient, who came to Dr. N, a paediatrician, had an appointment. This confirms the argument, that medical treatments at specialists are more predictable. Second, although Dr. P forces a strict appointment system, more than 60% of his patients were coming without an appointment. Third, Dr. M and Dr. H use appointments only for either clear predictable treatments such as taking a blood sample or for a short time period during the office hours.

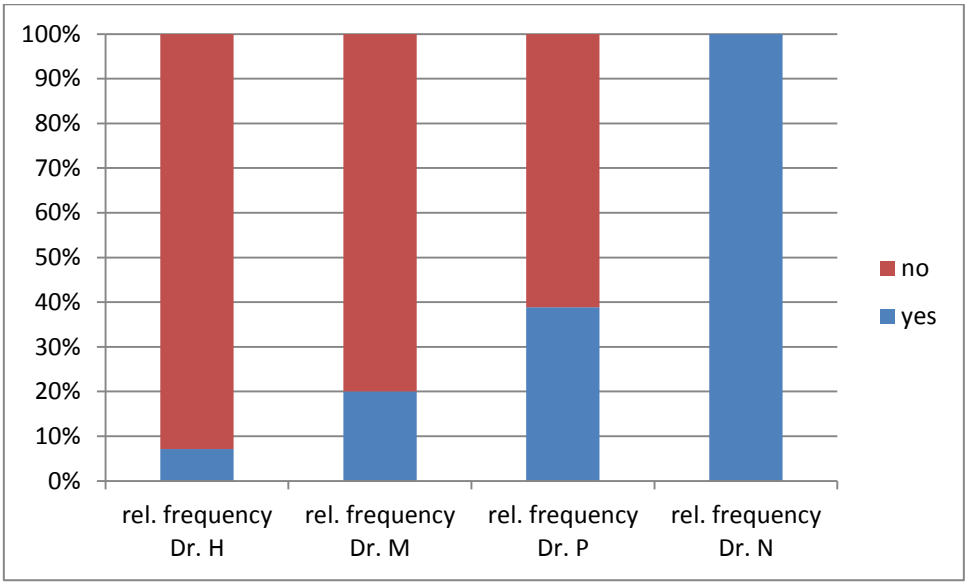

Figure 23: Distribution of appointments between residential physicians

4.2.2 Perception of waiting times

The perception of waiting times plays a big role in waiting time theory and psychology. The questions A4 ("What is your perception of the length of waiting times?"), A5 ("How do you

sense the waiting time?") and A6 ("What improvements could you think about to make the waiting time more enjoyable?") consider those issues. The results are presented separately for the hospital, physicians with an appointment system (Phy 2) and physicians without an appointment system (Phy 1).

4.2.2.1 Perception of waiting times length

The perception of waiting times forms one of the major outputs of this study. The results of question A4 are displayed in Table 14:

Perception	*rel. freq. Phy1*	*rel. freq. Phy2*	*rel. freq. hospital*	*rel. freq. Dr. H*	*rel. freq. Dr. M*	*rel. freq. Dr. P*	*rel. freq. Dr. N*
Long	41.7%	0.0%	33.9%	42.9%	40.0%	0.0%	0.0%
Ok	50.0%	51.4%	62.7%	50.0%	50.0%	50.0%	52.4%
Short	8.3%	48.6%	3.4%	7.1%	10.0%	50.0%	47.6%
Sum	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table 14: Distribution of perception of waiting times

The results show, that the physicians Dr P and Dr. N, who have an appointment system outrank the other physicians without an appointment system and the hospital by far. Figure 24 shows, that the perception of waiting times is quite the same in the hospital and at physicians without an appointment system, although the real waiting times are higher in the hospital.

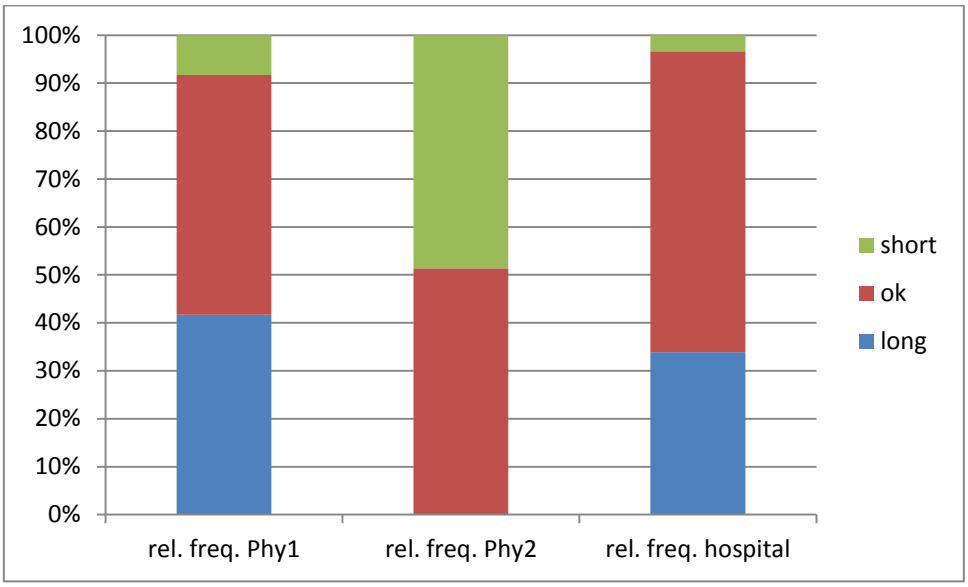

Figure 24: Distribution of perception of waiting times

Figure 25 shows that there is almost no difference within physicians with and without an appointment system. Although the patient structure of Dr. N and Dr. P varies a lot, around 50% of both doctors found that waiting times are "short", 50% "ok" and not a single patient described the waiting time as "long". The results at Dr. M and Dr. P are also quite the same, although waiting times are higher at Dr. H (see chapter "Waiting times" at page 51). Here almost half of the patients perceived the waiting time as long.

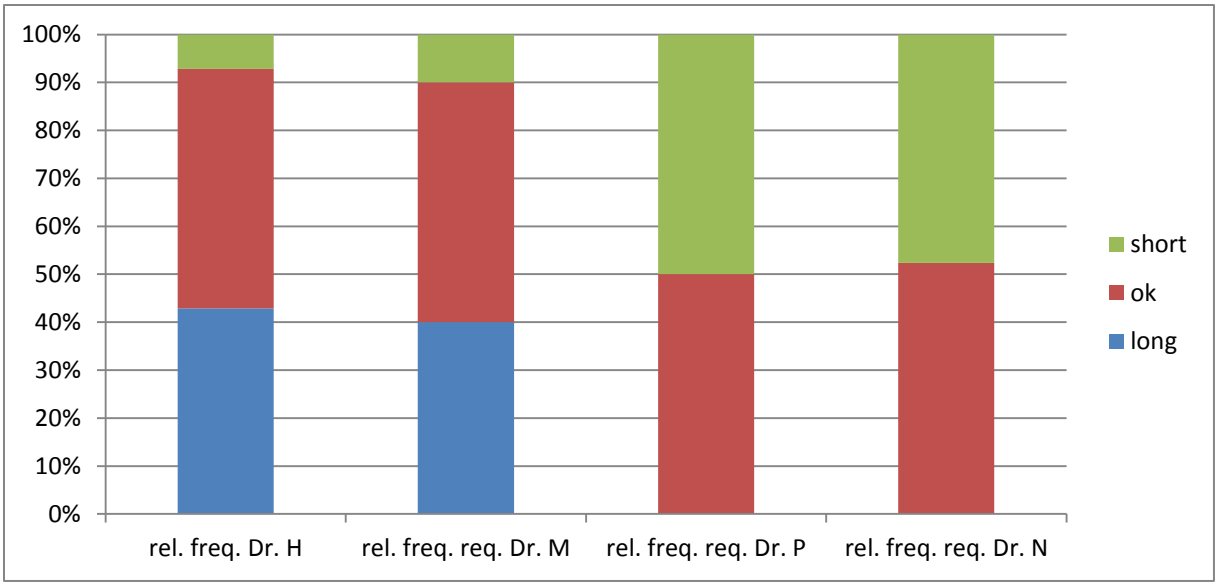

Figure 25: Distribution of perception of waiting times between residential physicians

4.2.2.2 Sensation of waiting times

Question A5 targets the sensations and feelings which arise during the waiting process. Besides the subjective perception of the length of waiting times, the feelings and emotions of the patients are a major issue. The results are displayed in table 15.

Perception	*rel. freq. Phy1*	*rel. freq. Phy2*	*rel. freq. hospital*	*rel. freq. Dr. H*	*rel. freq. Dr. M*	*rel. freq. Dr. P*	*rel. freq. Dr. N*
comfortable	66.7%	25.0%	10.2%	28.6%	20.0%	66.7%	66.7%
neutral	30.8%	66.7%	81.4%	57.1%	80.0%	27.8%	33.3%
uncomfortable	2.6%	8.3%	8.5%	14.3%	0.0%	5.6%	0.0%
sum	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table 15: Distribution of sense through waiting times

The results of physicians with an appointment system are similar to the perception of waiting times. Figure 26 shows that they outrank the other categories by far. 66.7% of the patients feel comfortable at physicians with an appointment system. Patients at the hospital and at physicians without an appointment system have more or less neutral emotions concerning waiting.

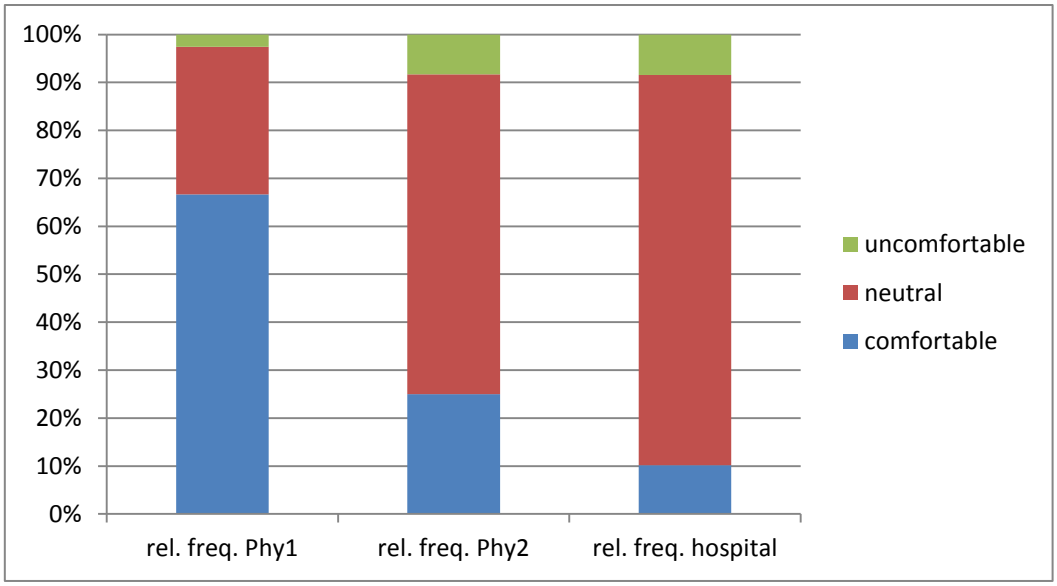

Figure 26: Distribution of sense through waiting times

The trend from the chapter before is repeated here. Figure 27 shows that Dr. P and Dr. N, who are providing appointments, have better results than the others. Interesting is, that the feelings of the patients are similar at Dr. P and Dr. N although the absolute waiting time is longer at Dr. P. Therefore one can guess that just the fact to have an appointment system and the patients knowing about it, makes the patients feel more comfortable. Nevertheless it is interesting to see that long waiting times are mostly perceived neutrally and not uncomfortable.

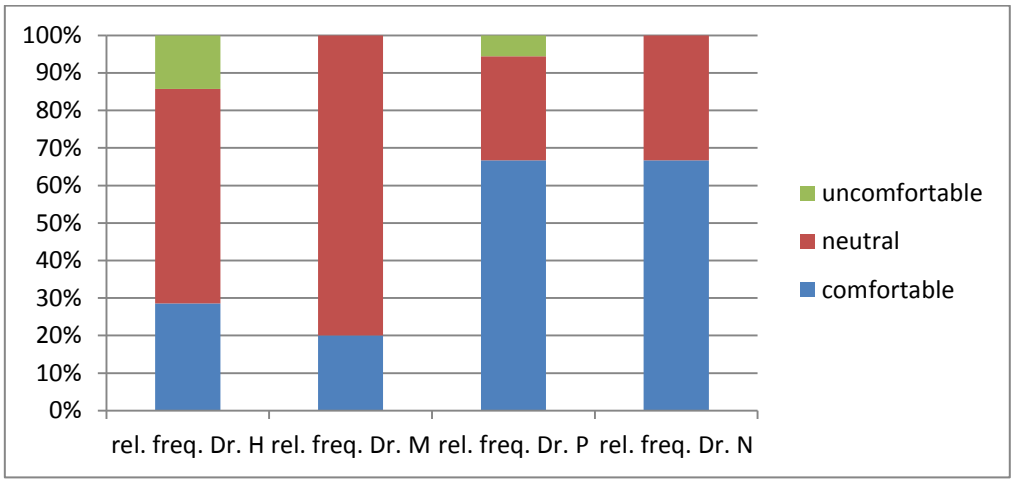

Figure 27: Distribution of sense through waiting times between residential physicians

4.2.2.3 Improvements

To reduce the perception of the length of waiting times as well as to make waiting times as such more comfortable, it is necessary to know what to improve. Question A6 is dealing with improvements to make the waiting process more comfortable. Results are shown in Table 16.

Within the tables and the figures, physicians with and without an appointment system are gathered together as the divided results didn't show any significant differences. Furthermore, it was possible to tick multiple answers.

Improvement	*rel. freq. resident phy.*	*rel. freq. hospital*	*rel. freq. phy. Dr. H*	*rel. freq. phy. Dr. M*	*rel. freq. phy. Dr. P*	*rel. freq. phy. Dr. N*
more magazines	11.5%	25.7%	12.5%	8.3%	13.3%	12.5%
more media	3.3%	7.3%	0.0%	16.7%	0.0%	0.0%
more space	19.7%	9.2%	43.8%	8.3%	6.7%	18.8%
increase cleanliness	1.6%	1.8%	6.3%	0.0%	0.0%	0.0%
new furnishing	3.3%	2.8%	0.0%	8.3%	6.7%	0.0%
drink dispenser	29.5%	16.5%	12.5%	41.7%	33.3%	37.5%
more medical journals	9.8%	1.8%	12.5%	0.0%	13.3%	12.5%
I want to know how much longer I have to wait	18.0%	33.9%	12.5%	16.7%	26.7%	18.8%
Wi-Fi	1.6%	0.9%	0.0%	0.0%	0.0%	0.0%
Using waiting times for other transactions	1.6%	0.0%	0.0%	0.0%	0.0%	0.0%
sum	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table 16: Distribution of the claimed improvements

There are five topics which were ticked the most: more magazines, more space, drink dispenser, more medical journals and "I want to know how much longer I have to wait". Especially the knowledge about the waiting time seems to be an important point – even more in the hospital. Besides simple improvements such as more magazines and drink dispenser, which are easy and not costly to implement, other improvements such as more space and "I want to know how much longer I have to wait" need either a change within the organisational structure or a costly rental or construction of the facilities.

4.2.3 Costs of waiting times

A major issue of this thesis is to examine the "lost" time caused by the waiting time and to find out what patients would have done instead of waiting. The questions A7 ("Are you coming alone or in company?"), A7.1 ("If you are coming in company, what would this person do if he or she wouldn't be here?") and A8 ("What would you do if you wouldn't be here?") are dealing with this topic.

4.2.3.1 Alone or in company

The results of the question whether the patient comes alone or in company to the health care facility are shown in Table 17. As Dr. N is a paediatrician, parents are in company of their children. For this reason, data from patients from Dr. N is dropped for this analysis.

Company	*rel. freq. hospital*	*rel. freq. phy.*	*rel. freq. Dr. H*	*rel. freq. Dr. M*	*rel. freq. Dr. P*
spouse	18.5%	7.1%	0.0%	10.0%	11.1%
friend	7.4%	0%	0.0%	0.0%	0.0%
child(ren)	11.1%	4.8%	0.0%	10.0%	5.6%
alone	63.0%	88.1%	100.0%	80.0%	83.3%
sum	100.0%	100.0%	100.0%	100.0%	100.0%

Table 17: Distribution of company of patients

Figure 28 shows a clear trend visible that patients bring company more often in hospitals. The number of people who are visiting the hospital in company is more than three times higher as at residential doctors. Altogether, 37% of the patients came in company to the hospital while only 11.9% of the patients at resident physicians came in company. Within the various resident doctors there is no substantial difference. Most of the patients in company were attended by their spouse or their children, at the hospital some patients also had friends with them.

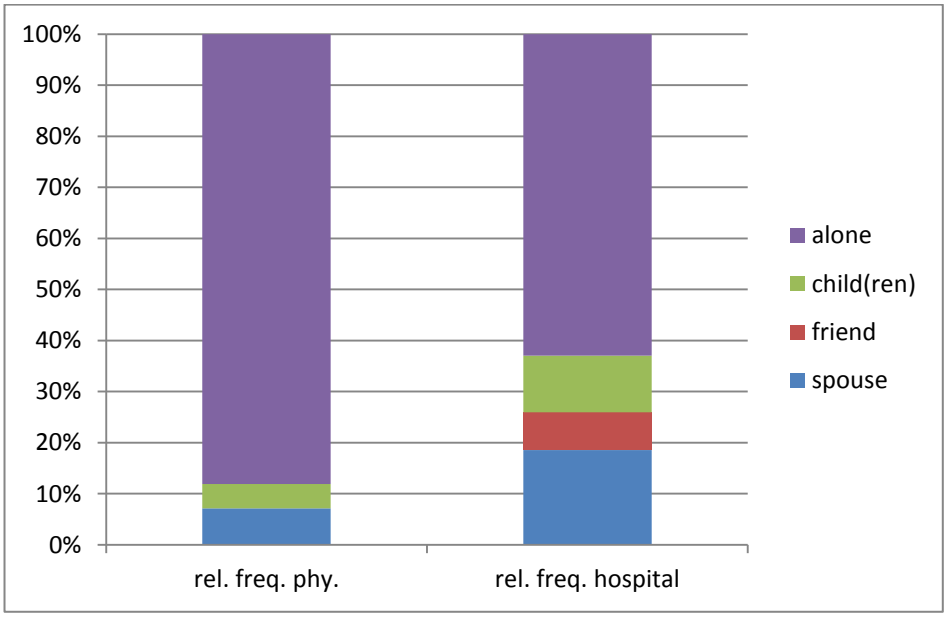

Figure 28: Distribution of company of patients

4.2.3.2 Activities of company

To calculate the lost GDP caused by waiting times (see chapter "Analysis of loss of gross domestic product" on page 42) not only for the patients but also for the persons accompanying them, it is necessary to know what they would have been doing, if they had not been waiting with the patients. Table 18 shows the results of the survey.

Activity company	*rel. freq. phy.*	*rel. freq. hospital*
gainful work	25.0%	73.7%
spare time	25.0%	21.1%
at home	50.0%	5.3%
Sum	100.0%	100.0%

Table 18: Distribution of activities of company of patients, instead of waiting

There is a completely different picture at resident physicians and the hospital when it comes to the activities of the companions of the patients. People accompanying the patients to the hospital would more often prefer to work instead of waiting in the hospital. People accompanying the patients to the resident physicians would more often have spare time or be at home instead of waiting with the patients. One reason for that may be that patients coming to the hospital are often not able to go there alone, because they are hurt more badly than the patients at the resident physicians. Patients in the observed hospital setting also were significant younger than the patients at the resident physician and so were the persons

accompanying them. The younger people in the hospital might be more often employed and therefore missing work, while elderly people at the resident physicians might be more often retired and would be at home or have spare time instead of waiting.

4.2.3.3 Activities of patient

Even more important for the calculation of the lost GDP caused by the waiting times as the activities of the company of the patients are the activities of the patients themselves. Not all patients visiting the hospital or the resident physician are acute ill and would therefore be working instead of waiting or doing other things. A lot of patients for instance are seeing a doctor for a medical check-up, for vaccination or other medical treatments not causing a sick leave. Therefore the questionnaire contained a question (A8) dealing with this issue. The results are shown in Table 19.

Activity Patient	*rel. freq. phy.*	*rel. freq. hospital*
gainful work	50.0%	49.1%
spare time	16.1%	15.8%
at home	21.0%	8.8%
become healthy at home	11.3%	22.8%
school	1.6%	3.5%
sum	100.0%	100.0%

Table 19: Distribution of activities of patients, instead of waiting

The results at resident physicians and at the hospital are quite similar. Approximately 50% of the patients would be working instead of waiting.

4.2.4 Shorten waiting times

Within this section, the answers to the questions B1 to B3 of the questionnaire are listed and visualized. This section contains several approaches to reduce waiting times or make them more comfortable.

4.2.4.1 Online doctor

The results of question B1 ("Could you imagine visiting your doctor online?") are shown in Table 20.

Internet consultation	*rel. freq. phy.*	*rel. freq. hospital*	*rel. freq. Dr. H*	*rel. freq. Dr. M*	*rel. freq. Dr. P*	*rel. freq. Dr. N*
yes	53.2%	47.4%	61.5%	70.0%	22.2%	66.7%
no	46.8%	52.6%	38.5%	30.0%	77.8%	33.3%
sum	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table 20: Distribution of answers concerning online doctor visits

The results are quite consistent. About 50% of patients, at resident physicians as well as at the hospital, can imagine visiting their doctor online. There is only one remarkable outlier. Almost 80% of patients of Dr. P cannot imagine visiting their doctor online. This may be explainable

by the higher age of the patients of Dr. P. This outlier is visualized in the third column of Figure 29.

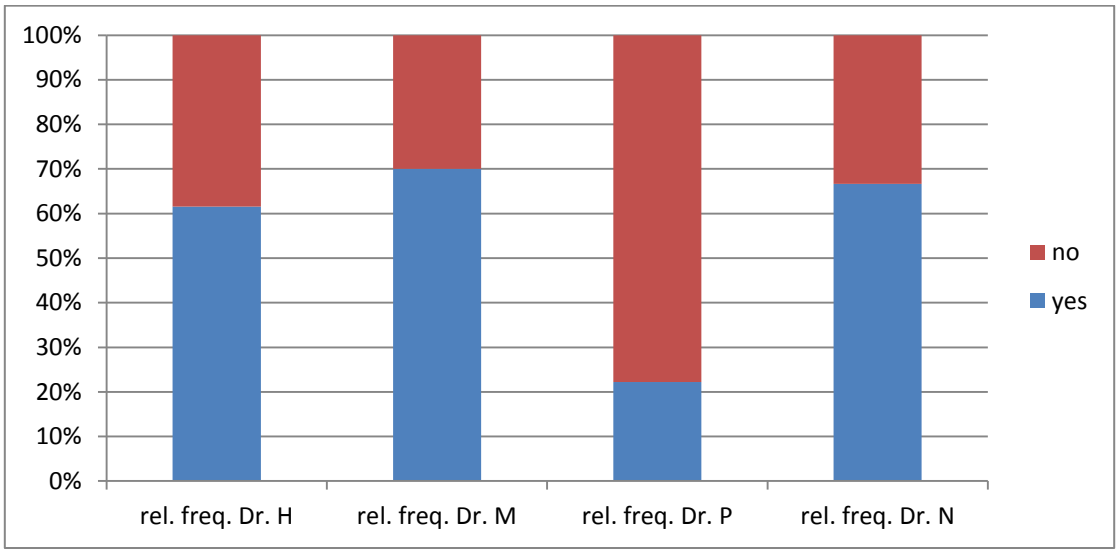

Figure 29: Distribution of answers concerning online doctor visits between resident physicians

4.2.4.2 Online waiting times

A solution for making waiting times more comfortable is to publish them online, so that everyone is able to plan the visit according to the current waiting time. Questions B2 ("Would you like to see waiting times online?") and B2.1 ("Would you plan your visit according to the online waiting times?") deal with this issue. The results are shown in Table 21 and Table 22.

See waiting times online	*rel. freq. phy.*	*rel. freq. hospital*	*rel. freq. Dr. H*	*rel. freq. Dr. M*	*rel. freq. Dr. P*	*rel. freq. Dr. N*
Yes	58.7%	79.3%	71.4%	70.0%	33.3%	66.7%
No	41.3%	20.7%	28.6%	30.0%	66.7%	33.3%
sum	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table 21: Distribution of answers concerning online waiting times

There is a clear wish to see waiting times online among the patients in the hospital as well as at residential physicians. Figure 30 shows that the willingness of patients at the hospital is higher. This is interesting as the results of the question B1 are not following the same pattern. As already shown in Figure 29, there is an outlier: Dr. P's patients are not as willing to use the presented online health care services as the other patients.

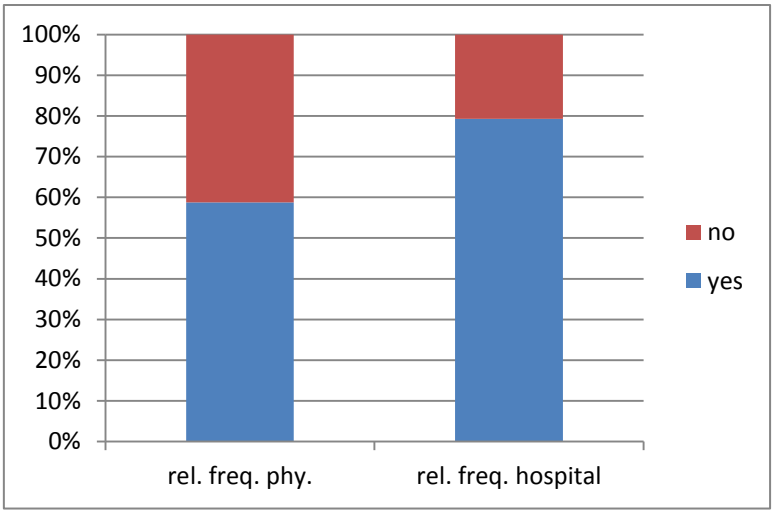

Figure 30: Distribution of answers concerning the wish to see waiting times online

Table 22 shows that most people who can imagine having a look on online waiting times are also willing to plan their visit according to the online waiting times.

Plan visit according to online waiting times	*rel. freq. phy.*	*rel. freq. hospital*
yes	73.8%	83.0%
no	26.2%	17.0%
sum	100.0%	100.0%

Table 22: Distribution of answers concerning planning the visit according to online waiting times

4.2.4.3 Strict appointment system

Question B3 („Do you prefer a strict appointment system?") is dealing with the acceptance of strict appointment systems. It was shown that doctors who are using appointment systems have lower waiting times. The question is, whether the patient is willing to give away the freedom to see a doctor whenever he or she wants for the advantage of lower waiting times. The results are shown in Table 23.

strict appointment	*rel. freq. phy.*	*rel. freq. hospital*	*rel. freq. Dr. H*	*rel. freq. Dr. M*	*rel. freq. Dr. P*	*rel. freq. Dr. N*
Yes	58.7%	67.3%	35.7%	40.0%	61.1%	81.0%
No	41.3%	32.7%	64.3%	60.0%	38.9%	19.0%
Sum	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table 23: Distribution of opinions about a strict appointment system

Having a look at the numbers of hospitals and resident physicians, there is a majority of the patients in both settings in favour of a strict appointment system.

An interesting result can be seen in Figure 31. The majority of patients visiting physicians who do not offer a strict appointment system (Dr. H and Dr. M) are also not in favour of such a system. On the contrary, patients visiting physicians who follow a strict appointment system (Dr. P and Dr. N) are in favour of the strict system.

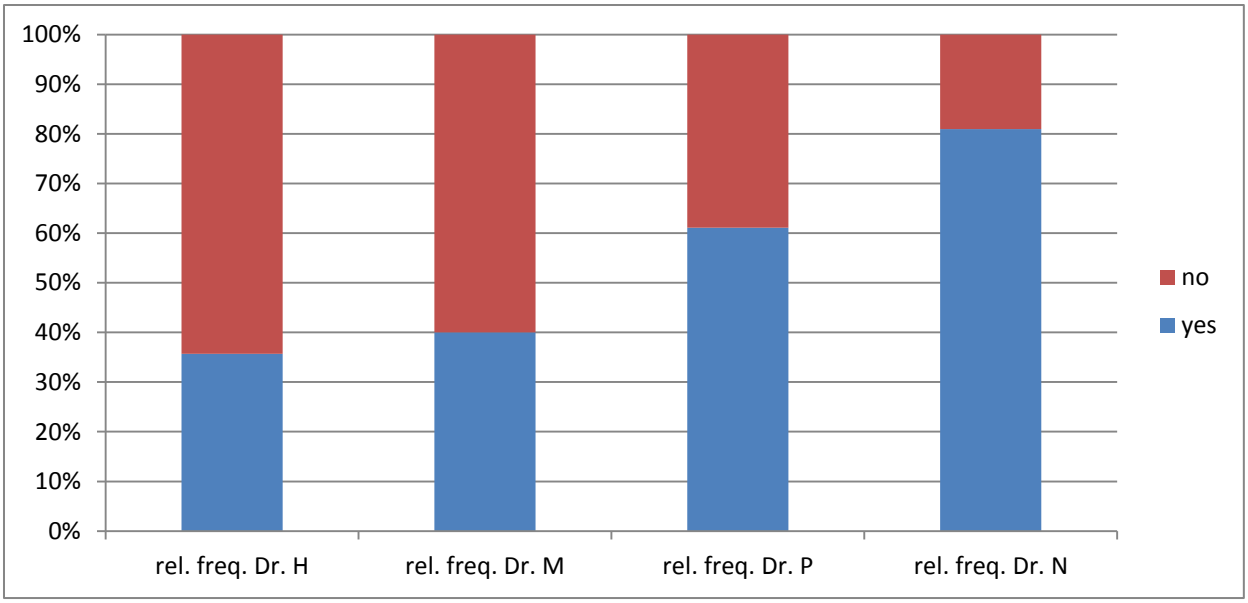

Figure 31: Distribution of opinions about a strict appointment system between residential physicians

4.2.4.4 Other suggestions

To be able to cover all suggestions for the reduction of waiting times, the questionnaire provided a free text field, where patients could suggest more activities to decrease waiting times. Table 24 shows a list of all suggestions.

Issue	Mentions*	Quotation
Improve patient scheduling	4 x DRW 2 x DRO 10 x HSP 16	„Reduce number of patients so there is enough time in reserve.“[34] „Allocate time according to diagnoses and adequate treatment.“[35]
More staff an capacities	2 x DRW 9 x DRO 11	„more capacities“[36] „more staff (doctors)“[37]
Quality before quantity	3 x DRO	„Quality before quantity, when it comes to patient treatment“[38] „Prefer waiting to an inaccurate diagnoses“[39]
Special desk fore prescriptions	1 x DRW 1 x DRO 2	„Special administrative desk for prescriptions“[40] „There is a long waiting time to get a prescription“[41]
Waiting times are a necessary evil	1 x DRO	„Waiting time is most of the time a necessary evil, it occurs out of acute patients. “[42]

[34] Original quotation: „Nur so viele Patienten wie terminmäßig passen, dass auch Reservezeit bleibt.“
[35] Original quotation: „Termine nach Diagnose und entsprechender Behandlung einteilen.“
[36] Original quotation: „Mehr Kapazitäten“
[37] Original quotation: „Mehr Personal (Ärzte)“
[38] Original quotation: „Qualität statt Quantität im Umgang mit dem Patienten.“
[39] Original quotation: „Lieber warten dafür eine genaue Diagnose.“
[40] Original quotation: „Eigenen Schalter für Rezepte“
[41] Original quotation: „Dauert lange bis man das Rezept bekommt“

Use assistance staff	1 x DRW	„Use assistance staff“

Table 24: How to decrease waiting times (qualitative answers)

* DRO … Physician without appointment system
DRW … Physician with appointment system
HSP … Hospital

4.2.5 Demographic key numbers

The following tables and figures show demographic key numbers like age and sex. Table 25 shows that especially the age may influence the answers to the questions B1 to B3.

The age was divided into the following groups:

1 < 20
2 20-29
3 30-39
4 40-49
5 50-59
6 60-69
7 > 70

Labels	*Dr. H*	*Dr. M*	*Dr. P*	*Dr. N*	*Resident phy.*	*Hospital*
Min	2	2	2	2	2	1
Q_1	3.25	3	5	3	3	2
Median	5	4	6	4	4	3
Q_3	6	4.75	7	4	6	4
Max	7	7	7	7	7	7
IQR	2.75	1.75	2	1	3	2
Upper Outliers	0	0	0	2	0	0
Lower Outliers	0	0	0	0	0	0

Table 25: Distribution of the age of the patients

The distribution of the age of the patients shows that the median patient was between 30 and 60 year old. Hospital patients were in median 30-39, patients at the resident physicians 40-49 years old.

Figure 32 shows that the oldest patients were at Dr. P's office. This matches with the answers of the chapter "Shorten waiting times" starting at page 62, where patients of Dr. P were not willing to use online tools.

[42] Original quotation: „Wartezeiten sind meist ein notwendiges Übel damit auch Akutfälle rasch eingeschoben werden können. In diesem Fall entstehen Wartezeiten.“

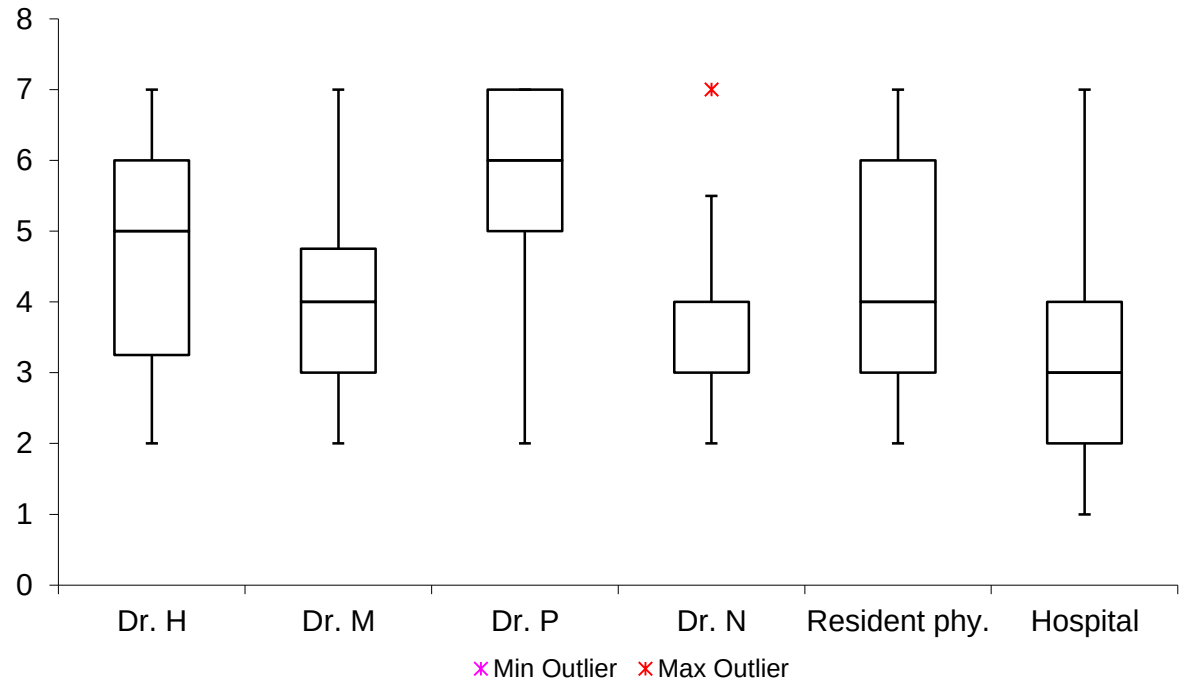

Figure 32: Box plot of the age of the patients

Table 26 shows the gender of the participants. It is interesting to notice that there were slightly more female patients at resident physicians, while in the hospital there were slightly more male patients. It is assumed that this gender gap does not have any influence on the results.

gender	*rel. freq. phy.*	*rel. freq. hospital*
female	60.3%	47.4%
male	39.7%	52.6%
sum	100.0%	100.0%

Table 26: Distribution of the gender of the patients

4.2.6 Waiting times

In addition to the questionnaire survey there was also done participant observation in the waiting areas. The results of the participant observation are shown in Table 27. To have the opportunity to compare the results from the participate observation to the results of the questionnaire survey and results from the qualitative interviews with the physicians, the right column shows the doctor where the issue was observed.

Issues	observed at
Patients were waiting at the hallway.	Dr. H
The waiting room was full almost the whole day.	Dr. H
A drink dispenser was available.	Dr. H
Increased waiting times due to unpredictable blood samples.	Dr. H
One third of the patients were private patients (health care insurance is not paying).	Dr. N
Calculated timeslots: • pregnancy passport: 30 minutes • ECG: 20 minutes • Vaccination: 20 minutes • First admission including ultra sound: 40 minutes • Earache: 20 minutes • Bacterial infection: 20 minutes	Dr. N
Appointments are allocated concerning the historic experience with each patient (some may need longer, some shorter).	Dr. N
Problems to lead the patient to the right spot.	HSP
Information panels have bad positions and are too small.	HSP
No information for the patients, patients are angry to be left in the dark.	HSP
Calls are fuzzy sometimes.	HSP

Table 27: Results of the participant observation

4.3 Validation Interview

The aim of the validation interview was firstly, to verify the results of the questionnaire, secondly, to present the results to the involved physicians and thirdly, to note the response to the results. Two validation interviews took place, one with Dr. M, a physician not using a strict appointment system, and one with Dr. P, who is using an appointment system. Both are resident physicians working as general practitioners.

The following pages show all questions and reactions starting with the interview with Dr. P followed by the interview with Dr. M.

The interviews were conducted as telephone interviews. As a result, the answers are not strict quotations but represent the spoken content.

4.3.1 Validation interview Dr. P

1. Issue: The waiting time at the reception desk is lower than one minute for 40% of the patients. Nevertheless, there was the demand for a separate desk for prescriptions.

   Reaction: Another employee is not affordable. One hour costs around 10-20 patients. Hiring another employee would make it necessary to have more patients, what decreases the time I have for each patient. However, I would like to have a second employee as well.

2. Issue: 50% of your patients think, that the waiting times are ok, 50% think that they are short. They are much lower than in offices without appointment systems.

   Reaction: It is good to know that appointment systems decrease waiting times.

3. Issue: 33.3% demanded a drink dispenser, 26.7% would like to know how long they have to wait and 13.3% want more magazines in the waiting area.

   Reaction: We will provide water and cups, drink dispensers are too expensive. The desire to know how long patients have to wait is understandable but hard to implement.

4. Issue: 77.8% cannot imagine visiting you online.

   Reaction: This is strange, because I regularly use emails to communicate with my patients, e.g. for prescriptions. Maybe there were only elderly people answering your questionnaire.

5. Issue: 33.3% of your patients would like to see the waiting times online.

   Reaction: This is hard to implement, because I decide spontaneously which patient I see next according to the medical issue. Vaccinations for example are faster done, so I prepone such patients.

6. Issue: 61.1% prefer appointment systems to non-appointment systems.

   Reaction: The worst thing is, when you have an appointment system and it doesn't work and so the patients have to wait although they have an appointment. This makes patients unhappy.

7. Issue: 60% of the patients are female.

   Reaction: Women are visiting physicians more often.

In general Dr. P was very interested in the results and confirmed that the results were similar to her observations. She was aware of most of the problems.

4.3.2 Validation interview Dr. M

1. Issue: The waiting times at your administrative desk are very long compared to other physicians and in the perception of the patients.

   Reaction: A lot of patients only come for prescriptions, which are done by the administrative personnel. There is also the possibility to get a prescription via telephone.

2. Issue: 40% of the patients said that waiting times are "long".

   Reaction: We are currently trying to implement an appointment system. But the change process is difficult.

3. Issue: 41.7% of the patients would like to have a drink dispenser, 16.7% would like to know how much longer they have to wait and 16.7% want to have more magazines in the waiting area.

   Reaction: There are already cups with water available.

4. Issue: 70% of the patients could imagine to visit the doctor online.

   Reaction: Good idea, but it won't be paid.

5. Issue: 70% would like to see waiting times online.

   Reaction: The technical implementation is very difficult.

6. Issue: 75% prefer a strict appointment system.

   Reaction: This confirms my impression. The currently mishmash system between appointments and not appointments is very unsatisfactory.

In general Dr. P was also very interested in the results. She said that waiting times disturb herself the most but that they are often not preventable.

5 Analysis and discussion

Within the following chapter the results from the previous chapters are analysed concerning the research questions and objectives from chapter 1.1. This analysis includes data from the quantitative (questionnaire survey from chapter 4.2) and qualitative survey (pre questionnaire interview from chapter 4.1, questionnaire validation interviews from the chapter 4.3). Furthermore, results and statements of other studies and articles, which were presented in chapter 2, are included to underlay or question the results.

5.1 Process oriented evaluation of the origin of waiting times

The first objective and research question aims to clarify the origin and the causes of waiting times. Several points were detected during the interviews and surveys:

5.1.1 Standardized medical process

One approach to detect the causes of waiting times is a process-oriented approach. Modelling the doctor-patient-interaction as well as the business processes of the doctor's office and the hospital ambulance, it may be possible to see where waiting times occur. During the study it became evident that the medical process concerning the doctor-patient-interaction depends on several factors, which makes it hard to draw a process. One of the results of the pre questionnaire interview was, that "there is no medical process" and that it is "difficult to standardize a medical process" (Issue no. 2 and No. 3 in Table 7). The process going on from the first contact with the patients to their diagnoses and the treatments in combination with the functioning of a doctor's office is very inhomogeneous. A process from one medical institution cannot be compared to the process of another one. Designing such a process would lead to an either very complex or inaccurate outcome (Issue no. 1 in Table 7).

The literature confirms that the creation of a standardized medical process is hard to achieve. A study from the United States concludes that the incalculable medical everyday life, for instance that there can be a call from another institution concerning a patient during the office hours, leads to longer waiting times [33]. Another example is the appearance of emergency patients what deranges the waiting list [44]. It can be assumed that within this study sample the impossibility to standardize the medical process leads to longer waiting times.

5.1.2 Estimation of time for medical issue

Within an appointment system, patients normally call before visiting the doctor's office. During this calls patients are asked to state the medical issues, so a certain appropriate time slot within the appointment system can be reserved for the patient (Issue no. 5 and No. 6 Table 7). The ability to state the medical issue in a way that the receptionist is able to reserve an appropriate time slot is unequal distributed over the patients. Some patients might be able to express themselves, others might not. This kind of problem is related to health literacy. „Health literacy is a function of the interaction between individuals in health context to which they are opposed". This applies to the patient, physician but also to the administrative personnel such as the receptionists or nurses. A lack of health literacy especially concerns the lower social classes [78]. However, the improvement of the scheduling system is one of the main claims of the patients (Table 24).

5.1.3 The unpunctual patient

A challenge within a strict appointment system is a patient, who misses his/her appointment or is being late. It may take a long time till the system works again (Issue no. 8 in Table 7). If the patient totally misses the appointment the doctor either has a gap, or he/she can treat the next patient, if he/she is already there. A bigger problem occurs with a late coming patient. Physicians may have a gap waiting for the patient and then two patients come at the same time – what can delay the whole system.

A survey from the Hartmannbund in Germany comes to the conclusion that patients miss one in seven appointments at specialists, and one in ten appointments at general practitioners [17]. Following these results, doctors might reserve shorter time slots for the patients, so that the gap is not that big or that the next patient is already waiting and can be treated first, if another patient comes late. Norman and Bailey showed that long waiting times decrease the consultant's average time wasted [21].

5.1.4 Too many patients, too few doctors

Probably the simplest but most extensive reason for waiting times is the quantity of patients (Issue no. 10 in Table 7). A way this problem could be solved is to hire more physicians (Issue no. 17 in Table 7). The necessity of more doctors and personnel in general is not only demanded by physicians but also by patients (table 18). This problem is related to political, financial and organizational issues which are beyond the scope of the thesis.

5.1.5 Long waiting times affects patients and physicians differently

The influence of waiting times on patients and physicians is completely different. Patients are affected directly as they lose the waiting time immediately. Physicians are affected in a different way (Issue no. 14 in Table 7). First of all, they feel the pressure of patients waiting and therefore they may reduce the treatment time per single patient. Furthermore, they face the anger and impatience once the long waiting patient is treated [22].

Second, the longer the waiting queue is, the larger the waiting room has to be. This statement bases on the claimed improvements from question A6 of the questionnaire. Table 28 shows the results for the item "more space" concerning the patients of the various physicians and the hospital. Dr. H. has by far the longest waiting times and therefore the highest need for more space.

Improvement	*rel. freq. resident phy.*	*rel. freq. hospital*	*rel. freq. phy. Dr. H*	*rel. freq. phy. Dr. M*	*rel. freq. phy. Dr. P*	*rel. freq. phy. Dr. N*
more space	***19.7%***	***9.2%***	***43.8%***	***8.3%***	***6.7%***	***18.8%***
Others	80.3%	90.8%	56.2%	91.7%	93.3%	81.7%
sum	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table 28: Excerpt of Table 16 concerning the claimed improvements

Third, the probably biggest effect for physicians is that they earn a bad reputation on doctor rating online platforms. There, patients mostly have the opportunity to rate the waiting times and other patients can chose their physician according to the ratings. The overall satisfaction with Dr. H, an example for a physician with long waiting times on one of the biggest customer assessment online portals in Austria, *docfinder.at*, is quite poor (49% overall rating). On the

contrary, the overall rating for Dr P, a representative of physicians with short waiting times, is rated very well (90% overall rating). Figure 33 shows the ratings in detail.

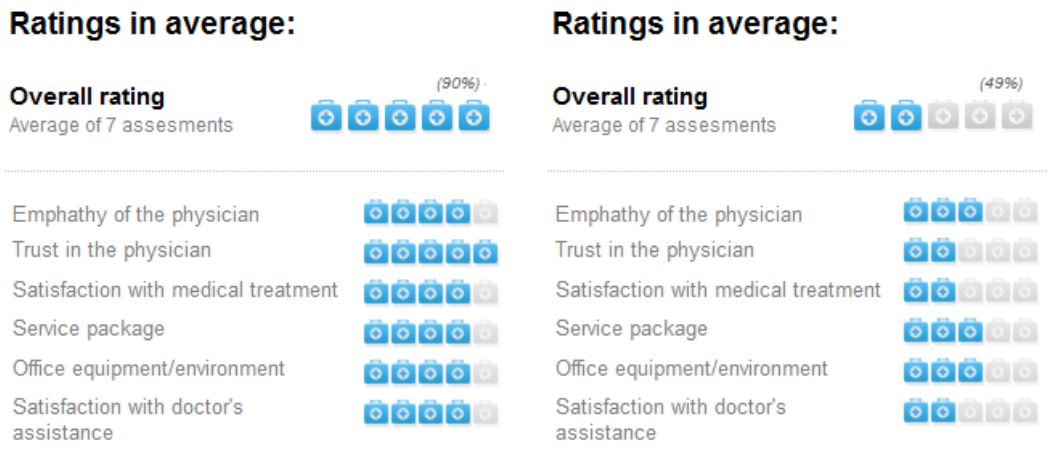

Figure 33: Comparison of Dr. P's rating (left) and Dr. H's rating (right) on the customer assessment online portal docfinder.at [at 07.11.2014 10:00]

Nevertheless, waiting times are not always the worst thing for physicians as they minimize idle time between two patients. A study from Norman Bailey says that long waiting times are intended to prevent possible idle statuses [21].

Although, physicians and patients are concerned in a different way, both sides see that each party must contribute, so that waiting times become shorter.

5.2 Evaluation of duration of waiting times

The second, third and fourth question discusses the length of the waiting times in different surroundings. Furthermore, the perception of waiting times in combination with possible improvements of the waiting process is discussed. First the waiting times at the administrative desk are discussed and then the waiting times for each observed medical setting will be presented. Those results will be compared to results from the literature.

5.2.1 Administrative desk

There is no significant difference between waiting times at the administrative desk at the hospital ambulance and at resident physicians. While the majority of the patients were waiting less than six minutes (Table 9 and italic items in Table 29), some patients still were waiting more than eleven minutes. In all the observed offices there was only one person working at the administrative desk.

Waiting time	*rel. freq. at hospital*	*rel. freq. at resident phy.*	*rel. freq. Dr. H*	*rel. freq. Dr. M*	*rel. freq. Dr. P*	*rel. freq. Dr. N*
0-1 min.	***46.7%***	***44.8%***	***18.2%***	***20.0%***	***41.2%***	***75.0%***
2-3 min.	***20.0%***	***20.7%***	***27.3%***	***30.0%***	***17.6%***	***15.0%***
4-5 min.	***15.6%***	***19.0%***	***36.4%***	***0.0%***	***29.4%***	***10.0%***
6-7 min.	8.9%	0.0%	0.0%	0.0%	0.0%	0.0%
8-9 min.	0.0%	1.7%	0.0%	0.0%	5.9%	0.0%
10-11 min.	8.9%	6.9%	18.2%	20.0%	0.0%	0.0%
> 11 min.	***0.0%***	***6.9%***	***0.0%***	***30.0%***	***5.9%***	***0.0%***
Sum	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table 29: Distribution of waiting times at the administrative desk (compare Table 9)

In all the observed offices there was only one person working at the administrative desk. The waiting time at the administrative desk therefore easily increases when it comes to administrative issues such as the extension of long-term medications or the writing of sick notes. If one or more patients, who don't need to see the doctor but just need to have some administrative issues done, are queued up, the waiting time for the others increases rapidly. Due to that, several patients demanded an extra desk for administrative issues only to separate the patients relating to their needs (Table 24). This was a topic during the validation interviews. Both physicians participating in the validation interviews admitted to know about that reasons for the increase of the waiting times at the administrative desk. Both also expressed the wish for more administrative stuff, but acknowledged that it is just not affordable to hire another administrative person (see chapter "Validation Interview" at page 68: "Another employee is not affordable. One hour costs around 10-20 patients. Hiring another employee would make it necessary to have more patients, what decreases the time I have for each patient.").

Waiting times differ between hospital ambulances and resident physicians, but also between the resident physicians with and without appointment system.

5.2.2 Hospital

Patients at the hospital ambulance for follow-up care, where the survey for this thesis took place, normally get an appointment calculated by the computer. The computer system is supposed to assign an appointment every 15 minutes. This allocation is in no way displayed by the data. Most patient's appointment was at 8:00 (5 times out of 47 surveys), 9:00 (12 times out of 47 surveys) or 10:00 (6 times out of 47 surveys). Some patients even got an appointment at 9:20 which would be impossible according to the computer system. So either the right appointment time doesn't reach the patient due to false communication or the system is flawed.

The majority of the patients (more than 60%) were waiting between 60 and 120 minutes. However, there were patients who waited less than 30 minutes (8%) but there were more patients who waited more than 120 minutes (around 20%). The median was 90 minutes (bold and italic items in Table 30).

Waiting time	***rel. freq. hospital***	*rel. freq. resident phy.*
15 min.	***4.08%***	29.82%
30 min.	***4.08%***	29.82%
45 min.	***8.16%***	15.79%
60 min.	***14.29%***	5.26%
75 min.	***10.20%***	3.51%
90 min.	***16.33%***	7.02%
105 min.	***10.20%***	5.26%
120 min.	***12.24%***	0.00%
135 min.	***2.04%***	1.75%
150 min.	***2.04%***	0.00%
165 min.	***2.04%***	1.75%
180 min.	***8.16%***	0.00%
195 min.	***2.04%***	0.00%
210 min.	***4.08%***	0.00%
225 min.	***0.00%***	0.00%
240 min.	***0.00%***	0.00%
> 240 min.	***0.00%***	0.00%
Sum	***100.00%***	100.00%

Table 30: Excerpt of Table 10 concerning measured waiting times

Those waiting times are comparable to the results from Dansky's and Miles's [23] and Becker's and Douglass's [22] research. Within their survey in an urgent care department, Dansky and Miles found out that patients waited 55 minutes in the waiting area on average before entering the exam room. Becker and Douglass included different kinds of waiting times such as total time in clinic, time spent with doctor and time in the examination room. The average total time in the clinic was 63 minutes, the total waiting time was 48 minutes and the time spent with a physician was 13 minutes.

Only one third of the participants of the survey from the present thesis perceived the waiting time at the hospital ambulance as "long". Almost two thirds thought the waiting time was "ok" (bold and italic items in Table 31).

Perception	*rel. freq. Phy1*	*rel. freq. Phy2*	***rel. freq. hospital***	*rel. freq. Dr. H*	*rel. freq. Dr. M*	*rel. freq. Dr. P*	*rel. freq. Dr. N*
long	41.7%	0.0%	***33.9%***	42.9%	40.0%	0.0%	0.0%
ok	50.0%	51.4%	***62.7%***	50.0%	50.0%	50.0%	52.4%
short	8.3%	48.6%	***3.4%***	7.1%	10.0%	50.0%	47.6%
sum	100.0%	100.0%	***100.0%***	100.0%	100.0%	100.0%	100.0%

Table 31: Excerpt of Table 14 concerning perception of waiting times

This perception of waiting times is similar to the perception of waiting times at the general practitioners without an appointment system (Figure 24). However, the waiting at the hospital triggered most often "neutral" (more than 80%) sensations (bold and italic items in Table 32). These results indicate, that people are used to long waiting times at the health care facilities and accept those waiting times.

Perception	*rel. freq. Phy1*	*rel. freq. Phy2*	***rel. freq. hospital***	*rel. freq. Dr. H*	*rel. freq. Dr. M*	*rel. freq. Dr. P*	*rel. freq. Dr. N*
comfortable	66.7%	25.0%	***10.2%***	28.6%	20.0%	66.7%	66.7%
neutral	30.8%	66.7%	***81.4%***	57.1%	80.0%	27.8%	33.3%
uncomfortable	2.6%	8.3%	***8.5%***	14.3%	0.0%	5.6%	0.0%
sum	100.0%	100.0%	***100.0%***	100.0%	100.0%	100.0%	100.0%

Table 32: Excerpt of Table 15 concerning measured waiting times

To overcome the physical and psychological burdens of waiting times [26], hospitals often offer some kind of entertainment program such as TV or magazines within the waiting area. However, two fundamental issues are not provided to the patient: First, information about the waiting time or number in the waiting line. Second, giving people the opportunity to leave the waiting room for some time, as they have to wait in front of the exam rooms so they don't miss their call [50].

To increase the attractiveness, and consequently decrease the anxiety of patients [22], the following improvements were suggested by the patients: They would like to have more magazines and medical journals to read and to have more space in the waiting area. But the most often patients demanded to know how long they have to wait. To comply with this request it would be necessary to publish the algorithm of the waiting queue and show it on the available screens in the waiting area. Then patients would know the approximate waiting time. This would reduce stress and tenseness of patients drastically as they could e.g. go to the toilet without having the feeling that they might miss their call.

5.2.3 Resident physicians

Both, Dr. M and Dr. H, who are not using a strict appointment system, experience longer waiting times than their colleagues, who use an appointment system. The median waiting time at Dr. H was 77.5 minutes and at Dr. M 23.5 minutes (bold and italic items in Table 33). A closer look at the data reveals that the span of waiting times at Dr. M is quite high. The reason for that might be that Dr. M was called to an emergency during the consultation hours.

Labels	*Dr. H*	*Dr. M*	*Dr. P*	*Dr. N*	*Resident phy.*	*Hospital*
Min	38	10	4	1	0	5
Q_1	53.5	17.75	15	6	10	55
Median	***77.5***	***23.5***	***20***	***10***	***20***	***90***
Q_3	88.5	82.75	38.75	20	44.25	110
Max	100	155	60	39	155	200
IQR	35	65	23.75	14	34.25	55
Upper Outliers	0	0	0	0	5	2
Lower Outliers	0	0	0	0	0	0

Table 33: Excerpt of Table 11 concerning measured waiting times

The median waiting at physicians who use appointment systems (Dr. P and Dr. N) was 20 and ten minutes (bold and italic items in Table 33). Those waiting times did not occur because the appointment system didn't work, but because patients arrived before their appointment and had to wait then or because they didn't have an appointment due to having acute problems. Especially at Dr. P's office there were a lot of acute patients. Even then usually patients with an appointment were called exactly at the appointed time.

A study from the main association of the social insurance in Austria showed that 50% of the patients of general practitioners wait for more than 30 minutes (mean: 33.8 minutes). At specialists 40% of the patients are waiting more than 30 minutes (mean: 28.3 minutes). Figure 34 shows the results at specialists for Austria. The study also concluded, that patients wilfully accept waiting times, if the certain physician has a good reputation [29]. Although there is no distinction between physicians with and without appointment systems, the numbers cover the results from the survey.

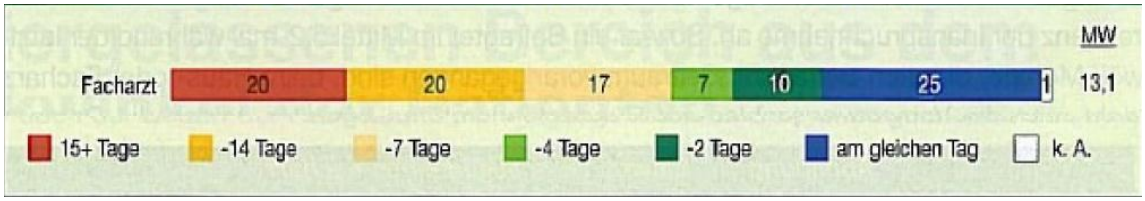

Figure 34: Comparison of the waiting times for appointments in Austria [29] (excerpt of Figure 5)

Furthermore, it is interesting to see that physicians without appointment systems estimate their waiting times quite well, while physicians with appointment systems overestimate their waiting times (Table 34).

	Dr. H	*Dr. M*	*Dr. P*	*Dr. N*	*Hospital*
Estimated waiting time	30-60 min.	*	10 min. with appointment, 60 min. without appointment	30-60 min.	15 min.
Real waiting time	77.5 min.	23.5 min.	20 min.	10 min.	90 min.

Table 34: Comparison of estimates waiting time (Table 12) and real waiting time (Table 11)

50% of the patients of physicians without an appointment system state that the length of the waiting time was "ok", but 41.7% considered the waiting time as "long". In contrast, 51.4% of the patients of physicians with an appointment system regarded the length of the waiting times as "ok" and 48.6% said that they waited a "short" time (bold and italic items in Table 35).

Perception	*rel. freq. Phy1*	*rel. freq. Phy2*	*rel. freq. hospital*	*rel. freq. Dr. H*	*rel. freq. Dr. M*	*rel. freq. Dr. P*	*rel. freq. Dr. N*
long	***41.7%***	0.0%	33.9%	42.9%	40.0%	0.0%	0.0%
ok	***50.0%***	***51.4%***	62.7%	50.0%	50.0%	50.0%	52.4%
short	8.3%	***48.6%***	3.4%	7.1%	10.0%	50.0%	47.6%
sum	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table 35: Excerpt of Table 14 concerning the perception of waiting times

Those results are comparable to a study from the *Techniker Krankenkasse* in Germany, where 50% of the patients said that they are not satisfied with the waiting times [43].

The majority of patients at physicians without appointment system felt "neutral" concerning the waiting times. This result is similar to the hospital results, where also most of the patients had a "neutral" feeling towards waiting times. Again, the results differ from the results of physicians with an appointment system. There, two thirds of the patients considered the waiting as "comfortable" (bold and italic items in Table 36). Consequently, the length of the waiting times affected the sensations of the patients while waiting more than the waiting surrounding and environment.

Perception	*rel. freq. Phy1*	*rel. freq. Phy2*	*rel. freq. hospital*	*rel. freq. Dr. H*	*rel. freq. Dr. M*	*rel. freq. Dr. P*	*rel. freq. Dr. N*
comfortable	***66.7%***	***25.0%***	***10.2%***	***28.6%***	***20.0%***	***66.7%***	***66.7%***
Neutral	30.8%	66.7%	81.4%	57.1%	80.0%	27.8%	33.3%
uncomfortable	2.6%	8.3%	8.5%	14.3%	0.0%	5.6%	0.0%
Sum	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table 36: Excerpt of Table 15 concerning the perception of waiting times

The improvements demanded by the patients for the waiting areas at the resident physicians are similar to the improvements demanded for the hospital. Here patients would like to have more magazines and more medical journals as well. They also would like to have a drink dispenser. It is interesting to see that more space is demanded by some patients as well. The demand for "I want to know how much longer I have to wait" is not as high as in the hospital, but was addressed by some patients too. Due to a smaller and more individual system at the resident physicians compared to the hospital, it is not easy to display and explain the queue mechanisms (Issue no. 9 in Table 7). However, small improvements like a drink dispenser or magazines are acceptable for the resident physicians. The validation interviews showed, that physicians are, under certain limits, willing to adopt the suggested improvements, e.g. provide water or more magazines. On the contrary, costly improvements such as drink dispenser or displaying waiting times are not accepted due to financial reasons.

5.3 Electronic appointment systems

The fifth research question examines the influence of electronic appointment systems on waiting times. As this is a direct comparison, only the results from the resident physicians will be taken into account.

The interviews with the physicians, illustrated in Table 7, showed that using an appointment system is part of a general approach of a physician's organization (issue no. 11). In general, there are two different ways to run a physician office: The first approach is to use an appointment system, reserve time slots (issue no. 5) and process patients within the reserved time. The second approach is to call one patient after another and give them as much time as they need.

The results show that waiting times are lower at physicians with an appointment system (Table 33). The Median is ten (Dr. N) and 20 (Dr. P) minutes at physicians with an appointment system, while at physicians without appointment systems it is 23.5 (Dr. M) and 77.5 (Dr. H) minutes. The perception of the waiting times by the patients emphasises those results. Patients at physicians who are using an appointment system perceive the waiting times as shorter and more pleasant (Table 35 and Table 36). Long waiting times in combination with an appointment system increase patients' dissatisfaction drastically (see chapter "Validation Interview" at page 68).

Once physicians work without an appointment system, it is hard to change to an appointment system for the physician, the administrative staff but also for the patients (issue no. 18). Table 23 shows that patients at physicians without appointment systems prefer those, and the other way around. Using a strict appointment system, a lot of administrative work is shifted from the physician to the administrative personnel, who need to be specially trained. Thus, implementing an appointment system does not only need reorganization within the doctor's office, it also demands an educated patient, who is able to estimate the time he or she needs before entering the doctor's office. This kind of education is called health literacy and describes the ability to communicate with someone concerning one's health issues [78]. However, a working and strict appointment system decreases waiting times dramatically and increases satisfaction of the patients.

Hence, a suitable appointment system, which meets the needs of the patients and the clinical staff is able to decrease waiting times significantly. This argument it also supported by Norman and Bailey, who pointed out that the waiting times in out-patient departments could save waiting time without creating idle time of physicians by implementing an appointment system [21].

5.4 Solutions for reducing waiting times

The aim of the sixth question is to find (IT-based) solutions, which are able to reduce waiting times. To reach this aim, related work including published articles as well as innovative products and newspaper articles, were taken into account. The questionnaire survey included several questions concerning the general acceptance of the tools suggested in the literature. Besides the implementation of (IT-based) tools, the possibility of changes within the intra-

institutional processes, which are developed in cooperation with physicians and administrative personnel, are evaluated.

5.4.1 Online doctors

A topic which has been of much debate lately in literature but also in the public is the emergence of online doctors. Within such a setting, a patient sits at home in front of the computer connected to the doctor via camera and microphone. On the one hand this tool enables the patient to wait at home in a familiar surrounding which makes the waiting time much more comfortable. On the other hand it gives the physicians independence from space.

One of the online doctor portals which got the most attention recently is *DrEd* (*http://www.dred.com/)* [79]. *DrEd* is based in London, Great Britain, symbolizes a fundamental change in health care and is a pioneer for tele health applications. For the first time patients are able to get a doctors opinion to certain medical issues online. In July 2011 *DrEd* got permission to work with patients from the *British Care Quality Commission (CQC)*. Today he treats patients in whole Europe. According to the company's own information more than 200,000 patients were treated since then. In an interview a representative of the section "physicians" from the *Austrian Medical Chamber* sees such tools as a modern form of "a medical dictionary on a poor level". The impossibility of a verbal conversation with the patient includes a lack of receiving nonverbal signals which are important for the treatment, Dr Rolf Jens says. Furthermore, he points out that every kind of somatic or psychological disease is thereby unrecognizable. He questions the advantage of reducing waiting times over the possibility for a "real" doctor to evaluate, control and monitor certain physical values and test results. However, he admits that tele medical treatment of chronical patients is an imaginable form of health care [79].

Figure 35: Screenshot from DrEd's homepage [accessed 19.11.2014]

The acceptance of online doctors within this study is miscellaneous. About two thirds of the waiting patients participating in my survey at Dr. N can imagine visiting their doctor online. On the contrary, the majority of the patients of Dr. P cannot imagine visiting their doctor online. To find out the reasons for this, further studies would be necessary.

Patients at the hospital, who had to wait a lot longer than patients at resident physicians, were torn. 47.4% can imagine to visit their doctor online, 52.6% cannot (bold and italic items in Table 37).

Internet consultation	*rel. freq. phy.*	*rel. freq. hospital*	*rel. freq. Dr. H*	*rel. freq. Dr. M*	*rel. freq. Dr. P*	*rel. freq. Dr. N*
yes	53.2%	***47.4%***	61.5%	70.0%	22.2%	66.7%
no	46.8%	***52.6%***	38.5%	30.0%	77.8%	33.3%
sum	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table 37: Excerpt of Table 20 concerning the possibility to consult the doctor online

Those results correspond to the results from a study from the *Techniker Krankenkasse* in Germany shown in Figure 36, where up to 44% of the patients can imagine visiting a doctor online [43]. It is interesting to see that the higher the level of education, the more patients are willing to see their physician online to reduce waiting times.

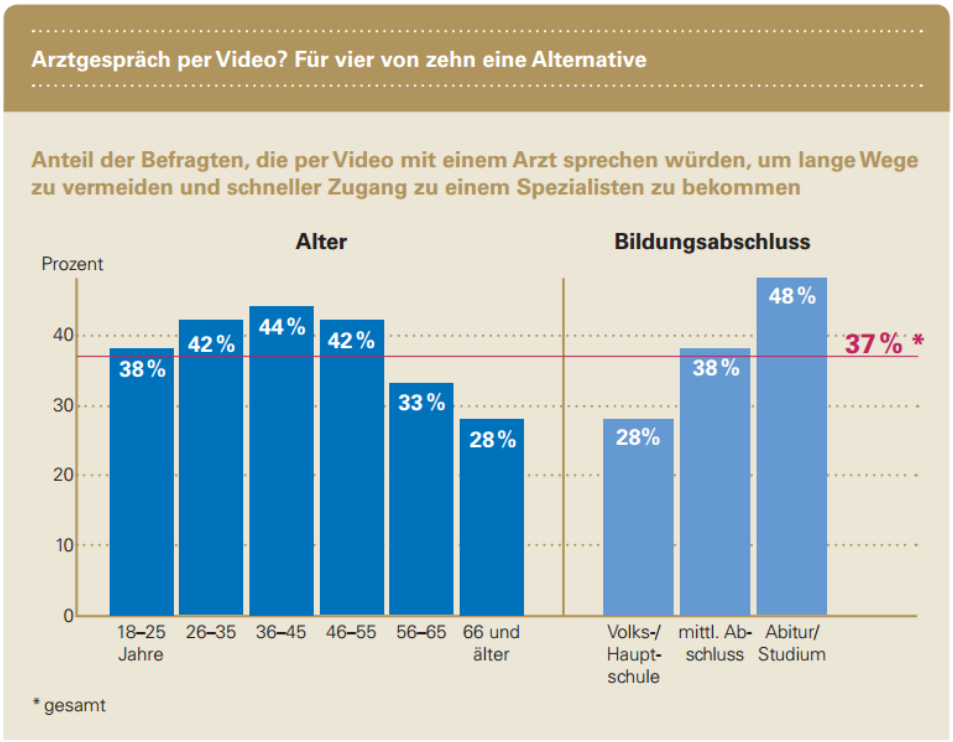

Figure 36: Percentage of patients how could imagine seeing their physicians online to reduce waiting times (in German)

To sum up, the question of visiting an online doctor is not related to waiting time. People who are waiting longer don't tend to visit doctors online. It is rather depending on the way the physician works and maybe also depending on demographic factors like age or being a digital native or not. The results clearly show the importance of the internet in the health care sector and correspond with the results from a study by *google*, which says that the internet (in detail the hospitals' websites) are the most frequented resource prior to a health care consummation. The fact that more than 60% of the patients visit two or more hospital websites before visiting a health care institution shows how important the online presence of health care institutions as a communication platform between them and their patients is [80].

5.4.2 Waiting times online

Several hospitals in Vancouver, Canada, offer waiting times online to enable patients to choose either the time when to visit a specific hospital or to choose one of more reachable hospitals [44]. This is an attempt to increase the efficiency of the regions' health care resources and improve the patient flow. Organized by local authorities, real-time waiting times from the emergency departments are published online on *http://www.edwaittimes.ca/*. Figure 37 shows an example how the waiting times are published. Besides the average waiting times, there is also a history of average waiting times in the past two hours. The data is retrieved automatically from the emergency department's information systems. The list covers the most important emergency departments within the region. Originally, this system was designed for emergency calls so the paramedic could see which clinic was able to treat patients. Those numbers are applicable on non-critical ill patients; the waiting times of critical ill patients are quite short.

Figure 37: Published waiting times at the emergency departments in the Vancouver area [http://www.edwaittimes.ca/ accessed 10.11.2014]

During the last years another kind of publishing of waiting times has been developed. Several hospitals use *twitter* and other social media platforms to tell their patients how long the waiting times are. Figure 38 shows an example where the emergency department of the Progress West in St. Louis, Missouri, USA, publishes the waiting times every two hours via *twitter*.

Figure 38: Published waiting times of the Progress West emergency department in Missouri, USA [accessed 10.11.2014]

The results of the questionnaire of the present thesis showed, that patients waiting at the hospital are mostly in favour of having a look on published online waiting times. 79.3% of the patients would like to see the waiting times online (bold and italic items in Table 38). This replicates when it comes to resident physicians. Around two thirds of the patients would like to see waiting times online. Only patients of one doctor, Dr. P, predominantly would not like to see waiting times online. Patients of this doctor also cannot imagine visiting their doctor online as mentioned above.

See waiting times online	*rel. freq. phy.*	*rel. freq. hospital*	*rel. freq. Dr. H*	*rel. freq. Dr. M*	*rel. freq. Dr. P*	*rel. freq. Dr. N*
Yes	58.7%	***79.3%***	71.4%	70.0%	33.3%	66.7%
No	41.3%	***20.7%***	28.6%	30.0%	66.7%	33.3%
sum	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table 38: Excerpt of Table 21 concerning the possibility to see waiting times online

In addition to the wish to see the waiting times online 73.8% of the patients of resident physicians and 83% of the patients waiting at the hospital are also willing to plan their visit according to the online published waiting times (bold and italic items in Table 39).

Plan visit according to online waiting times	*rel. freq. phy.*	*rel. freq. hospital*
yes	73.8%	83.0%
no	26.2%	17.0%
sum	100.0%	100.0%

Table 39: Excerpt of Table 22 concerning planning the doctor's visit according to online published waiting times

Besides the possible reduction of waiting times by publishing them, the acceptance of waiting times increases when transparency concerning the length and origin of waiting times are given [81]. Furthermore, providing information about the reasons for the waiting time also reduces the difference between perceived waiting time and actual waiting time [40].

Dansky and Miles postulate that informing the patient had positive influence on his or her satisfaction, because waiting time is the most significant predictor for patient satisfaction [23].

5.4.3 Other solutions

The literature offers a lot of other solutions to reduce waiting times. This chapter gives an overview about those solutions.

Centralized authority assigning appointments

In Germany a discussion about a centralized authority assigning appointments is going on [18]. Such an authority could ensure that patients are equally distributed over all physicians and hospitals. Although, there are compelling reasons not to implement an authority, the reality is, it could decrease waiting times. Such a system is already in place in the United States in the Denver area [82]. A website enables patients to choose between 55,000 physicians and make an appointment with one of them. This system is supposed to reduce waiting times and improve accuracy concerning adherence to appointments.

Online appointments

In the United States, an increasing number of hospitals offer online appointments for the emergency department. Through TV commercials and slogans like "wait for the ER from home" they try to shift attention to the topic [83].

In Austria, there are several systems connecting some resident physicians and offering online appointments for them. One of those systems is *mednanny* (*https://www.mednanny.com/*). Currently (09.11.2014) ten general practitioners from Vienna are part of the system. After choosing a doctor (Figure 39), this system allows to select a certain treatment and reserve a time slot for it (Figure 40).

Figure 39: General practitioners in Vienna on the *mednanny*-online portal [09.11.2014]

Figure 40: Individual online appointments within the *mednanny*-online portal [accessed 09.11.2014]

Although several general practitioners are included in this system, Dr. Jens Rolf, representative of the section "physicians" at the Austrian Medical Chamber, questions the applicability of online appointment systems for general practitioners [84]. According to him, patients who have made an appointment online, would be upset afterwards because they had to wait anyhow as medical treatments are not able to be scheduled (at least for the general practitioner).

The comparable system *InQuicker* (*https://inquicker.com/*) is used for resident physicians as well as for hospitals within the US. Figure 41 and Figure 42 show examples of the platform. It gives the patient the opportunity to search the next available time slot for an appointment within his or her area.

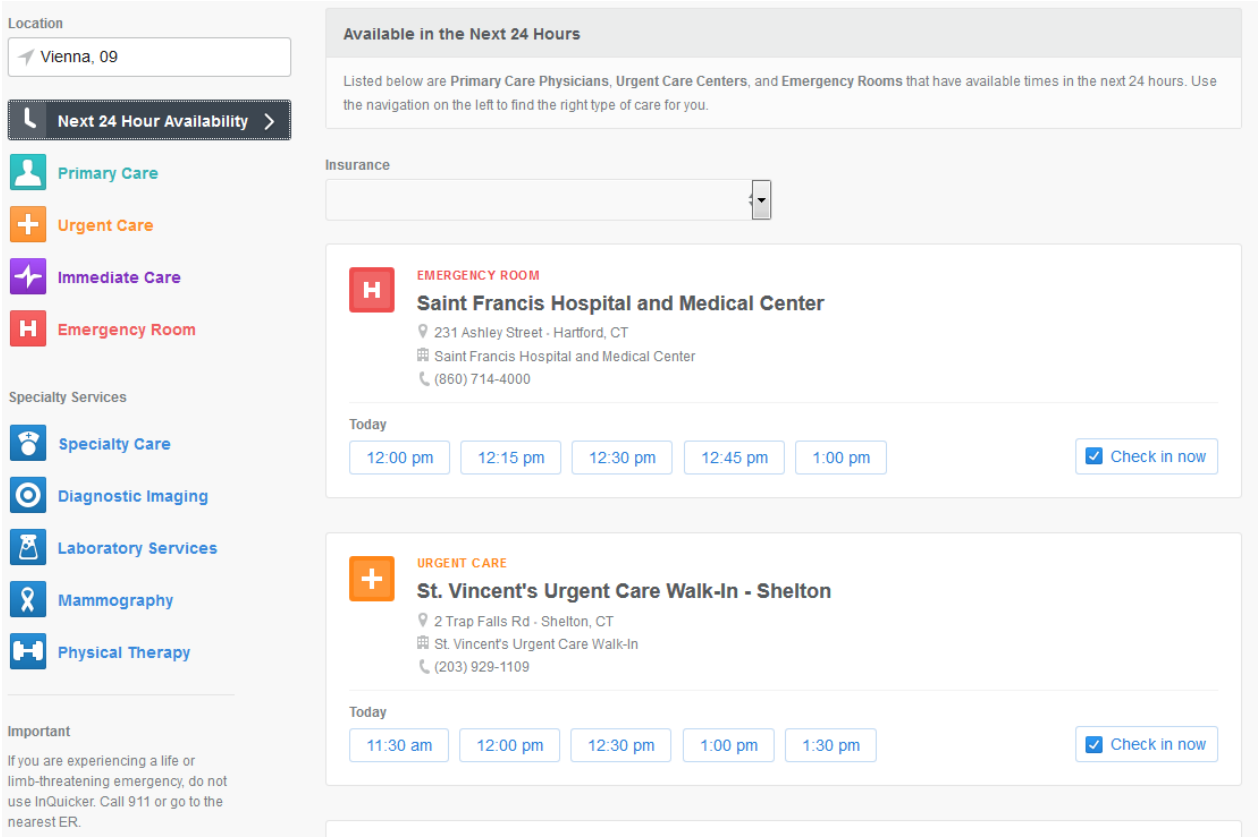

Figure 41: Example of *InQuicker* (https://inquicker.com/) for the next 24h availability of an emergency department or department for urgent care (accessed 10.11.2014)

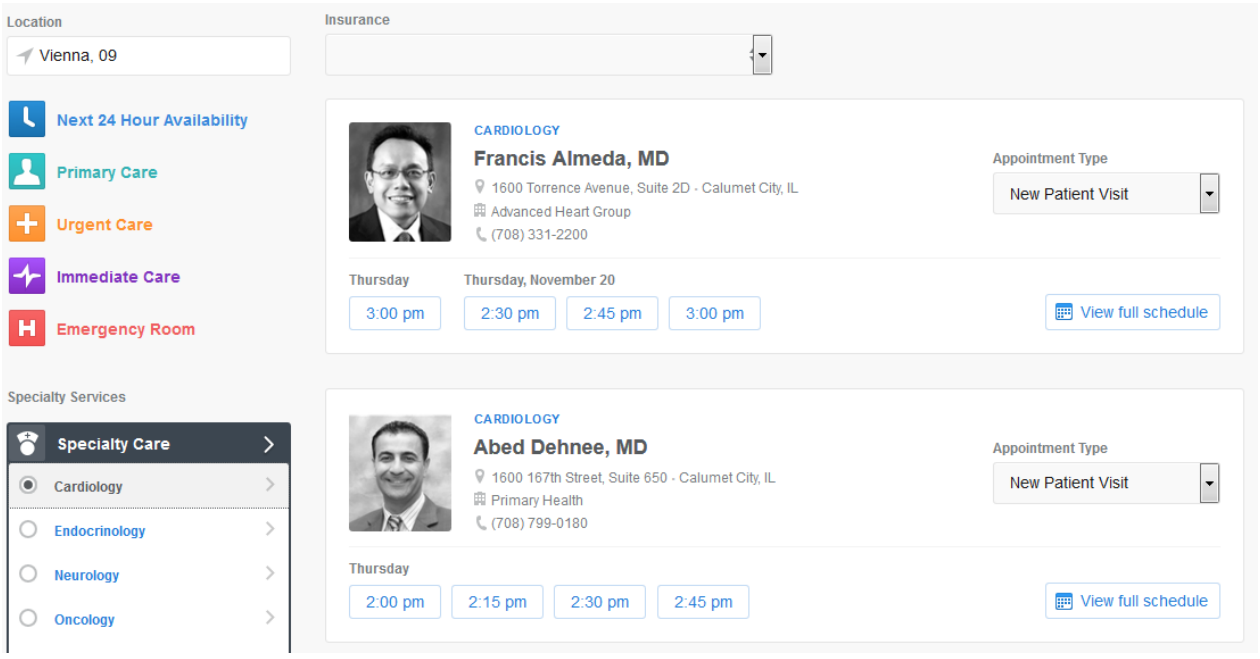

Figure 42: Example of *InQuicker* (https://inquicker.com/) for the next 24h availability of a cardiologist (accessed 10.11.2014)

According to the company's information, patients are able to have a look on estimated treatment times, check-in online for treatments and provide information about the waiting

environment and the waiting room. It increases patients' satisfaction by decreasing patients' perception of waiting times, boosts hospital revenue due to new insured patients from a larger geographical area, balances the ER load by shifting peak traffic hours and prevents readmissions. In addition to that it increases quality by offering an appropriate follow-up appointment system. According to the last fact, the company mentioned a study which results show a decrease of the follow-up compliance of about 23%, when appointments are scheduled prior discharge [85].

Virtual care centre

In the United States a new kind of hospital is currently under construction – a virtual care centre, where no patients are present, but only doctors and nurses. They are available 24/7 via audio, video and data connections for three million telehealth visits per year [86].

Education

An article suggests, that forming a functioning appointment system is also related to educational steps for patients, physicians and administrative personnel [19]. Each of the three involved parties has to accept, that short waiting times are a result of working together.

Long waiting times causes frustrated patients, who have the need to tell their doctor that they are frustrated. Because of this the time for the medical treatment increases, which again causes longer waiting times for the other patients. According to [19] the two main factors for decreasing waiting times are, first, an efficient use of the resources of physicians and second, an appointment system that is close to reality.

A major issue in appointment systems is the impossibility to forecast acute patients. E.g. on Mondays there are more acute patients than on other weekdays, in average. In order to solve this problem Lamers suggests to implement a system with clear objectives such as "patients with appointment are waiting five minutes maximum, patients without appointment are not waiting any longer than 15 minutes". There should be a division between three kinds of patients concerning the time they need. With a yearly check-up those objectives should be evaluated [87].

Another way to decrease waiting times is to reorganize the common ambulance care. Normally, a hospital is divided into departments specialized on a specific discipline like dermatology or surgery. The hospital in Müllheim, Germany, tries to reorganize the departments. They are no longer specialized in disciplines but in diseases including combination of diseases. A leading centralized contact point categorizes patients. As a result patients are treated faster [88].

Appointment systems

The advantages of appointment systems have already been discussed in the previous questions. Concerning the waiting time alone, it is strongly recommended to use appointment systems. The migration from a system without appointments to a system which provides appointments is tough and tricky as the workflow has to be changed dramatically.

5.5 Loss of gross domestic product

The seventh and eighth research questions handle the loss of GDP due to waiting times. Following the pathway described in the methods chapter "Analysis of loss of gross domestic product" on page 41, first, the median waiting time of people who would and would not work instead of waiting at the hospital ambulance or the general practitioner is calculated. The results are shown in Table 40.

Median waiting time	Hospital ambulance	General practitioner (GP)	GP with appointment system	GP without appointment system
People who would work	81	30	23	64
People who would not work	90	38	20	73

Table 40: Median of people who would/would not work at hospital and GPs

The average loss of GDP per visit per person, shown in Table 41, results from multiplying the numbers of Table 40 with the average GDP per person per hour. This is done for two groups, the working (1) and the average population (2) (see Formula 2).

Loss of GDP (per visit)	Hospital ambulance	General practitioner (GP)	GP with appointment system	GP without appointment system
People who would work	€ 20.06	€ 7.43	€ 5.70	€ 15.85
People who would not work	€ 9.49	€ 4.00	€ 2.11	€ 7.69

Table 41: Average loss of GDP per visit per person who would/wouldn't work

The average loss of GDP per person for one year, shown in Table 42, is calculated by multiplying the results from Table 41 with the frequency of visits to hospitals and physicians per year (Formula 3).

Loss of GDP per person (yearly)	Hospital ambulance	General practitioner (GP)	GP with appointment system	GP without appointment system
People who would work	€ 425.08	€ 146.81	€ 112.56	€ 313.20
People who would not work	€ 201.00	€ 79.14	€ 41.65	€ 152.03

Table 42: average loss of GDP per person for one year

To calculate the loss of GDP due to waiting times for whole Austria for one year, the numbers from Table 42 will be extrapolated to the people (nationwide) who would work and who would not work (Formula 4). The results are shown in Table 43.

Loss of GDP (yearly)	Hospital ambulance	General practitioner (GP)	GP with appointment system	GP without appointment system
People who would work	€1,428,506,473.25	€493,371,924.41	€378,251,808.72	€1,052,526,772.08
People who would not work	€771,953,804.83	€303,940,366.51	€159,968,613.95	€ 583,885,440.93
Sum	€2,200,460,278.08	€797,312,290.92	€538,220,422.67	€1,636,412,213.01

Table 43: Loss of GDP per year due to waiting times

According to this very simplified calculation, the loss of GDP due to waiting times in hospital ambulances is € 2.2 billion and due to waiting times at general practitioners € 800 million a year. According to the Statistik Austria the GDP was € 313 billion in 2013.

Column two (General practitioner (GP)) in Table 42 represents the setting in this study, where 18 out of 40 patients visited general practitioners who are using an appointment system. Column three (GP with appointment system) and column four (GP without appointment system) assume, that all patients in Austria visit doctors who either all use an appointment system or no one is using an appointment system.

Although those numbers underlay several assumptions, they show that there needs to be more intense effort to decrease waiting times. The difference between GP with strict appointment systems and without appointment systems is remarkable as it is almost three times higher.

Furthermore, waiting times between general practitioners and the hospital ambulance differ a lot. It should be tried to shift patients from the hospital to the resident physicians.

To sum up, the calculation showed that most of the loss was contributed from patients waiting at the hospital ambulance as waiting times at residential physicians are shorter than at the hospital. Furthermore, the waiting time at the hospital is longer than at the resident physicians. The government is aware of that fact and initiated the current health care reform which targets to shift patients from the hospital to the resident physicians [89].

6 Conclusion

Waiting times are a relevant issue in the field of health care. The literature review showed that several studies emphasize the need to concentrate not only on the patient's health needs, but also on secondary issues such as waiting times and the surrounding of the waiting areas. The present thesis picks up that point and aimed to estimate the impact of waiting times on health and economy regarding outpatient clinics and general practitioners. It analysed waiting times in waiting rooms of general practitioners and hospital ambulances. Eight research questions were set:

The first research question dealt with a process oriented analysis of the origin of waiting times in outpatient clinics (also called hospital ambulances) and at general practitioners. In order to achieve the targeted question, a literature review followed by expert interviews with physicians and a questionnaire survey among patients was used. One of the main results of the first research question is that it is difficult to standardize a medical process, which would allow using standard business process tools. The prior estimation of the needed time for a concrete patient is difficult as well. Furthermore, unpunctual patients and the appearance of emergency patients prevent an easy practicable system.

The second, third and fourth question were summed up to the issue "evaluation of duration of waiting times" and concentrated on the length of the waiting times. Furthermore, they took a look on the perception of waiting times and how waiting times can be perceived more comfortable. To answer this question, waiting times at the administrative desk, in the hospital ambulance waiting area and in the physician's waiting room were measured. While there is no significant difference between the waiting times at the administrative desk at the hospital and the resident physicians, the waiting times in the waiting room of the various physicians but also of the hospital ambulance, differ a lot. The median waiting time at the hospital is 90 minutes. The median waiting time at the various resident physicians ranges from ten to 77.5 minutes.

The perception of the length of the waiting time differs according to the measured waiting times. However, the results show that both, physicians and their stuff as well as patients are negatively affected by long waiting times and need to work together to enable a system on time. Patient's feelings differ from uncomfortable to anger and were perceived as a psychological burden [50]. Putting some resources to increase the feel-good factor in the waiting areas can drastically decrease the impact of waiting times on patients [22]. The results show that a nice and pleasant waiting surround is not only able to decrease the bad perception of waiting but also to increase the perceived quality of care. Therefore, the design of the waiting room as well as providing drink dispenser or reading material is able to make waiting more comfortable.

Within the fifth question, the impact of (electronic) appointment systems on the waiting times was analysed. It shows that physicians using an appointment system have lower waiting times and that their patients are more satisfied with the waiting environment. It doesn't seem important whether it is an electronic appointment system or a handwritten appointment

system. An appointment system however can not only be seen as a new tool, it rather needs a special kind of working procedure which corresponds to the appointment system. Patients have a certain time slot according to certain health issues that have to be treated within these time slots. All other not planned issues need to be done within another time slot. Switching from a non-appointment system to an appointment system, certainly takes freedom from the physician as he or she has to be aware of time. Nevertheless, there are patients whose occurrence is not able to be scheduled, as they occur as emergency patients. Such cases derange the waiting process of other patients. The literature provides similar results to this topic. Especially the incalculability of medical issues plays a crucial role [33, 44].

The sixth question tried to find (IT-based) solutions for reducing waiting times. A well-known solution within the Anglo-American countries is the possibility to visit doctors online. Via tele health applications it is possible to see the doctor by using a tablet or a computer from the pleasant surroundings of one's home. Those kinds of visits are preferred for simple health issues or follow up visits. There are several international institutions offering that kind of service. The results of the questionnaire survey show, that about 50% of the patients can imagine visiting their doctor online. Another solution, which is popular in the United States and Canada, is to publish waiting times online. The idea is, once a patient knows how long waiting times in certain hospitals are, he or she will go to the hospital when waiting times are low (emergency cases are excluded). This solution guarantees a better distribution of patients over the opening hours. The results of the questionnaire confirmed an intention on the patients' side to have a look on waiting times online. The majority of the patients within this study would plan their visit according to the published waiting times. There are other solutions discussed such as a centralized authority who assigns appointments, as it is planned in Germany, online appointment systems or the increase of health literacy.

To sum up, IT-based tools have not only the possibility to shift waiting time from the unpleasant waiting areas and waiting rooms to a comfortable surrounding such as one's own home, they could also help to decrease waiting times themselves. The results show clearly, that the internet, which entered our life in every kind of area in the last two decades, now starts to influence the healthcare sector as well, [90, 91] as the internet is the base of all the presented solutions.

Another issue, which is important in the today's society, is transparency. People not only demand transparency from public institutions and the government, they also demand it in the health care sector. The study showed, that patients normally have no clue how waiting lines are worked off. It seems to be obvious, that it is not always first come first serve [44], but the rules who is called first and who has to wait longer are hidden. Patients want to know how long they have to wait and how waiting lines are ranked. It should be topic of further research to have a look on the acceptance of waiting times including patients who do know and patients who don't know how waiting lines are worked off.

The last two questions aimed to calculate the loss of national added value due to waiting times. The data shows that a certain amount of patients could go to work instead of waiting at the doctor's waiting room or the hospital waiting area. Furthermore, the question how much of the lost national added value could be saved due to the use of (electronic) appointment

systems was answered. The results have to be seen with caution, as several assumptions were made within the calculation to simplify it. A loss of € 2.2 billion in hospital ambulances and € 800 million at general practitioners per year was calculated. If all general practitioners would use an appointment system, the loss at general practitioners could be reduced to € 540 million per year. This result not only emphasizes the use of appointment systems, but also a shift from the hospital ambulance to the resident physicians.

7 Limitations and further research

There have been some restrictions concerning the samples for this thesis. The results may not be generally valid, as the participation of the patients, the physicians and the hospitals was voluntary. Furthermore, it was not easy to find hospital ambulances willing to participate in such a study. The selection of the follow-up ambulance was chosen deliberately due to the fact that most patients were non-critical and the follow-up visits could have been planned almost completely. However, this selection also provides uncertainty concerning the reflection of the results on other hospital ambulances.

Although the results of this thesis as well as the literature review show a dependency of the attractiveness of the waiting surrounding and the satisfaction with the waiting situation, further investigations within this issue would be worth the effort. A bigger sample and surveys in different waiting areas, ranging from very simple interior to modern interior oriented on the patient's needs, would be interesting.

It has to be considered that physicians and hospitals in urban areas normally have other organizational structures and patient numbers than physicians and hospitals in rural areas. This issue would also be interesting to examine in further studies.

Another topic is the relevant number of observations needed to get valid information. Norman and Bailey suggest that more than 400 observations are necessary to estimate the average consultation time with a fair degree of accuracy [21]. As this number of observations is not reached within this thesis, the results cannot be seen as generally valid.

Although there are a number of limitations, the results show clearly, that waiting times have an impact on the health of the patients as well as on the economy and that there is plenty of room for improvement.

8 Literature

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9 Figures

10 Tables

11 Appendix

11.1 Questionnaire

11.1.1 Resident physicians (in German)

Befragung zu Wartezeiten im Gesundheitswesen

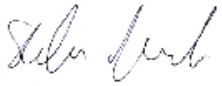
Sehr geehrte Patientin! Sehr geehrter Patient!

Im Rahmen meiner Diplomarbeit an der Technischen Universität Wien untersuche ich Rahmenbedingungen für **das „Warten"** beim Arztbesuch. Die Ergebnisse werden helfen den **Warteprozess angenehmer und kürzer** zu gestalten.

Danke, dass Sie an dieser Umfrage teilnehmen und sich kurz Zeit nehmen. Bitte beantworten Sie die Fragen **ehrlich** und **sorgfältig**.

Selbstverständlich sind die Fragebögen **anonym** und es kann in keinem Fall ein Personenbezug hinsichtlich Ihrer Person oder der Person des Arztes/der Ärztin hergestellt werden.

Vielen Dank für Ihre Unterstützung,



Stefan Janzek-Hawlat.

Teil A: Fragen zum „Warten"

A1 Um welche **Uhrzeit** haben Sie das Wartezimmer **betreten**? _____ (z.B. 13:25)

A2 Wie lange haben Sie **bei der Sprechstundenhilfe gewartet**? _____ (in Minuten)

A3 Hatten Sie vorher einen **Termin** ausgemacht? ☐ Ja ☐ Nein

A3.1 Falls ja: um welche **Uhrzeit** hatten Sie diesen **Termin**? _____ (z.B. 13:30)

A4 Wie **empfinden Sie die Dauer der Wartezeiten** in dieser Arztpraxis?

☐ lange ☐ ok ☐ kurz

A5 Wie **empfinden Sie das „Warten"** in dieser Arztpraxis?

☐ angenehm ☐ neutral ☐ unangenehm

A6 Wie könnte das **Warten** in dieser Arztpraxis **angenehmer gestaltet** werden? (Mehrfach-Nennung möglich)

☐ Mehr Zeitschriften/Bücher ☐ Mehr mediale Unterhaltung ☐ Mehr Platz

☐ Sauberkeit erhöhen ☐ Wartezimmer neu einrichten ☐ Getränkeautomat/ Wasserspender

☐ Mehr medizinisches Informationsmaterial ☐ Ich will wissen, wie lange ich noch warten muss

Sonstiges:

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11.1.2 Hospital ambulance (in German)

Befragung zu Wartezeiten im Gesundheitswesen

Sehr geehrte Patientin! Sehr geehrter Patient!

Im Rahmen meiner Diplomarbeit an der Technischen Universität Wien untersuche ich Rahmenbedingungen für **das „Warten"** beim Ambulanzbesuch. Die Ergebnisse werden helfen den **Warteprozess angenehmer und kürzer** zu gestalten.

Danke, dass Sie an dieser Umfrage teilnehmen und sich kurz Zeit nehmen. Bitte beantworten Sie die Fragen **ehrlich** und **sorgfältig**.

Selbstverständlich sind die Fragebögen **anonym** und es kann in keinem Fall ein Personenbezug hinsichtlich Ihrer Person oder des Krankenhauses hergestellt werden.

Vielen Dank für Ihre Unterstützung,

Stefan Janzek-Hawlat.

Teil A: Fragen zum „Warten"

A1 Um welche **Uhrzeit** haben Sie den Wartebereich **betreten**? _____ (z.B. 08:25)

A2 Wie lange haben Sie **bei der Anmeldung gewartet**? _____ (in Minuten)

A3 Hatten Sie vorher einen **Termin** ausgemacht? ☐ Ja ☐ Nein

A3.1 Falls ja: um welche **Uhrzeit** hatten Sie diesen **Termin**? _____ (z.B. 08:30)

A4 Wie **empfinden Sie die Dauer der Wartezeiten** in dieser Ambulanz generell?

☐ lange ☐ ok ☐ kurz

A5 Wie **empfinden Sie das „Warten"** in diesem Wartebereich?

☐ angenehm ☐ neutral ☐ unangenehm

A6 Wie könnte das **Warten** in diesem **Wartebereich angenehmer gestaltet** werden? (Mehrfach-Nennung möglich)

☐ Mehr Zeitschriften/Bücher
☐ Mehr mediale Unterhaltung
☐ Mehr Platz
☐ Sauberkeit erhöhen
☐ Wartebereich neu einrichten
☐ Getränkeautomat/ Wasserspender
☐ Mehr medizinisches Informationsmaterial
☐ Ich will wissen, wie lange ich noch warten muss

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Befragung zu Wartezeiten im Gesundheitswesen

Teil A: Fragen zum „Warten" (Fortsetzung)

A7 Werden Sie von jemandem hierher **begleitet** (Mehrfachnennung möglich)?

☐ Ehegattln/Lebensgefährtln ☐ Bekannte/Verwandte ☐ Kind(er)

☐ Sonstige/r: _____

☐ Nein, ich bin alleine hier

A7.1 **Falls** Sie eine **Erwachsene**/ein **Erwachsener** begleitet:
Welcher **Tätigkeit** wäre **Ihre Begleitung** nachgegangen würde sie nicht mit Ihnen hier warten?

☐ Erwerbsarbeit ☐ Freizeitaktivitäten ☐ Tätigkeit im häuslichen Umfeld

☐ Sonstiges: _____

A7.2 **Falls** Sie ein **Kind** begleitet:
Gibt es im Wartezimmer einen geeigneten **Zeitvertreib**? ☐ Ja ☐ Nein

A8 Welcher **Tätigkeit** wären **Sie** nachgegangen, würden Sie nicht hier warten?

☐ Erwerbsarbeit ☐ Freizeitaktivitäten ☐ Tätigkeit im häuslichen Umfeld

☐ Auskurieren der Krankheit im häuslichen Umfeld

☐ Sonstiges: _____

Teil B: Fragen zur Verkürzung der „Wartezeit"

B1 Könnten Sie sich vorstellen, in gewissen Fällen Ihrer **Ärztin**/Ihren **Arzt** **über das Internet** (von zu Hause aus) zu **um Rat** zu **Fragen?** ☐ Ja ☐ Nein

B2 Könnten Sie sich vorstellen, **online** einsehbare **Wartezeiten** abzurufen? ☐ Ja ☐ Nein

B2.1 Falls ja, würden Sie Ihren **Arztbesuch danach planen**? ☐ Ja ☐ Nein

B3 Bevorzugen Sie den **Arztbesuch nur auf Termin** (Akutfälle ausgeschlossen)? ☐ Ja ☐ Nein

B4 **Wie** könnte man Ihrer Meinung nach **Wartezeiten verkürzen**?

Teil C: Fragen zu Ihrer Person

C1 Bitte nennen Sie bitte noch Ihr **Alter**: Unter 20 ☐ 20-29 ☐ 30-39 ☐ 40-49 ☐ 50-59 ☐ 60-69 ☐ Über 70 ☐

C2 Bitte nennen Sie bitte noch Ihr **Geschlecht**: ☐ weiblich ☐ männlich

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11.2 Expert interview guideline

11.2.1 Resident physicians (in German)

Interviewleitfaden „Arzt-Interview"
Wartezeiten im Gesundheitswesen

Teil A: Fragen zum medizinischen Ablauf

A1 Wie laufen die Standard-Patienten-Prozesse ab. Welche Fälle gibt es?

A2 Warum entstehen Ihrer Meinung nach Wartezeiten?

- **A2.1** Innerorganisatorische/endogene Gründe
- **A2.2** Systemische/Exogene Gründe

A3 Wie lange schätzen Sie die (durchschnittliche) Wartezeit ein?

A4 Welche Möglichkeiten gäbe es Wartezeiten zu verkürzen?

- **A4.1** Innerorganisatorisch/Endogen
- **A4.2** Systemisch/Exogen
- **A4.3** IT-Basierte Möglichkeiten

A5 Verwenden Sie ein Terminsystem in Ihrer Arztpraxis?

- **A5.1** Wie viel Prozent der Patienten kommen mit einem Termin?
- **A5.2** Wie viel Prozent der Patienten könnte einen Termin vorab ausmachen? Wie viele Prozent der Besuche sind Aktufälle?
- **A5.3** Verkürzt der Einsatz von einem Terminsystem die Wartezeit bzw. werden die administrativen Aufwände kleiner?

Teil B: Ausstattung der Arztpraxis

B1 Wie ist die Arztpraxis eingerichtet?

- **B1.1** Beim Aufnahmeschalter
- **B1.2** Im Wartezimmer

B2 Gibt es Unterhaltungsmöglichkeiten (Spielecke, Unterhaltungsmöglichkeiten, ...)?

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11.2.2 Hospital ambulance (in German)

Interviewleitfaden „Personal-Interview" Wartezeiten im Gesundheitswesen

Teil A: Fragen zum medizinischen Ablauf

A1 Wie laufen die Standard-Patienten-Prozesse ab. Welche Fälle gibt es?

A2 Warum entstehen Ihrer Meinung nach Wartezeiten?

- **A2.1** Innerorganisatorische/endogene Gründe
- **A2.2** Systemische/Exogene Gründe

A3 Wie lange schätzen Sie die (durchschnittliche) Wartezeit ein?

A4 Welche Möglichkeiten gäbe es Wartezeiten zu verkürzen?

- **A4.1** Innerorganisatorisch/Endogen
- **A4.2** Systemisch/Exogen
- **A4.3** IT-Basierte Möglichkeiten

A5 Verwenden Sie ein Terminsystem?

- **A5.1** Wie viel Prozent der Patienten kommen mit einem Termin?
- **A5.2** Wie viel Prozent der Patienten könnte einen Termin vorab ausmachen? Wie viele Prozent der Besuche sind Akutfälle?
- **A5.3** Verkürzt der Einsatz von einem Terminsystem die Wartezeit bzw. werden die administrativen Aufwände kleiner?

Teil B: Ausstattung der Ambulanz

B1 Wie ist die Ambulanz eingerichtet?

- **B1.1** Beim Aufnahmeschalter
- **B1.2** Im Wartebereich

B2 Gibt es Unterhaltungsmöglichkeiten (Spielecke, Unterhaltungsmöglichkeiten, ...)?

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