Discovering the ins and outs of the implementation of the ATISS through three critical implementation factors.

Antibiotic Therapy Information Support System (ATISS)

UNIVERSITY OF TWENTE.

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Abstract

Introduction

Misuse and overuse of antibiotics in healthcare is a leading cause of the growing population of resistant “super” bugs. These bugs can cause untreatable diseases and in some cases even death. To counter the effects of misuse and overuse of antibiotics, antibiotic stewardship programs (ASPs) can be used. The Antibiotic Therapy Information Support System (ATISS) is an example of a system that has been implemented as part of an ASP in the Klinikum Herford and the Euregio-Klinik in Nordhorn to assist the physicians with the antibiotic treatment therapy.

Main question

To optimize the implementation process, a plan must be made that incorporates different perspectives and opinions. Therefore the CeHReS roadmap has been used during this research to identify the critical factors of implementing the ATISS. The main question of this study that has been formed is:

What are the critical factors for the successful implementation of the Antibiotic Therapy Information Support System (ATISS) in German hospitals?

Theoretical framework

Five theories have been used to form the interview questions. The diffusion of innovation theory describes optimal diffusion, the normalization process theory shows different constructs to optimize implementation, embedding and integration, the sense-making theory focusses on implementing communication practices and the interaction with the existing practices, the voice of customer theory gives insight in what the customer wants and needs and the computer technology principles theory describes twelve principles to guide implementation of new technology.

Methodology

To answer the research question, five categories based on the Roadmap have been used to incorporate different stages of the implementation process. These five categories are: content, system, innovation/service, dissemination and effect. Twenty scenario based interviews (scenarios based on an experts opinion) with physicians of the mentioned hospitals were used to determine the importance of each category and to develop an implementation plan for the ATISS in German hospitals.

Results

Content: the contents of the ATISS and “normal practice” vary. This resulted in some physicians preferring the ATISS and other preferring the “normal practice”.

System: the ATISS only connects to the system on computers. WIFI isn’t in place at both hospitals which is why the ATISS doesn’t work on a tablet or smartphone.

Innovation/service: the ATISS was mostly rated as good or user friendly. The innovation was comprehensible for most of the participants and 55% stated it met their expectations.

Dissemination: the ATISS is best introduced through a top down method per department. This can be done during the morning meetings for example.

Effect: the expected effects that were mentioned were for example decreased healthcare costs due to infectious diseases, a diminishing population of resistant supper bugs, optimizing the antibiotic therapy procedures and feeling more secure about the decision of antibiotic treatment.

Discussion and conclusion

Three critical factors have been determined during this study for the implementation of the ATISS in German hospitals. These factors are: the *development* of the ATISS which includes determination of the content, the *introduction* of the ATISS to the end-users and the *effect* it has on the end users and their work.

Content

Introduction

There is a worldwide problem with the use of antibiotics, particularly with their misuse and overuse. The misuse of antibiotics is a major cause of the growing drug-resistant micro-organisms population (Mayo Clinic Staff, 2014). Resistant microorganisms (including bacteria, fungi, viruses and parasites) are able to withstand treatment with antimicrobial drugs, such as antibacterial drugs (e.g., antibiotics), antifungals, antivirals, and antimalarial, so that standard treatments have become ineffective and infections persist, increasing the risk of spread to others (World Health Organisation, 2014).

Misuse of antibiotics can cause problems that can result in death or disability for individuals who would otherwise continue a normal life course (World Health Organisation, 2014). Resistant bacteria cause infectious diseases to be the second leading cause of deaths in hospitals worldwide for example with healthcare-associated infections (Spellberg, et al., 2007).

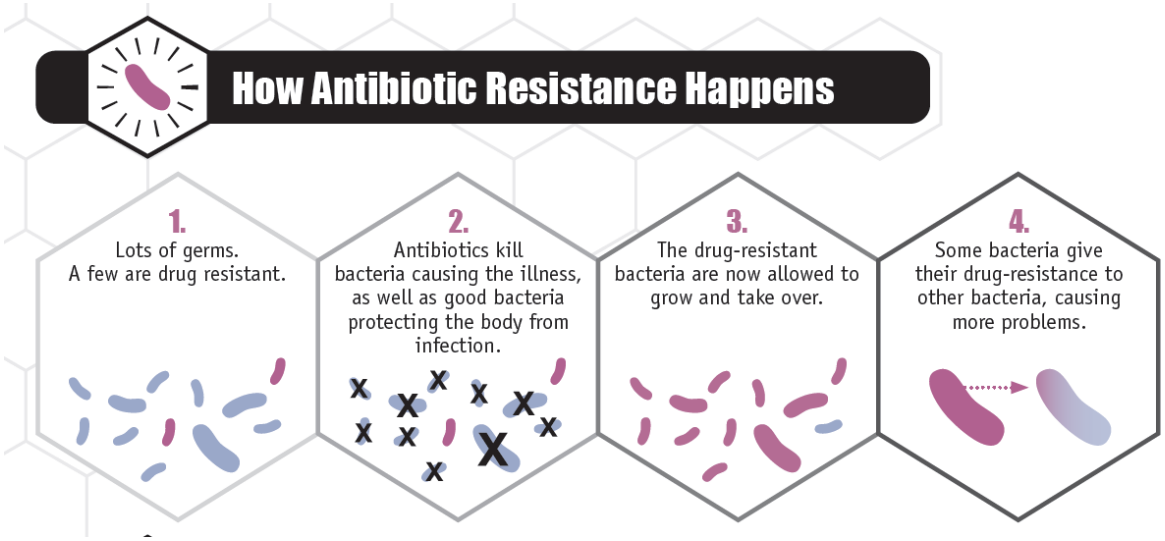

Figure 1: Antibiotic resistance (US Department of Health and Human Services & Centers for Disease, Control and Prevention, 2013).

Healthcare-associated infections

Healthcare-accociated infections (HAI) are infections that patients get while staying in a hospital. A World Health Organization (WHO) study (Allegranzi, 2011) demonstrates that HAI causes an estimated 37,000 attributable deaths annually and contribute to 110,000 deaths in addition to that in Europe alone. It is also estimated that it increases health care expenses by approximately €7 billion in Europe per year.

Methicillin-resistant staphylococcus aureus (MRSA) is one example of a HAI and is a multi-drug resistant super bug. Mainly people with a weak immune system are affected by MRSA and these people are often found in health care establishments such as hospitals, nursing homes etc. For these people MRSA can induce severe problems with bloodstream infections, pneumonia and surgical site infections (Centre for Disease Control and Prevention, 2013). In order to control these problems caused by misuse and overuse of antibiotics, eHealth can be used (Cheng, et al., 2009).

EHealth

EHealth (electronic health) is a broad concept that focuses on the deliverance of health care independent of time, space and the care giver. There are different definitions of eHealth, but the most broad and most used definition is by Eysenbach (2001), who describes eHealth as:

"An emerging field in the intersection of medical informatics, public health and businesses, referring to health services and information delivered or enhanced through the internet and related technologies. In a broader sense, the term characterizes not only a technical development but also a state-of-mind, a way of thinking, an attitude and a commitment for networked, global thinking, to improve health care locally, regionally, and worldwide by using information and communication technology".

According to Eysenbach's definition, eHealth exists to help improve health care and the care delivery process (Eysenbach, 2001). The focus of eHealth is not only on the sick, but also on the healthy citizen. A few examples of how eHealth can be used are: for obtaining information, as a guidance tool, for online diagnoses, for treatment from a distance and for contact between the patients, or the patient and the physician (van Gemert-Pijnen, Peters & Ossebaard, 2013). An example of how eHealth can be implemented is through antibiotic stewardship.

Antibiotic Stewardship

There are various studies that show the positive effect of the implementation of Antibiotic Stewardship Programs (ASP) in health care facilities to optimize the use of antibiotics (Bevilacqua, et al., 2011) (Cheng, et al., 2009) (Kaki, Elligsen, Walker, Simor, Palmay, & Daneman, 2011).

There are different terms used for ASPs (for example: antibiotic management or antibiotic control program), but they generally all refer to a program that is being used to change and direct more efficient antibiotic use (MacDougall & Polk, 2005). ASPs have a primary goal of optimizing clinical outcomes and minimizing undesirable effects of misuse and overuse of antibiotics. Another important goal is to keep health care costs as low as possible while retaining a high quality of health care. The definition of the Antibiotic Stewardship Programs used by MacDougall and Polk (2005) is: "An on-going effort by a health care institution to optimize antimicrobial use among hospitalized patients in order to improve the patient's outcome, ensure cost-effective therapy, and reduce adverse sequel of antimicrobial use (including antimicrobial resistance)".

According to MacDougall and Polk (2005) the creation of a successful ASP requires stakeholders to be included in its development and implementation process. These stakeholders need to be: physicians who are specialists in the development and implementation of pharmacy and drugs; a microbiological laboratory to provide the antibiotic resistance rates; and a hospital administrator responsible for implementing funding and institutional policy (MacDougall & Polk, 2005)

Antibiotic Therapy Information Support System (ATISS)

The Antibiotic Therapy Information Support System (ATISS) developed by Infectionmanager is one example of an eHealth intervention that was specifically developed to support an ASP.

The ATISS makes information about antibiotic therapy and infectious diseases more easily accessible, up to date and it can assist physicians that treat patients with antibiotics in their daily practices. The focus of the ATISS is on the care delivery process of antibiotic treatment. If the delivery process is

managed efficiently (by better use of available information) this can have a positive effect on the prescription and use of antibiotics in hospitals (Infection Manager, no date). The system has been implemented in two German hospitals, the Klinikum Herford in Herford and the Euregio-Klinik in Nordhorn where physicians are able to use it.

The content of the ATISS can be modified according to the needs of an individual hospital. This means that the ATISS will be delivered empty so it can be filled with general and hospital-specific information. Buttons and functions can be named, filled with information, exchanged and personalized by the responsible physicians. Therefore the content of the Herford ATISS and the Nordhorn ATISS are different. But there are also certain functions both have in common such as the contact buttons (see Figure 2) that provide contact with other physicians in the hospital to discuss certain problems. Figure 2 and 3 provide screenshots of the Herford ATISS. These have been used as the Herford system had more functions and more information than the Nordhorn ATISS (the Nordhorn ATISS was implemented at a later date).

The ATISS is accessible to the general public on the internet (http://herford.infectionmanager.com/), but within the two hospitals the ATISS is also accessible on the intranet. The intranet is an organisation-bound network that is only accessible with authorization within the hospitals. This network is only installed on the computers used in the hospitals because there is no WIFI in the hospitals. Therefore, ATISS is not accessible for physicians who want to use the ATISS on tablets or smart phones.

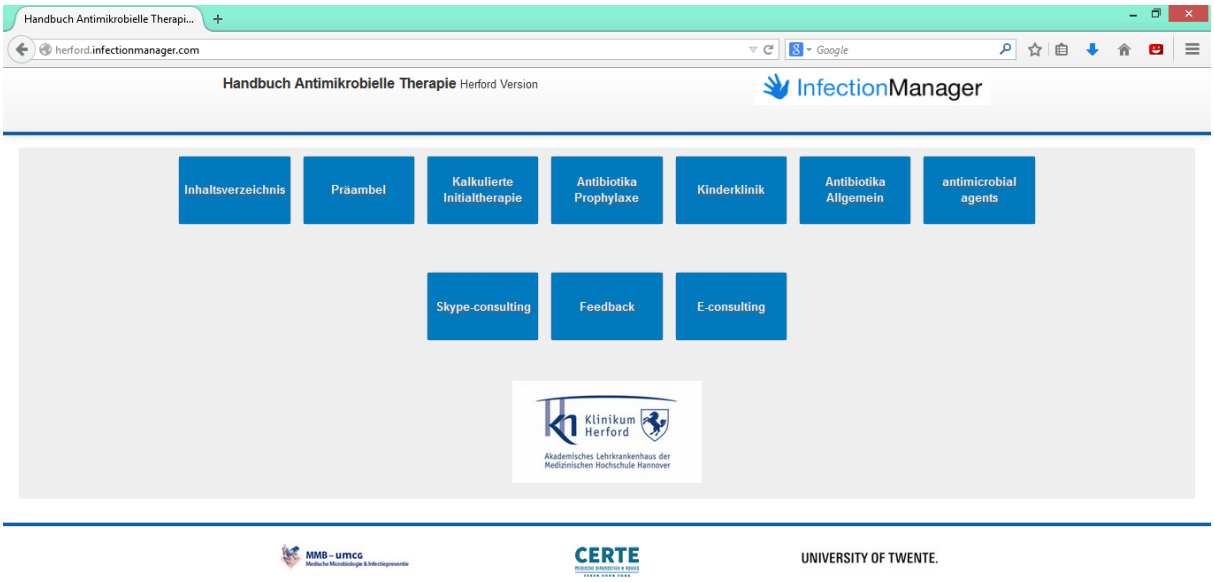

Figure 2: Herford ATISS home screen *(Infection Manager, no date)*.

For people who don't know how to navigate through the ATISS yet, the button "Inhaltsverzeichnis" (content) is important. Within this section of the ATISS every button and the different layer buttons are listed. The button "Kalkulierte Initialtherpie" shows different symptom areas under which the physicians can find further information about the infection (see Figure 3). The buttons "Präambel" (preamble) and "Antibiotika Allgemein" (antibiotics, general information) contain more general information such as important conditions for antibiotic therapy, antibiotic dosage and antibiotics during pregnancy, and the button "Kinderklinik" (children's clinic) is focused on antibiotic therapy for

children in different situations. “Antibiotika Prophylaxe” (antibiotic prophylaxis) is focused on the prevention of diseases with the help of antibiotics (see Appendix 1).

Figure 3: Second layer buttons “Kalkulierte Initialtherapie” (Infection Manager, no date).

The Centre for eHealth Research and Disease Management Roadmap

During the implementation of the ATISS, different steps of the CeHRes roadmap for developing or redesigning an eHealth technology can be used.

The CeHRes roadmap describes a holistic approach for developing eHealth technologies or for redesigning existing technologies. Different aspects of the roadmap will be used continuously throughout this paper for the development of the sub-questions, the interview questions etc. This is done because the roadmap can guide the understanding of the development process of the ATISS. It describes the process of development of an eHealth technology from contextual inquiry to the evaluation of the product. During this process, for each step that is taken forward it can also mean a step back to assess new developments or insights and incorporate them in the process. This will positively influence the next steps in the process and the success of eHealth.

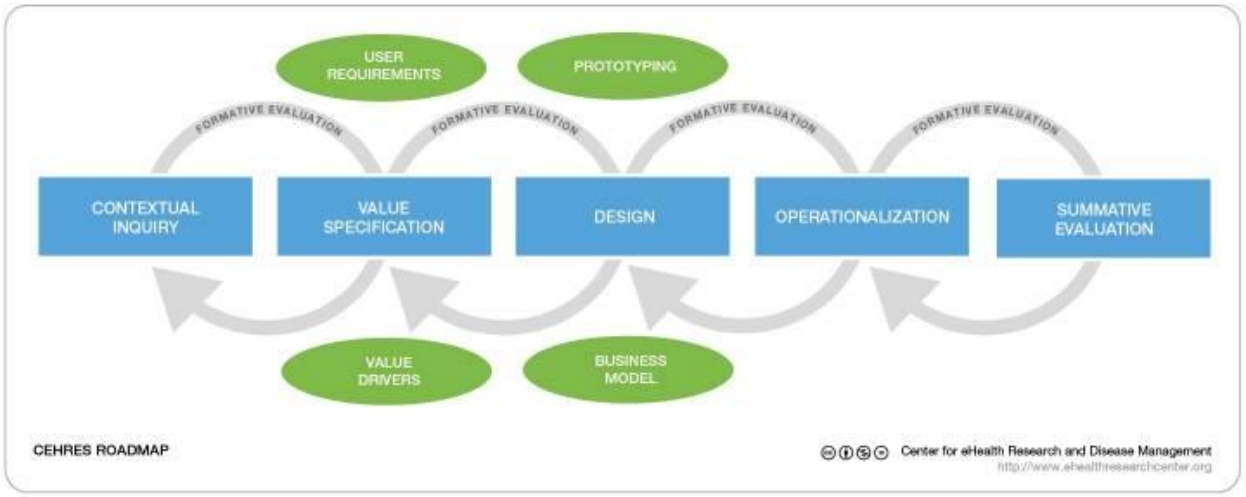

Figure 4: CeHRes roadmap (van Gemert-Pijnen, et al., 2011).

In this study only certain specific categories of the roadmap have been used that merged/went together with the implementation of the ATISS. Therefore the roadmap has been used to evaluate the implementation of the ATISS and not to develop. This study emphasizes the third step of the roadmap, the design step. This step consists of three levels: the content quality, the system quality and the service quality.

The content quality (the information the technology provides) can be evaluated with different quality indicators. These indicators include: whether the information is based on standards, whether the information is complete, whether the language is comprehensible for everyone and whether the context of the information is clear. The quality indicators for the system qualities (the way the technology works) can be: its ease of access, its ease of use, its technical security and its presentation of the content. The last level is service quality (the benefits of using the technology). Indicators for this level can be: the perceived usefulness of the technology, the ability to provide quick services, good social dynamics and good psychological influences (Verhoeven, 2009).

After testing of the three levels of design of the ATISS, the dissemination step can take place. Before implementing the technology a plan for the implementation should be made so the process can take place in an organized way. This can be done by (van Gemert-Pijnen, et al., 2011).

The last step that can be mentioned with regard to the roadmap is the summative evaluation. In this step the achievements at a given time should be determined. Important indicators of its success are its uptake (is the technology being used) and the impact (are the intended goals being realised, what is the effect) of the new technology (van Gemert-Pijnen, et al., 2011). This can be determined by asking end users for feedback about the technology and its implementation, to incorporate wishes or change the innovation to improve on the uptake and impact. This will lead to a more successful product.

These three levels of design, dissemination of the technology and its impact and effect are the steps of the roadmap design which have been used to categorize and construct the sub-questions (see below under Objectives). The ATISS had already been partly implemented at the time of this study

and therefore the first three steps of the roadmap are less discussed to assess the implementation process in this case and the focus was retrospective.

Objectives

The Purpose of this research is to assess the critical factors that German health care professionals want to see fulfilled with regard to implementing the new Antibiotic Therapy Information Support System (ATISS). Before implementing such a support system in German hospitals, it is important to seek out the expectations and needs for the support system, and to discuss different ways of implementation. It has been shown that informed implementation can have a positive effect on the uptake of a new practice because it will more likely be in sync with the wishes and expectations of the end users. Because the ATISS has already been implemented partly in both hospitals at the times of the interviews this study is retrospective. The main- and sub-questions that were determined will follow below.

Main question

What are the critical factors for the successful implementation of the Antibiotic Therapy Information Support System (ATISS) in German hospitals?

Sub-questions

The main research question is answered via multiple sub-questions. The sub-questions are divided into five different categories. The sub-questions focus on different aspects of ATISS that are important for its implementation, using the CeHRes Roadmap as a framework. The categories and sub-questions are:

Content:

- *To what extend is the content of the ATISS similar to the currently used resources?*
- *Does the ATISS help in the decision-making process with regard to antibiotic therapy?*

System:

- *Is the ATISS applicable in practice?*
- *In what way does working with the ATISS differ from the current practice?*
- *Does the ATISS connect to the available systems, applications, protocols, etc?*

Innovation/service:

- *Does the ATISS meet the values/expectations of physicians?*

Dissemination:

- *How should the ATISS be introduced?*
- *By whom should the ATISS be introduced?*
- *Through what kind of communication channels should the ATISS be introduced?*
- *How should the training/observability be managed?*

Effect:

- *When/ in what kind of situation is the ATISS used?*

Methodology

This chapter consists of five sections, first the study design, -setting and –population are discussed, then the procedure is described and data-analysis is explained.

Study design

The study design is both qualitative and explorative. Thus, it focusses on an in-depth understanding of the study population whose behaviour was captured with the help of interviews. The explorative nature of the study is illustrated by the fact that it was conducted without there being a specific or clearly defined problem, but rather to determine a best practice for the implementation of the ATISS.

The data used in this study were collected in two different ways: a literature study and scenario based interviews. The main objective of the literature study was to discover information about implementation strategies for eHealth technologies. Therefore five relevant theories were found that could be used to develop relevant interview questions. Together with the CeHRes roadmap these theories were used to construct the interviews by using the relevant information from the literature based on what was described as best practice implementation and experience with testing the ATISS itself (see above for detailed discussion of the literature used).

The interviews were semi-structured and scenario based. The scenario that described symptoms of an infectious patient was chosen based on the expert opinion of a microbiologist who was part of the development process of the ATISS in both hospitals. This expert therefore had insight in the progress of the implementation process of the ATISS and had contacts that could be used for the purpose of the interviews. Interview questions were based on the literature mentioned earlier in this study and illustrated in Appendices 2 and 3. In Appendix 2 the relevant literature for each sub-question is associated with the interview question numbers and in Appendix 3 this association is explained more in detail. For the full interview see Appendix 4.

Setting

The interviews were held face to face in the German hospitals. Approximately half of the interviews were done in the participant's actual work place and the other half were done in break rooms. Most of the interviews were held with access to a computer and a few with the help of paper based handouts of the ATISS. This was done so that ATISS could then be tested directly. The tablets that would be accessible in the Herford hospital were not used during the interviews because they did not work without Wi-Fi. Also the ATISS was not tested on private smart phones during the interviews, because of the Wi-Fi problem in both hospitals.

Study population

The study population consisted of physicians who work in the Klinikum Herford hospital and the Euregio-Klinikum hospital in Nordhorn. These two hospitals were chosen because the implementation process of the ATISS was ongoing or had just started and therefore the study population was a convenience sample in both hospitals because the physicians were chosen on basis of availability or if they were on the hygienic staff or not. The physicians were contacted either by e-mail or by telephone (see Table 1).

The study population chosen for this research can be seen in the Table 1. It consists of physicians from various departments with various specialities.

Table 1: Participant data Klinikum Herford and Euregio-Klinik hospitals.

Topic:	Klinikum Herford	Euregio-Klinik (Nordhorn)	Total
Hospital departments	General surgery, anaesthesiology, neurology, vascular surgery, cardiology, intensive care, pharmacy	Gynaecology, abdominal surgery, internal medicine, anaesthesiology, cardiology, intensive care	Not applicable
Part of hygienic commission	8 out of 10	4 out of 10	12 out of 20
Average age	43,3 (min 32-max 57)	40,8 (min 27-max 53)	42,05 (min 27-max 57)
Average years worked in hospital	9,4 (min 2-max 23)	7,5 (min 1-max 22)	8,45 (min 1-max 23)
Gender	7 men, 3 women	9 men, 1 woman	16 men, 4 women

Twenty interviews were conducted in total, ten interviews in each hospital. In both hospitals there was a main contact person who provided contact information (email addresses or telephone numbers) of other physicians and these were drawn from those would be the end user of the ATISS. Some of the participants were part of the hygienic commission, which consists of the hygienic staff from every department in the hospital as well as a microbiologist from the laboratory. The mix of hygienic commission physicians and other physicians for the interviews were chosen because the hygienic commission was assumed to know more about the development process of the ATISS, and the other physicians were assumed to know less, which made them a target group for the implementation of the ATISS. The hygienic commission is a commission that is concerned with the development and implementation of the ATISS in the two hospitals. The other participants were physicians from different departments in both hospitals. Table 1 describes the participants of this study in more detail.

Procedure

The study's procedure contains five consecutive stages. The literature that was searched for as part of the initial stage was relevant literature for the main and sub-questions. After that, the formulating of the interview questions followed.

The interviewing stage followed from the development of the main and sub-questions. The participants were interviewed for between 20-40 minutes. All interviews were recorded on a tablet with the help of the Quick Voice app and began with general questions designed to assess the characteristics of the physicians that were interviewed. These questions were asked in order to take

the influence of sex, age, profession and technical knowledge into account in the answers. The scenario was then described, and was followed by more specific questions. This was the scenario:

A patient is admitted to the hospital with an irritated red leg and Cellulitis. He has been treated with Penicillin for one day and now has a rash over his entire body. This is probably an allergic reaction to the Penicillin. What do you do next?

The entire interview (in German) is shown in appendix 4.

Data analysis

The data analysis stage of this study followed the 7 stages of the framework method (Gale, Heath, Cameron, Rashid, & Redwood, 2013).

1. Transcription

The recorded interviews were transcribed verbatim.

2. Familiarisation with the interview

The transcripts were read several times and potentially important quotes were highlighted. These quotes were later used to support the outcomes in the results (see chapter Results).

3. Coding

The transcripts had to be read carefully during the coding process. Important pieces of text were highlighted and labels (codes) were applied. These labels aimed to interpret the passage of text that was highlighted. For example when asked about the right person to introduce the ATISS, the answer would get the code presenter. Other codes and their meaning can be found in Appendix 5.

4. Developing a working analytical framework

The first formed codes were reviewed and discussed with the study's supervisors. The connection of the coding to the literature was clarified and the codes were revised several times.

5. Applying the analytical framework

After reviewing the codes and identifying potentially useful descriptions in the literature the final coding was completed. The final codes reflect combinations of the literature and the data obtained from the interviews. The literature was used to compare the data with already existing literature and form cords that combined the two.

6. Charting data into the framework matrix

The final codes and corresponding quotes, were charted/ put into tables. These tables were later used to describe the results and are presented in the next chapter.

7. Interpreting the data

Interpretation of the data involved the following process. The codes were counted in order to determine to what extend the participants thought alike. The same answer from the same participant wasn’t counted twice. Then the connections between the different codes were displayed in tables or

elaborated and these are discussed in the next chapter. The tables show the codes with associated answers (see chapter Results). The definition of the codes and any relevant quotes can be found in Appendix 5.

Theoretical framework

The theories mentioned below are used to assess the different stages of development of the new information support system that are relevant to this paper. The theories used for this study are: the Diffusion of innovation, which seeks to explain the dissemination of an innovation; the Normalization Process Theory that focusses on the implementation, embedding and integration of new technologies; Sense-making, a theory that tries to find the sense in individual actions; the Voice of customer, that evaluates technology by using opinions of the end users; and, the Computer technology principles, that focus on implementation of innovations in health care. These theories were chosen for this study because they complement and add to the CeHRes roadmap theory and contribute to the understanding of the five chosen categories that were used to divide the sub-questions.

Diffusion of innovation

Diffusion of innovation is a theory that revolves around explaining how new technologies enter the healthcare system and how they spread. During this study the diffusion of innovation theory has been used to define relevant interview questions about the implementation of the ATISS. This theory illustrates different implementation aspects that could be valuable to assess before implementing the ATISS. This theory has been chosen because it is particularly applicable to the ATISS in describing the different stages of diffusion because it takes into account all the different stages of diffusion the ATISS can meet. All of the mentioned critical dynamics (see below) have also been used to structure the answers.

Cain and Mittman (2002) define diffusion as: “The process by which an innovation is communicated through certain channels over time among the members of a social system”. The social system, in this study, is a healthcare facility. Innovation is defined by Cain and Mittman (2002) as: “An innovation is an idea, practice, or object that is perceived as new by an individual or some other unit of adoption.”

Cain and Mittman describe ten critical dynamics of innovation diffusion (see Table 2). These dynamics describe the stages of adoption (Cain & Mittman, 2002) which are consistent with the *dissemination* step of the roadmap. Also the *content* can be reviewed with the diffusion theory (relative advantage) and the systems compatibility with the infrastructure.

Table 2: Diffusion of Innovation stages (Cain & Mittman, 2002).

Stage	Definition
Relative advantage	The diffusion of an innovation will be faster if the anticipated value or benefit of the innovation is higher than the current practice.
Trainability	Adoption and diffusion of an innovation is improved by the opportunity to test the innovation without commitment. Also, if trying out the new innovation costs minimal investment it will more often be used.
Observability	The adoption and diffusion of an innovation can improve by users showing other potential users the benefits of the innovation.
Communications channels	The way people communicate within an organisation (opinion leaders and others) about the new innovation can have an effect on the pattern and pace of the diffusion of the innovation.
Homogeneous groups	Within a homogeneous group (people with similar characteristics) an innovation will spread more easily and faster than in a heterogeneous group (people that differ in important ways).
Pace of innovation/reinvention	Different innovations can have different diffusion patterns. Some will be relatively stable and don't evolve much while they diffuse and others can evolve very quickly or can be altered by users.
Norms, roles, and social networks	The diffusion of innovations is shaped by rules, formal hierarchies and informal mechanisms of communication.
Opinion leaders	The pace of diffusion can be affected by the opinion of individuals that are highly respected or listened to by others that value their opinion.
Compatibility	Adoption of an innovation and the diffusion of it will be dependent on the ability of the new innovation to coexist with existing technologies and social patterns.
Infrastructure	The existing infrastructure or existing technologies can have an effect on the adoption of the innovation.

Normalization Process Theory (NPT)

Normalization Process Theory focusses on the implementation of new technologies or new ways of acting and working. It describes how these can become routines in daily practice. The NPT theory focusses on the embedding and integration of any new technology and is therefore an extension of the diffusion theory mentioned above that focusses on implementation. This is important for sustaining the new practice with the ATISS because only implementing it will not guarantee people using it. Therefore the different components mentioned below have been used mainly for developing interview questions and assessing answers about sustainability.

The NPT includes sociological tools that can explain the processes of operationalizing new practices of thinking, enacting and organizing work. The three core problems the NPT is concerned with are (May, et al., 2009):

1. ***Implementation***. The organization of bringing practices in action.
2. ***Embedding***. The process that ensures that practices become a routine at the workplace.
3. ***Integration***. The process of reproducing and sustaining a practice in an organisation.

The NPT first focusses on the work that people do, the actions they undertake. The actions are divided in four constructs that are clarified in Table 3. The different kinds of work that people can do are divided in these four constructs (May, et al., Cohorence, 2010). In regards to the roadmap this connects to the content category because it describes the users values of the new practice, the innovation/service category because the expectations of the users are discussed and also the effect category because the system also needs to be sustained after implementation.

Table 3: NPT, Constructs and Components (May, et al., NPT Core Constructs, 2010).

Construct	Components	Definition
Coherence	***Differentiation***	How a new technology can differ from another technology or the usual way of working.
	Communal specification	A sense-making aspect of the coherence construct. It relies on people working together for a communal understanding of aims, objectives and benefits.
	Individual specification	Participants need to understand their tasks and responsibilities in the field of work they are in.
	Internalization	Participants do not only understand the work they're doing but also the value, benefits and importance of a set practices.
Cognitive participation	***Initiation***	A newly implemented product can be driven forward by key participants.
	Enrolment	Reorganizing and rethinking individual and group relationships because of the new set of practices that is introduced.
	Construct legitimation	The participants believe it is right to be involved in the new set of practices.
	Activation	The participants need to stay involved in the new practice and need to sustain it.
Collective action	***Interactional workability***	The interaction participants have during operationalization of the new practice on a daily basis.
	Relational integration	The work participants do to build and maintain confidence in a practice as well as in each other.
	Skill set workability	The division of work that is connected with the new practice.
	Contextual integration	Managing a new practice through different recourses, protocols, policies and procedures.
Reflexive monitoring	***Systematization***	The effectiveness and usefulness of a practice for the participants and others. This means it is necessary to collect the right information about the practice.
	Communal appraisal	Participants working together to evaluate the worth of the new practice.
	Individual appraisal	Participants evaluate the new practice individually, and they evaluate the effects it has on them personally with this component. This determines the personal relationship the participants develop with the new practice.
	Reconfiguration	The appraisals of participants (communal or individual) that could result in changes to the practice.

Sense-making

The main questions asked in the theory of sense-making are: How do people construct what they construct, why do they do it and what are its effects? The theory focuses on implementing communication practices and the design of the existing communication structures. Sense-making is also mentioned as part of the NPT which is mentioned with the *communal specification* component and it is included in this study so as to have a better understanding of the sense-making part of the NPT as well as the sense-making theory on its own. The NPT describes the role of users during the implementation and focusses more on the structure of the organisation whereas the sense-making theory describes the user's way of thinking in regards to the implementation. This theory was used to enhance the questions that originated from the NPT theory and to gain a deeper understanding of some of the answers given during the interviews.

Sense-making in organisations involved looking for explanations in terms of people's opinions instead of within the structures of the organisation. Organizational problems or issues often are a direct result of people's way of thinking.

The third aspect of sense-making (Enactment) is the aspect that gets the most attention in this paper. It revolves around participants who act in a certain way in order to bring structure into a new way of working and to set them in action. With the new technology a new practice will be set in motion. This is done because it is crucial for the implementation of the ATISS that the new practice (working with the computer and the new system) will be used to enjoy the positive effects it can have. This means participants have to change their routine and bring structure to a new routine that will be set in action (Weick, 1995). With the implementation of the ATISS the physicians will have to participate in a new way of working with the program. It is important for the success of the ATISS that the new practice will be as easy and consistent with the current practice as possible or even better, so the physicians see the benefits of using the ATISS.

The roadmap category that is most emphasized in this theory is the evaluation part that can be found in all five categories used in this study. An example of this is the retrospective aspect of this theory that can describe how the physicians evaluated the ATISS after the scenario. There are seven aspects of sense making according to Weick (1995) that are shown in Table 4:

Table 4: Sense making aspects

Aspects	Definition
Identity	Finding out who someone is by discovering how and what he/she thinks.
Retrospect	Thinking back to what was discussed earlier to learn about the now.
Enactment	Creating a discussion by doing or saying something as a reaction to other actions.
Social	The reaction of an individual is created by the social environment the individual is in as well as the anticipated reaction of others. It will have influence on the conclusion that can be reached.
On-going	The impression someone makes is ongoing in time. Even after the interests of that person have changed the reflection may not change with it.
Extracted cues	The impression that has been communicated is only a small part of the truth. Context and personal disposition also play a role but are sometimes difficult to spot.
Plausibility	Sufficiency and plausibility take precedence over accuracy. This means information about a "project" needs to be sufficient but not too much.

Voice of customer (VOC)

To gain more insight into the customers' requirements, the VOC theory is applied in this study. It captures customers' requirements via a description of the process. It gives insight into what the customer's wants and needs, and focusses on prioritizing in terms of importance and satisfaction with current alternatives. This theory has been included in this study because a lot of the other theories (and also the CeHRes Roadmap) focus on the opinion of the end users, and the VOC theory can be used to explain this focus in terms of four aspects that will be mentioned below. Therefore it has been used to construct interview questions that aim to get insight on the wishes of the end users.

There are four aspects of the VOC according to Griffin et al (1993):

A *customer need* is the customer's description of the benefit that has to be fulfilled by the new goods or services. To understand this description the "lens" model can be used to understand the customer's perception. This model explains that customers will use a new product if they prefer it over other products that are already on the market or that they already use, but this is dependent on how customers perceive the world. The perception customers have is based on the features the product has, as well as advertisement, social context, word of mouth etc. To make a decision, the availability and price, and the personal preferences of the customers are weighted. This will trigger the decision to use or not use the new product (Gaskin, Griffin, Hauser, Katz, & Klein, 1993).

The *hierarchical structure* of the VOC theory is divided into primary, secondary and tertiary needs. The primary needs are strategic needs that can help set the strategic direction of marketing. Secondary needs are the tactical needs that explain in more detail what must be done to fulfil the primary needs. The tertiary needs are the detailed needs. These eventually can provide a detailed set of product characteristics or promoting ideas that will fulfil the primary and secondary needs (Gaskin, Griffin, Hauser, Katz, & Klein, 1993).

Customers might have *priorities* when it comes to the perceived needs they have expressed. These priorities can be estimated for example by counting the times a priority has been mentioned by different customers or by letting the customers chose a most and least important need.

This theory is most recognizable in the evaluation phase of the CeHRes roadmap. It describes the customer's needs and wishes but also focusses on the organisational structure.

There is a simple process that can be described for using the voice of customer theory (see Table 5). This process can be outlined in 6 different steps (Gaskin, Griffin, Hauser, Katz, & Klein, 1993).

Table 5: Steps of VOC using process (Gaskin, Griffin, Hauser, Katz, & Klein, 1993).

Steps	Definition
Identify the customer	If the customer is not identified it will become very difficult to assess the opinion of this customer.
Initial opinion costumer	Gather information about the initial opinion of the customer. This can be done for example by using surveys, focus groups, complaints, correspondence etc.
Rate input	Formulate the collected data in a way that rates the importance of the input.
Prioritizing	Prioritize the requirements of a product based on the opinion of the customer. Then determine if it is possible to alter requirements based on how easy or difficult this will be.
Determine best practice	The information obtained will show the best process/practice that can be chosen to achieve the desired results.
Create ongoing process	The activities can be determined to create an ongoing process.

Computer Technology Principles

There are twelve principles to guide implementation of new technology (Ash, Fournier, Stavri, & Dykstra, 2003). Most of the principles that are listed below have been used during the study either to form an interview question or to help interpret an answer. For example, the value and trade-offs of the ATISS were part of the interview. This particular theory has been used during this study partly because it fits with the other theories used but it also offered the chance to gain more information about issues such as the organizational principles and it connects to the roadmap. The roadmap can be used to develop and implement a new technology in healthcare. This theory however focusses on the implementation of a new technology. Because the focus of this study is on the implementation the computer technology principles can be used as an extension of the roadmap implementation step.

These principles were formed during the testing of a computerized physician order entry (and can be seen in Table 6). The principles were clustered into four groups: computer technology, personal principles, organizational principles and environmental issues. In Table 6 the twelve principles and their clusters are shown (Ash, Fournier, Stavri, & Dykstra, 2003).

Table 6: Twelve computer technology principles (Ash, Fournier, Stavri, & Dykstra, 2003).

Group	Principle	Definition
Computer technology principles	***Temporal concern***	It should not take the users of the new technology any more time to use it then it did with the old system
	Technology/ meeting information needs	Technical aspects and the organization of information. User consideration and user friendliness are examples of technical details that fall under this principle.
	Multidimensional integration	Integration of different systems in the new technology system, and the integration of the new system into the already existing workflow.
	Costs	Costs are made by the new system. Examples are: costs of hardware and software, implementation costs, training costs and maintenance costs.
Personal issues principles	***Value to users and trade-offs***	The downside and upside of the new technology can be reviewed.
	Essential people	There are two groups of essential people: leaders who have high positions in the hospital and the opinion leaders who are well respected and enthusiastic about the system.
	Training and support	It is important to help the users with the system at the time of implementation. This means there should be post go-live support, not only pre-go-live training.
Organizational principles	***Foundational underpinnings***	The success of an implementation depends on the existence of a firm foundation within the organization.
	Collaborative project manager	A project manager's task is to bring groups of people together, and assure that team members treat each other with respect.
	Terms, concepts and connotations	The appropriate use of language and appropriate communication can be important during the implementation of a system. It can increase or hinder understanding.
	Improvement through evaluation and learning	It is important to have a feedback mechanism and the possibility of modification to insure continuous improvement.
Environmental principles	***Motivation and context***	Consider from which stakeholders the motivation is coming, and what it consists of. If the motivation comes from the physicians that have to eventually use the system, it will have a higher chance of success.

Results

Results will be shown according to the five categories discussed above: content, system, innovation/service, dissemination and effect. In order to elucidate the information, the Tables 7 to 12 have been added for each category to show the different outcomes that were measured.

The participants were asked what the main stakeholders were of the ATISS. The majority (43%) of the participants of the interviews stated that the stakeholders of the ATISS were all physicians working in the hospital, 44% mentioned specific physician groups (for example assistant physicians) and the rest responded not applicable.

Table 7: Stakeholders

Codes (labels)	Different answers	Frequency (Herford: 10 and Nordhorn: 10 participants)	Percentages
Stakeholders	**All physicians**	H:4 N:5	43%
	Assistant physicians	H:3 N:2	24%
	Primary emergency room physicians	H:2 N:0	10%
	Inexperienced physicians	H:1 N:1	10%
	Not applicable	H:0 N:3	15%

Content

As shown in Table 8 five alternative ways of finding information about antibiotic without the ATISS have been mentioned during the interviews. By far the most mentioned alternative (mentioned by 48%) was using hardcopy materials for example an antibiotic booklet that was handed out across the Euregio-Klinik hospital in Nordhorn before the ATISS. One of the participants stated that:

"I use this system [shows a different system on intranet, eds.], and if I look at this case I get a different answer than from the ATISS. But I would probably use this information because I know where it came from."

The participant also stated that extra information about the date of the last update or a link to an appropriate information site would make the ATISS more reliable.

The interaction features (such as Skype and the feedback button) that can be used in the ATISS, had not been used by any of the participants because during the time of the interviews, none of the interaction features worked. When asked if the participants would use the interaction features if they were working, 29% showed interest in using Skype and 8% said they would use the feedback and e-consulting features. Mentioned by 46% of the participants, using the telephone to call a colleague/ supervisor was stated to be the preferable method. One participant stated:" I am the old generation so I prefer using the booklet. It [using the ATISS, eds.] would be good for the younger generation." Another participant said: "I already know too much about antibiotic therapy, the new physicians should use it [the ATISS, eds.]."

A total of 18% of the participants stated that the ATISS was complete, while 72% of the participants found there were still features missing, e.g. from the content, the other 10% were not applicable meaning they didn't know sufficient details about the ATISS to answer the question. 33% of the participants stated reference links and update information were missing in the ATISS (missing features).

Table 8: Content

Codes (labels)	Different answers	Frequency (Herford: 10 and Nordhorn: 10 participants)	Percentages
Current resources/ practice	**Hardcopy**	H:4 N:9	48%
	Intranet	H:3 N:1	15%
	Internet	H:4 N:1	19%
	Experience	H:1 N:1	7%
	Asking others	H:1 N:2	11%
Interaction features	**Telephone**	H:8 N:3	46%
	Skype	H:4 N:3	29%
	Feedback and e-consulting	H:1 N:1	8%
	Not applicable	H:1 N:3	17%
Completeness ATISS	**Complete**	H:3 N:2	18%
	Missing content	H:5 N:5	33%
	Missing features	H:8 N:2	33%
	Missing password/ login	H:0 N:1	3%
	Missing materials	H:0 N:1	3%
	Not applicable	H:3 N:0	10%

System

At the time of the interviews, a total of 10 (50%) of the participants had used the ATISS (see Table 3). Of these 10 participants three stated the ATISS was not relevant in daily practice. It was stated that the intended use rate was higher than the actual use rate due to a lack of WI-FI, slow intranet or the lack of computers in the patient rooms. After testing the ATISS all of the participants found the system to be an easy system to work with.

The ATISS, at the time of the interviews, was being used on fixed placed computers. The interviews have shown that 20% of the physicians do use tablets at home but none of them use tablets for work. In the Klinikum Herford hospital tablets were handed out to members of the hygienic staff but they didn't work because of the lack of WI-FI. 30% of the participants stated that they would use the ATISS on a tablet if that was an option because a tablet would be easy to carry around which means the physicians could always have access to the ATISS. 50% of the participants used smart phones for private use, and 25% of the participants used smart phones at work for apps which did not require WI-FI (none of the participants used it for the ATISS). An example of this is interview 17: "I sometimes use my smart phone for work. I don't use it for the ATISS yet, because it doesn't work."

Even though the ATISS could only be used on the computer during the time of the interviews the ATISS was ranked compatible with the hospital infrastructure by 75% because the participants did not see the problem with the ATISS but with the outdated internet system of the hospital. An example of

this is the participant that stated: “I think it is compatible because everybody can use it on the computer.”

Table 9: System

Codes (labels)	Different answers	Frequency (Herford: 10 and Nordhorn: 10 participants)	Percentages
Relevance	**Relevant**	H:4 N:4	40%
	Not relevant	H:2 N:1	15%
	Not applicable	H:4 N:5	45%
Actual use	**Hygienic staff**	H:4 N:2	60%
	Not hygienic staff	H:2 N:2	40%
Intended use	**Positive**	H:7 N:7	70%
	Indifferent	H:3 N:2	25%
	Not applicable	H:0 N:1	5%
Ease of use	**Easy**	H:10 N:10	100%
Fit of ATISS	**Therapy benefits**	H:11 N:9	47%
	Structural fit	H:9 N:11	47%
	Costs	H:1 N:1	4%
	Difficult patients	H:0 N:1	2%
Electronic use	**Computer**	H:10 N:10	100%
	Tablet private	H:2 N:2	20%
	Tablet work	H:0 N:0	0%
	Smart phone private	H:6 N:5	55%
	Smart phone work	H:2 N:3	25%
Quality ATISS	**Regular updates**	H:8 N:8	73%
	Secure content	H:2 N:0	9%
	Clinical study	H:0 N:2	9%
	Marketing	H:1 N:1	9%
Updates	**Departmental administration**	H:7 N:4	44%
	Feedback button	H:5 N:1	24%
	Update tracking	H:3 N:2	20%
	Not applicable	H:0 N:3	12%
	Every 12 months	H:1 N:4	25%
	Every update	H:3 N:2	25%
	Every 3 months	H:2 N:1	20%
	Not applicable	H:4 N:3	30%
System administrator	**Hygienic commission**	H:10 N:9	68%
	Head physician	H:2 N:2	14%
	Hospital board	H:1 N:0	4%
	IT	H:0 N:3	10%
	Not applicable	H:0 N:1	4%
Compatibility	**Compatible**	H:7 N:8	75%
	Not compatible	H:2 N:0	10%
	Not applicable	H:1 N:2	15%

Innovation/service

The ATISS provides information for doctors about antibiotic therapy. Not all of the participants (40%) knew about the existence of the ATISS or knew how to find the system, therefore their expectations about working with the ATISS rather than experience with the ATISS were queried.

After testing the system with the casus, 89 % (see Table 10) of the participants described their expectations of the system as good or user friendly based on the casus exercise. This quote illustrates that the ATISS is perceived as comprehensible by 63% of the participants: “Anyone that can`t operate this system, should not be allowed to be a doctor let alone a surgeon.” One participant however stated the ATISS was “Outdated”, because the technology used has been on the market for a long time. But 7% thought the ATISS will be difficult to implement because of access problems (based on the scenario testing). Which is why one of the participants, when asked about his opinion on the ATISS, responded with: “The idea is very good, the realization will be difficult.”

According to 55% of the participants the ATISS meets their expectations.

Table 10: Innovation/service

Codes (labels)	Different answers	Frequency (Herford: 10 and Nordhorn: 10 participants)	Percentages
Expectations ATISS	**Good**	H:7 N:7	52%
	User friendly	H:3 N:7	37%
	Difficult to implement	H:2 N:0	7%
	Outdated	H:0 N:1	4%
Cause of expectation	**Comprehensible**	H:7 N:8	63%
	Important information	H:4 N:2	25%
	Quick access	H:1 N:0	4%
	Resistance problem	H:1 N:0	4%
	Out of order	H:1 N:0	4%
Expectations fulfilled	**Meets expectations**	H:5 N:6	55%
	Doesn’t meet expectations	H:5 N:4	45%

Dissemination

The dissemination methods of the ATISS that were mentioned during the interviews can be seen in Table 11. The most frequently mentioned method was a top down presentation, which was mentioned by 95% of the participants, which should be done per department according to 95% of the participants (see Table 11).

It was stated that the head physicians (Chefarzt), senior physicians (Oberarzt) and hygienic staff (Hygienebeauftragte or Hygienekommission) should present the ATISS to the physicians. A snowball effect occurs when assistant physicians show other assistant physicians the ATISS and then these other physicians show others and so on. One of the participants said: “It [the ATISS, eds.] should be introduced top down. Head and senior physicians should promote it with other physicians.”

The ATISS could be presented with the help of training according to 70% or without any training according to 30% of the participants. If the training option is chosen this could be done once (57% participants), once a year (13% participants), through promotion (marketing the ATISS on a daily

basis) (30% participants) or a combination could be used. The presentation strategies with training could be done through education (23% participants) or during morning meetings (23% participants), with the help of technology (21% participants) and/or promotion (15% participants). A combination of the mentioned possibilities would also be practicable.

One of the participants stated: “In this department we presented the ATISS during a morning meeting. We took the assistant physicians to a computer room and showed them how the system works.” Another participant stated: “My colleague, who is mainly responsible for the intensive care unit, uses it [the ATISS, eds.]. She actually showed me the ATISS“. This is an example of the top down introduction combined with the promoting method.

According to 35% of the users, issues with the presentation can occur when physicians don’t use the ATISS while according to 17%, there have been issues when the maintenance is not kept up. Also 14% said there have been technical problems which make de ATISS unserviceable and 10% felt that there are dependency issues. Solutions for these issues could be quality related or could reflect problems with securing access to the ATISS in patient rooms. For the dependency problems one solution suggested was to appeal to the physicians to keep thinking for themselves and to not blindly follow the ATISS.

If there is no training needed at least an existence notification (according to 18% of the participants) would have to be used so that the physicians know the ATISS exists. This could be done by e-mail, or it could be mentioned in the morning meetings or by promotion.

Table 11: Dissemination

Codes (labels)	Different answers	Frequency (Herford: 10 and Nordhorn: 10 participants)	Percentages
Presentation	**Top down**	H:9 N:10	86%
	Snowball effect	H:2 N:1	14%
	All at once	H:1 N:0	5%
	Per department	H:9 N:10	95%
Other hospitals	**Same**	H:9 N:9	90%
	Not applicable	H:1 N:1	10%
Presenter	**Hygienic staff member**	H:8 N:5	48%
	Head physicians	H:3 N:4	26%
	Senior physicians	H:1 N:6	26%
Strategy	**Education**	H:5 N:3	23%
	Morning meeting	H:3 N:5	23%
	Promoting	H:5 N:2	21%
	Using technology	H:2 N:3	15%
	Existence notification	H:3 N:3	18%
Issues	**User issues**	H:5 N:5	35%
	Maintenance issues	H:3 N:2	17%
	Technical issues	H:3 N:1	14%
	Dependency issues	H:2 N:1	10%
	No issues	H:4 N:3	24%
Training	**Training needed**	H:7 N:7	70%
	No training needed	H:3 N:3	30%
Training strategy	**Once**	H:6 N:7	57%
	Once a year	H:2 N:1	13%
	Promotion	H:5 N:2	30%

Effect

25% of participants (see Table 12) stated that they would use the ATISS for patients with infectious diseases (not all were confronted with such cases on a daily basis) or with difficult patients that had unusual infections or several infections at the same time (30%). 10% of participants would also use it to look up guidelines and 5% would use the ATISS to keep track of changes, or they would use the ATISS if the system was easier to access. The rest of the participants could not answer the question because they didn't have enough experience with the ATISS.

Using the ATISS can have different effects. 21% of participants valued the diagnostic security the ATISS can give and the optimized therapy that using the ATISS can generate. 19% expected a standardized therapy, 17% expected time savings and 15% percent expected less multi resistant bug developments because of the ATISS. A decrease in costs was also mentioned as an expected effect by 7% of the participants.

Table 12: Effect

Codes (labels)	Different answers	Frequency (Herford: 10 and Nordhorn: 10 participants)	Percentages
Requirements of use	**Infected patients**	H:4 N:1	25%
	Difficult patients	H:2 N:4	30%
	Guidelines	H:2 N:0	10%
	Changes	H:0 N:1	5%
	Quick reference	H:0 N:1	5%
	Not applicable	H:2 N:3	25%
Expected effect	**Decreased costs**	H:3 N:0	7%
	Diminished resistance	H:4 N:3	15%
	Standardization	H:5 N:4	19%
	Time saving	H:6 N:2	17%
	Security	H:4 N:6	21%
	Optimizing therapy	H:3 N:7	21%

Discussion

First the sub- and main questions will be answered in this section. Then the interpretation and connection to the used literature will be discussed. Recommendations for future research and the limitations of this study will be covered last.

Research-questions

In this paragraph the answers to the research-questions will be summarized and discussed according to the five categories that have been used throughout this study.

Content

To what extend is the content of the ATISS similar to the currently used resources?

Because there had been an organised hospital-wide information booklet for antibiotic therapy in the Euregio-Klinik Nordhorn hospital before the ATISS, the content of this booklet was generated into the ATISS system which means the majority of the content was similar. In the Klinikum Herford every department seemed to have a different alternative to find antibiotic information which caused the content of the ATISS and other methods to show a greater difference.

Does the ATISS help in the decision-making process with regard to antibiotic therapy?

Most of the participants (72%) stated that there was still information missing in the ATISS which made them hesitant to use the system. There were also participants who had already used another system for antibiotic therapy information which they preferred over the ATISS. These outcomes suggest that the ATISS was not completely being taken advantage of at the time of the interviews which could lead to physicians using different antibiotic therapy practices in the same hospital.

System

Is the ATISS applicable in practice?

The intended use of the ATISS is 70% and the actual use is 50%. This difference originates from issues to do with the intranet or the WIFI. The physicians that stated that they had no intention of using the ATISS had access problems or thought they had sufficient experience not to need the information the ATISS could provide.

In what way does working with the ATISS differ from the current practice?

All of the participants stated that computers were used on a daily basis in the hospitals. Yet, 5 participants stated that there was no computer access in the immediate vicinity of the patients which made the ATISS unserviceable during consultations. Also 25% of the participants used their smart phones at work, but not for the ATISS because of access problems. Two of the participants stated they would search for ATISS information on their smart phones if it was possible. One of the participants stated that using a smartphone in the hospital was prohibited, on the other hand it was generally accepted.

Does the ATISS connect to the available systems, applications, protocols, etc.?

Although the ATISS was difficult to access, the innovation was ranked compatible with the hospitals existing infrastructure by 75% of the participants. This means the participants did not see the problem with the ATISS but rather with the (outdated) reach of WIFI and intranet of the institution.

Innovation/service:

Does the ATISS meet the values/expectations of physicians?

According to 55% of the participants the ATISS meets their expectations. The most often mentioned expectations described during the interviews were that the system would be good and user friendly, only 7% of the participants thought the ATISS to be difficult to implement because of access problems. Although 72% of the participants stated the content of the ATISS wasn`t complete the general opinion about the ATISS was positive.

Dissemination

How should the ATISS be introduced?

The ATISS could be presented through a top down method according to 86% of the participants and/or through a snow ball effect method according to 14%. This should be done per department (according to 95% of the participants) and could be done the same way in other German hospitals.

By whom should the ATISS be introduced?

The ATISS should be introduced by head and senior physicians/ the hygienic staff. Another possibility is the snowball effect introduction where the assistant physicians learn from each other and encourage each other to use the ATISS.

Through what kind of communication channels should the ATISS be introduced?

During the interviews different communication channels were mentioned. For example via the educational program, during morning meetings, promoting the ATISS, via e-mail or other technology use or with help of an existence notification (this can also be done via e-mail).

How should the training/observability be managed?

70% of the participants stated that a short training that includes showing the physicians where to find the ATISS and how it works, perhaps with an example, would be beneficial. This can be a onetime occasion (according to 57%) or a yearly reoccurrence (13%). Promotion as a training strategy was mentioned by 30% of the participants.

Effect

When/in what kind of situation is the ATISS used?

According to 25% of the study's participants the ATISS would be used in situations where patients had infectious diseases, while 30% of participants felt that it would be used where the infection may or may not be unusual. Using the ATISS to look up guidelines and changes was mentioned by 10% of the participants.

Main question:

The main question asked in this study is:

What are the critical factors for the implementation of the Antibiotic Therapy Information Support System (ATISS) in German hospitals?

The critical factors for implementation of the ATISS in German hospitals are: development, introduction and effect. The development factor of the ATISS determines the content and includes maintenance of the system. The introduction of the ATISS is preferably done top down and per department. The effect of the implementation of the ATISS can be measured individually, per department or hospital or eventually in the laboratory with presumably lower resistant bacteria levels in the region.

The *five categories* which are used during this study are all components of the three factors. The implementation of the ATISS starts in the development phase where the ATISS is formed. This includes determining the *content* of the ATISS, and ensuring the usability of the *system* in practice. With regards of the content, references and update information could be added to ensure reliability. The lack of WIFI, lack of computers near the patients and the slow intranet could be an interfering factor for the implementation process because this would mean physicians couldn't use the ATISS while in the patient room. By improving the WIFI conditions in the hospitals physicians could easily use the ATISS on tablets or smartphones.

For a successful introduction of the ATISS it is important to keep in mind the feasibility of the system during the development stage which is also the link to the introduction stage. The term feasibility was chosen because it can represent a variety of issues, such as its usefulness, user friendliness, or effectiveness. The ATISS was described as easy to use by all of the participants, and only positive effects were mentioned.

After the development of the ATISS its introduction follows. For the ATISS this means a top down and per department introduction, initiated by the hygienic staff. Training and/or education could help during the introduction phase to stimulate more physicians to use the ATISS and can be organised easily in each separate department. For new (/newly transferred) physicians the introduction to the ATISS can be incorporated into the mandatory schooling. Maintenance is important and referred to as one of the main advantages of the ATISS (easy to update) during the interviews.

After using the system in practice the effects can become clear. The requirements of use of the ATISS describe this perfectly, because it outlines the situations in which the ATISS would be used. Also the effects like decision certainty and time savings during the antibiotic therapy are described as expected effects that can come from using the ATISS.

During the interviews participants stressed that evaluation of the ATISS is important. This could point to content evaluation which could be discussed by the hygienic commission or feedback about the access problems with the ATISS through the feedback button that is on the ATISS. Evaluation keeps the ATISS updated if the communication channels are clear. It became clear during the interviews that the intended use of the feedback button was not clear. The button could be used for feedback about the ATISS, which could lead to a more up to date content (more eyes will see more mistakes).

Literature discussion

The connection to the used literature and the data obtained during this study will be discussed below according to the five categories.

Content

The computer technology principle describes the organisation of information with the meeting information needs principle (Ash, Fournier, Stavri, & Dykstra, 2003). By comparing the content of the ATISS with the content of other practices that were used to get antibiotic therapy information and valuing the completeness of the ATISS this principle was discussed. The comparison revealed that 72% of the participants found the ATISS incomplete and therefore not meeting the information needs principle.

System

Just like suggested in (for example) the NPT, differentiation theory the currently used and new practice (the practice without and with the ATISS) were compared and the differences of the two ways of working were demonstrated with the help of the casus (May, et al., Cohorence, 2010). These comparisons revealed positive and negative effects for some physicians. One physician for example stated that she would rather keep using a booklet instead of the ATISS because the ATISS was on the computer. Other physicians stated they preferred the ATISS because it was easy to update on the computer. This shows that difference of preference and interpretation can effect outcomes of interview questions severely.

The ability to see the end product and see others use it is described in the observability stage of the diffusion theory (Cain & Mittman, 2002). Because the interaction features were not activated yet, the participants had no chance to test them which means the observability stage of the diffusion theory did not occur. This resulted in confusion about who would be on the receiving end of the e-mail or Skype call, which made it hard for physicians to describe or form their opinion of the features. Furthermore one participant stated that Skype would not work without a microphone and would have no advantage to a phone call without a camera. All of this was extra material that the existing computers in the hospital did not have.

Innovation/service

The relative advantage stage of the diffusion theory describes the worth of the anticipated higher value or benefit of an innovation, and the effect it can have on the diffusion (Cain & Mittman, 2002). During the interviews these expectations were discussed. The expectations people had were mainly positive (user friendly, good) and the expected use of the ATISS was 75%. This would suggest that the positive expectations of the physicians could contribute to a swift dissemination of the ATISS in the hospitals. Because both of the hospitals were in the middle of the implementation stage the speed of the dissemination was not measured during this study.

Dissemination

The dissemination of the ATISS should be done top down (according to 86% of the participants) and per department (according to 95% of the participants). The described process of implementation is according to the initialization construct of the normalization process theory. The hygienic staff members or the senior/head physicians were described as higher level physicians during the interview that would have the authority and respect that is needed, to implement the ATISS successfully (they are key participants) (May, et al., Cohorence, 2010).

In a qualitative study from the Implementation Science initiative the difficulty of implementing an eHealth was studied (Murray, et al., 2011). The study concludes that the understanding of barriers and facilitators for successful eHealth implementation among implementers is an under-studied and under- appreciated field, although their views are generally significant. In this study however there is no significant difference between the views of the implementers (the hygienic staff, senior/head physicians) and the non-implementers (assistant physicians), which suggests that the dissemination method for the ATISS in the two hospitals would be: top down and per department.

Effect

The expected effects of the ATISS were all described positive during the interviews. The systematization construct of the normalization process theory illustrates the importance of the effectiveness and usefulness of a new practice (May, et al., Cohorence, 2010). The expected effect show signs of positive changes with the implementation of the ATISS. Because the ATISS was in the middle of the implementation process in both hospitals the outcome of these positive expected effects was not measured. However the intended use rate was measured at 70%.

Recommendations

In this section a few recommendations for practice and research will be discussed. The first and foremost recommendation for practice that can be mentioned is the use of the critical factors that determine successful implementation (development, introduction and effect). These factors have however never been tested before. To determine the implementation success of the model it is recommended to test the factors in practice. This means the implementation process should be recorded by tracking the point of introduction of the ATISS (in the departments), and the use of the ATISS for several weeks after the point of introduction. This could reveal important data about the initial use and the maintaining use of the system which could be interesting for further research.

Another recommendation for practice is the further investigation of the language usage. The system was implemented with partly English and partly German information. During some of the interviews the participants clearly struggled with the German language and indicated that their study had been in English. This could suggest that either translating the entire ATISS into English or letting the physicians choose between a German and English version of the ATISS could be beneficial for the implementation.

Furthermore, a recommendation for practice that can be mentioned is to add references to the internet sites. Also updates that have been used to determine the content of the ATISS should be shown. This would make the information in the ATISS more reliable and would eliminate possible doubts from physicians about the origination of the information.

The last recommendation is to do further studies about the implementation of the ATISS in more hospitals, resulting in a bigger study population. This will provide more diverse and accurate implementation factors, and it will be more easily generalizable to other hospitals.

Limitations

The first limitation specific for the ATISS that can be mentioned is that the scenario that was used during the interviews was a casus chosen based on an opinion from an expert that was involved with the development of the ATISS in both hospitals. This specific scenario was chosen because it was a difficult situation that could test the participant’s knowledge as well as their ability to work with the

ATISS. This casus only covered a small part of the ATISS, as it involved a time management decision. It was also based on only one expert's opinion but this expert was the only one with extended knowledge of the content of the ATISS in both hospitals that was available, so this made him the best option.

The second ATISS specific limitation is that the diffusion of innovation theory the importance of testing an innovation before implementation describes during the trainability stage (Cain & Mittman, 2002). During the interviews it became clear however that not all of the participants had tested the ATISS before, which made discussing certain parts of the innovation difficult. Therefore a casus was used to let participants test the ATISS, but this casus only let the participants test certain features. Also some of the participants didn't have access to a computer (and tablets were non-working) which meant they had to use a print out of the ATISS. Ideally all the participants would have tested (or at least heard of) the ATISS before the interviews and have access to the ATISS during the interviews.

Further investigation of the ATISS in both hospitals revealed another ATISS specific limitation namely that the ATISS was implemented with partly English and partly German text. None of the participants mentioned this during the interviews, but not all of the participants had worked with the ATISS before so they had no time to discover this inconsistency. It also became clear during a few of the interviews that not all of the participants spoke German that well. After asking about this they stated that their study was in English, which could suggest that an English version of the ATISS would be beneficial. On the other hand during the scenario none of the participants seemed to have a problem finding the answer with the ATISS.

A limitation for the science is that the data collection and analysis was done by only one person. To get a broader and more differentiated insight in the obtained data several analysts should be used. This could give a more complete picture of the data with different viewpoints. During this study the researcher had to work alone, although supervisors monitored the project.

The last limitation for the science that can be mentioned is a general limitation that applies to almost all qualitative researches. The replicability of the study is difficult. Qualitative study relies heavily on the researcher's opinion or point of view. Therefore reproducing the exact same study from another person's point of view is very difficult.

Conclusion

Three critical factors have been found that are important for implementation of the ATISS in German hospitals. The development factor (which includes the roadmap content, system and innovation/service categories), the introduction factor (which includes the dissemination category) and the effect factor (which includes the effect category). The evaluation of the ATISS is applied to all three factors to ensure maintenance (up-to-date information), feasibility of the innovation and the best practice training/education introduction method.

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Appendix

Appendix 1 ATISS functions

The different functions of the ATISS explained.

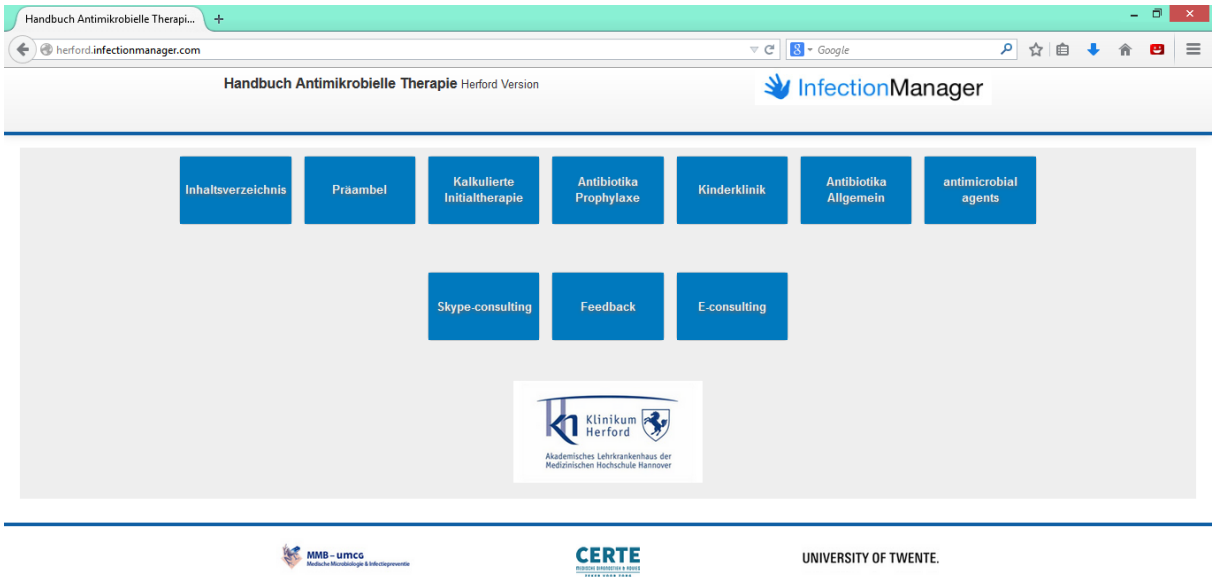
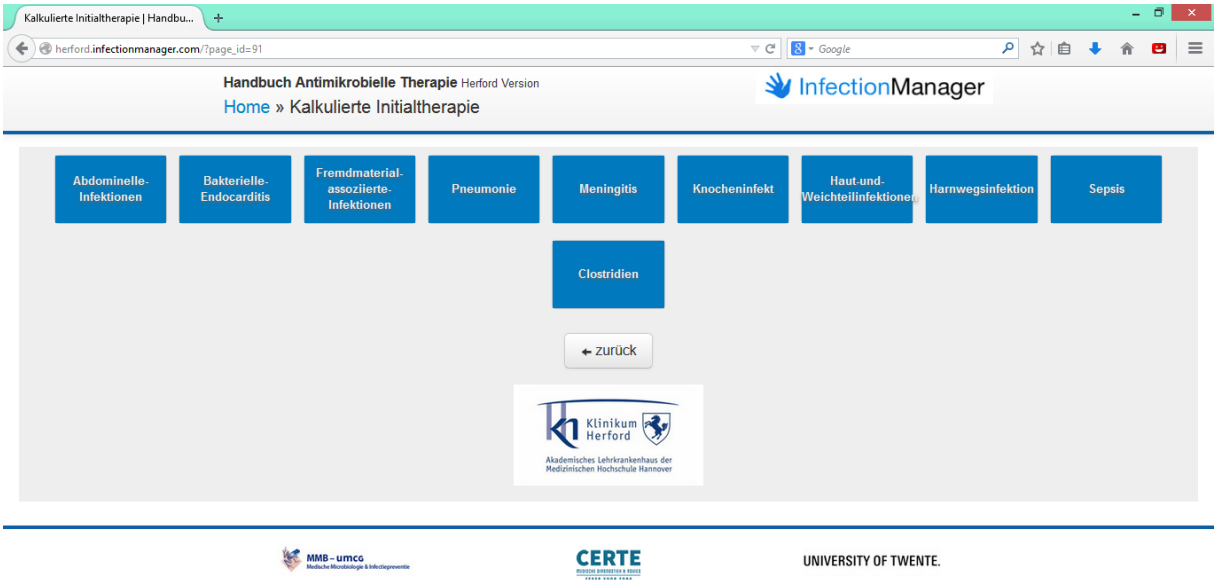


Figure 5: Herford ATISS home screen *(Infection Manager, no date)*.

There are two ways to search for the right antibiotic. The first way is by using the button “kalkulierte Initialtherapie” (calculated initial therapy), and the second is through the button “antimicrobial agents” (see Figure 5).

There are also three different contact buttons that can be used. The “Skype-consulting” button activates Skype and allows health care workers exchange information. The “Feedback” and “E-consulting” buttons are ways to get in contact via e-mail (see Figure 5). These buttons have not yet been activated.

The ATISS can have different layers which can be navigated through with the help of buttons. The following text and screenshots (Figures 6 and 7) of the Herford ATISS will show examples of these layers and their functions.



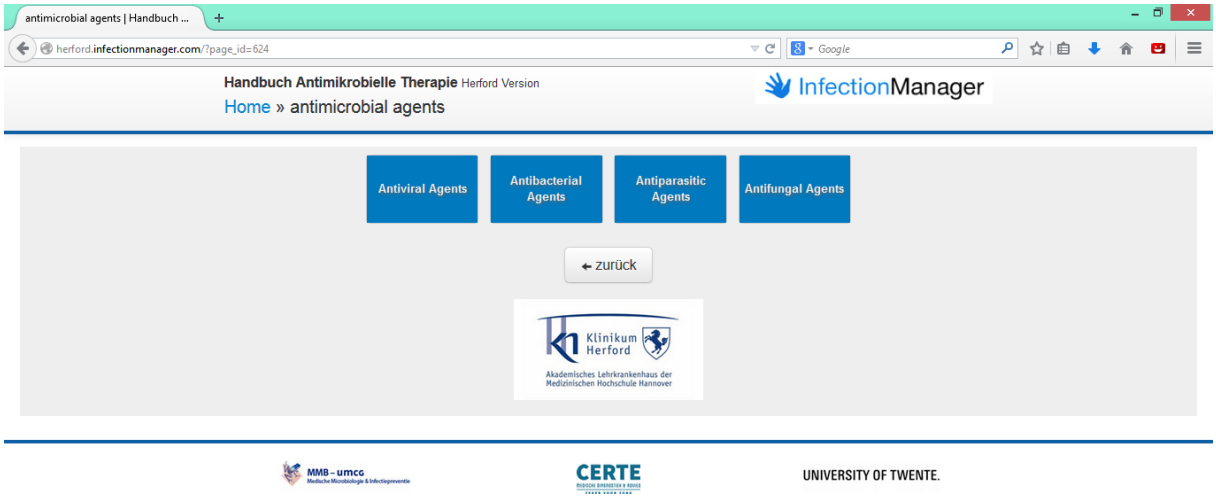
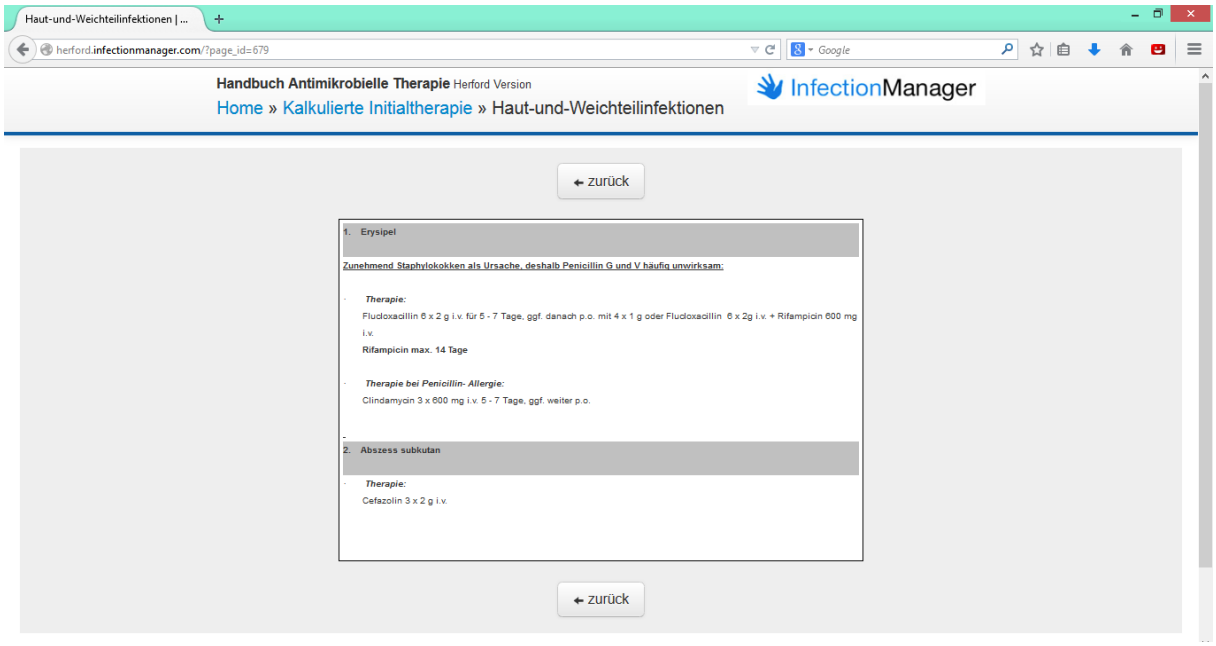


Figure 6: Second layer buttons “Kalkulierte Initialtherapie” and “antimicrobial agents” (Infection Manager, no date).

In the second layer of buttons behind the calculated initial therapy button, there is a list with the symptoms that the patient might have. Such symptoms include abdominal infections, bone infections, skin and soft tissue infections and sepsis. In the layer behind those buttons, appropriate antibiotic treatments for the different infections can be found (see Figure 7).



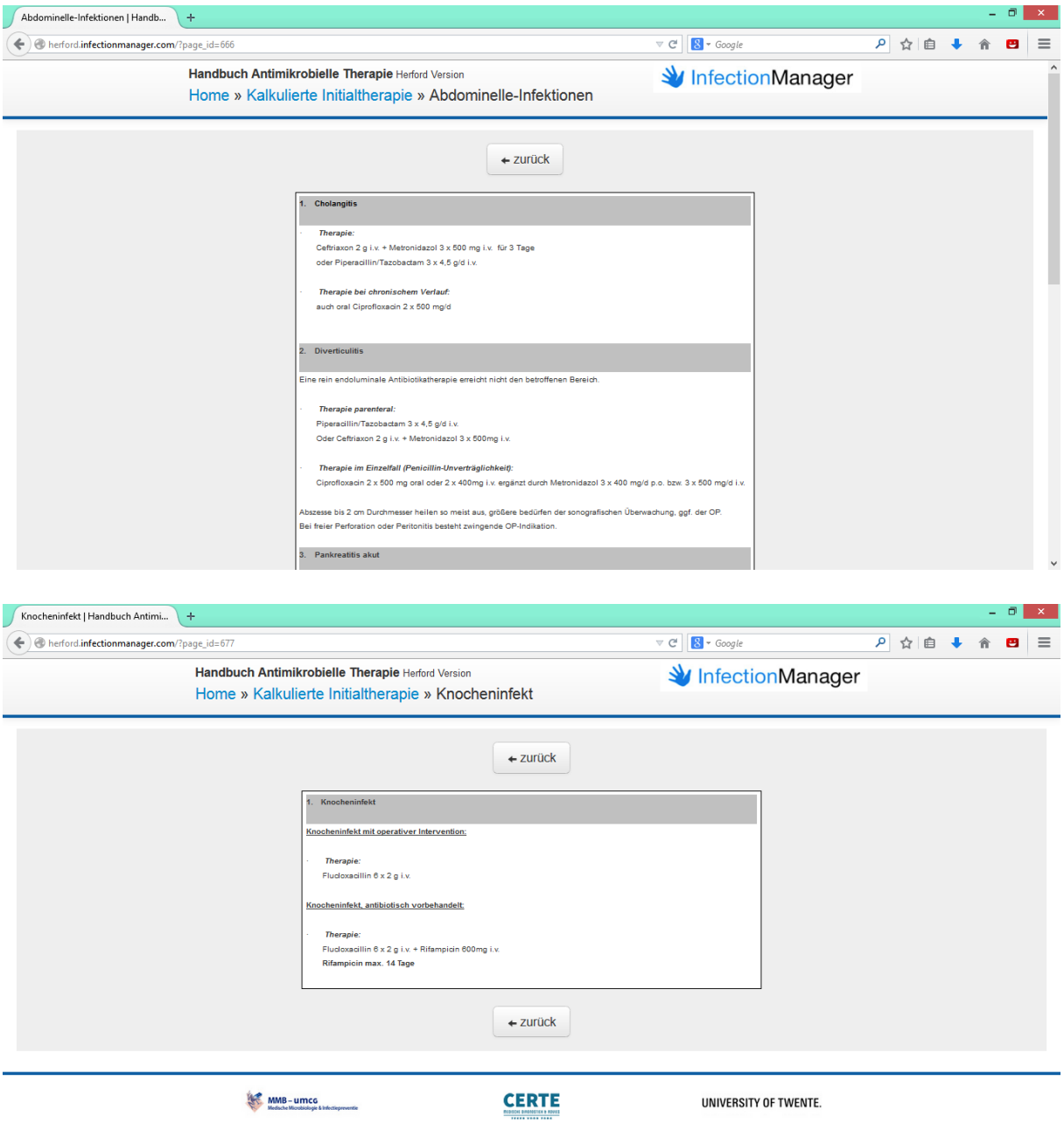


Figure 7: Third layer "Kalkulierte Initialtherapie", examples of treatment (Infection Manager, no date).

Because the viral environment statistics (the statistics that describe the frequencies of different bacteria, fungi etc. in a specific area) are taken into account with the ATISS in both hospitals, the ATISS shows the best practice treatment options for each infection in the specific regions. Because of climate and migration, viral environments can differ within countries or regions (World Health Organisation, 2010). If there are a lot of immigrants in a certain region chances are the viral environment will differ from a region with few immigrants, because of bacteria's that originated in other countries. This makes a regional personalized best practice treatment more efficient for these areas and will lead to less resistant super bugs.

Appendix 2 Theories used for interview questions

The different parts of the theories used to form the questions for the interview are shown beneath.

Design (Roadmap)	Sub-questions	Relevant theory	Questions linked to the theory:
Content (1)	Is the content of the ATISS similar to the current used resources?	**Diffusion**, *Relative advantage*, value of innovation versus current practice.	Diffusion: 3, 5, 6, 7, 8, 9, 10, 27, 28
		NPT, *Differentiation,* innovation differs from current practice.	NPT: 3, 5, 6, 7, 8, 9, 10, 15, 17
		Computer technology principles, *Value to users and trade-offs,* upside and downside of innovation.	CTP: 3, 5, 6, 7, 8, 9, 27, 28
		Computer technology principles, *Meeting information needs*, the organisation of information.	CTP: 9, 15
	Does the ATISS help in the decision making process regarding to antibiotic therapy?	**Diffusion**, *Relative advantage,* value of innovation versus current practice.	Diffusion: 10, 11, 27, 28
		NPT, *Relational integration,* maintain confidence in the practice.	NPT: 11, 12, 15, 17, 18, 25
		NPT, *Systematization,* the effectiveness and usefulness of the ATISS.	NPT: 11, 12, 13, 25
		NPT, *Communal appraisal,* evaluation of the worth of the innovation.	NPT: 11, 12, 18, 27, 28
		NPT, *Individual appraisal,* the effect the ATISS has on the individual participant.	NPT: 12, 26
		Voice of costumer, *opinion of costumer,* opinion about the innovation and its usefulness.	VOC: 10, 11, 12, 13, 25, 27, 28
System (2)	Is the ATISS applicable in practice?	**NPT**, *Construct legitimation,* participants believe it is right to use the innovation.	NPT: 9, 13, 25

		NPT, *Contextual integration,* managing innovation through different resources, protocols, policies etc.	NPT: 13, 25
		Computer technology principles, *Foundational underpinnings,* the organisations foundation is prepared for the innovation.	CTP: 14
	In what way does working with the ATISS differ from the current practice?	**Diffusion**, *Compatibility,* innovation can coexist with current social patterns.	Diffusion: 13, 14
		Diffusion, *Infrastructure*, innovation can coexist with current infrastructure.	Diffusion: 14
		NPT, *Differentiation,* innovation differs from current practice.	NPT: 9, 10, 15
		NPT, *Skill set workability,* work division with the new practice.	NPT: 16, 18, 25
		Sense making, *Enactment,* change in the routine because of innovation.	SM: 12, 15, 25
	Does the ATISS connect to the available systems, applications, protocols etc.?	**Diffusion**, *Compatibility*, innovation can coexist with existing technologies.	Diffusion: 14, 25
		Diffusion, *Infrastructure*, innovation fits in the existent infrastructure.	Diffusion: 14, 25
		Diffusion, *Norms, roles, and social networks*, influence of rules, hierarchies and communication on the innovation.	Diffusion: 16
Innovation/service (3)	Does the ATISS meet the values/expectations?	**Diffusion**, *Relative advantage*, value of innovation versus current practice.	Diffusion: 12, 13, 15, 17
		NPT, *Internalization,* understand the value and importance of the innovation.	NPT: 11, 13, 27, 28
		NPT, *Individual*	NPT: 12, 25

		appraisal, the effect the innovation has on the individual participant.	
		Voice of costumer, *Opinion of costumer,* opinion about the innovation and will the costumer use it in practice.	VOC: 11, 13, 25, 27, 28
Dissemination (4)	How should the ATISS be introduced?	**Diffusion**, *Trainability*, testing the innovation before implementation.	Diffusion: 7, 22, 23, 26
		Diffusion, *Pace of innovation/reinvention*, diffusion pattern of the innovation.	Diffusion: 22, 23, 24, 26
	By whom should the ATISS be introduced?	**Diffusion**, *Homophilous groups*, groups with similar characteristics.	Diffusion: 22, 23, 24, 26
		Diffusion, *Norms, roles, and social networks*, the rules, hierarchies and communication regarding the innovation.	Diffusion: 22, 23, 24, 26
		Diffusion, *Opinion leaders,* the opinion of individuals that are highly respected.	Diffusion: 22, 23, 24, 26
		NPT, *Initiation,* key participants drive innovations forward.	NPT: 22, 23, 24, 26
		Computer technology principles, *Essential people,* leaders and opinion leaders are essential for implementation	CTP: 22, 23, 24, 26
	Trough what kind of (communication) channels should the ATISS be introduced?	**Diffusion**, *Communication channels*, the way people communicate about the innovation.	Diffusion: 22, 23, 24
	How should the training/observability be managed?	**Diffusion**, *Observability*, end users see others adopting the innovation.	Diffusion: 19, 21, 26
		Computer technology principles, *Training and support*, support while first use of innovation.	CTP: 19, 20, 21, 26
Effect (5)	When/in what kind of	**NPT**, *Activation,*	NPT: 11, 13, 14,

	situation is the ATISS used?	participants use the innovation and need to sustain it.	25
		NPT, *Systematization,* effectiveness and usefulness of the innovation.	NPT: 12, 13, 25, 27
		NPT, *Communal appraisal,* evaluation of the worth of the innovation.	NPT: 8, 11, 13, 18, 25, 27
		NPT, *reconfiguration,* could result in changes in practice.	NPT: 25
		Voice of costumer, *Opinion of costumer,* opinion about the innovation and will the costumers use it in practice.	VOC: 8, 11, 13, 25, 27, 28

Appendix 3 Extension Appendix 2

Here the connexion between the theories and the interview questions are elaborated further. This is an extension of the table in Appendix 2.

Content (1)

Is the content of the ATISS similar to the current used resources?

Theory used	*Question number*	*Explanation for connection between theory and question*
Diffusion, Relative advantage, value of innovation versus current practice	3	The current practice is being described (for comparison with innovation)
	5	Specific part of practice is being described
	6	Describing the innovation and the new process (in comparison)
	7	Describing the innovation and the new process (in comparison)
	8	Process description with the ATISS/ ATISS description
	9	Description improvement with ATISS
	10	Description content of the ATISS
	27	General opinion ATISS
	28	Most important aspects of ATISS
NPT, Differentiation, innovation differs from current practice	3	The current practice is being described (for comparison with innovation)
	5	Specific part of practice is being described
	6	Describing the innovation and the new process (in comparison)
	7	Describing the innovation and the new process (in comparison)
	8	Process description with the ATISS/ ATISS description
	9	Description improvement with ATISS
	17	Content of the ATISS
	10	Description content of the ATISS
	15	Description quality of the ATISS
Computer technology principles, value to users and trade-offs, upside and downside of innovation	3	The current practice is being described (for comparison with innovation)
	5	Specific part of practice is being described
	6	Describing the innovation and the new process (in comparison)
	7	Describing the innovation and the new process (in comparison)
	8	Process description with the ATISS/ ATISS description
	9	Description improvement with ATISS
	27	General opinion ATISS
	28	Most important aspects of ATISS
Computer technology principles, meeting information needs, the organisation of information	9	Description information flow with ATISS
	15	Description quality of the ATISS

Does the ATISS help in the decision making process regarding to antibiotic therapy?

Theory used	*Question number*	*Explanation for connection between theory and question*
Diffusion, relative advantage, value of innovation versus current practice	10	Description of all the important information on the ATISS
	11	Importance of the ATISS during treatment
	27	General opinion of ATISS
	28	Most important aspects of ATISS
NPT, relational integration, maintain confidence in the practice	11	Importance of the ATISS during treatment
	12	Effect of the ATISS during treatment
	15	Quality of the ATISS
	17	Content of the ATISS
	18	Judging the content of the ATISS
	25	Using the ATISS in daily routine
NPT, systematization, the effectiveness and usefulness of the innovation	11	Importance of the ATISS during treatment
	12	Effect of the ATISS during treatment
	13	Usefulness of the ATISS
	25	Using the ATISS in daily routine
NPT, communal appraisal, evaluation of the worth of the innovation	11	Importance of the ATISS during treatment
	12	Effect of the ATISS during treatment
	18	Judging the content of the ATISS
	27	General opinion of ATISS
	28	Most important aspects of ATISS
NPT, individual appraisal, the effect the innovation has on the individual participant	12	Effect of the ATISS during treatment
	26	The effect on the individual stakeholder
Voice of costumer, opinion of costumer, opinion about the innovation and its usefulness	10	Description of all the important information on the ATISS
	11	Importance of the ATISS during treatment
	12	Effect of the ATISS during treatment
	13	Usefulness of the ATISS
	25	Using the ATISS in daily routine
	27	General opinion of ATISS
	28	Most important aspects of ATISS

System (2)

Is the ATISS applicable in practice?

Theories used	***Question number***	***Explanation for connection between theory and question***
NPT, construct legitimation, participants believe it is right to use the innovation	9	Description improvement with ATISS
	13	Usefulness of the ATISS
	25	Using the ATISS in daily routine
NPT, contextual integration, managing innovation trough different resources, protocols, policies, etc.	13	Usefulness of the ATISS in practice
	25	Using the ATISS in daily routine
Computer technology principles, foundational underpinnings, the organisations foundation is prepared for the innovation	14	Fit of the ATISS with existing systems and practices

In what way does working with the ATISS differ from the current practice?

Theories used	***Question number***	***Explanation for connection between theory and question***
Diffusion, compatibility, innovation can coexist with current social patterns	13	Usefulness of the ATISS in practice
	14	Fit of the ATISS with existing systems and practices
Diffusion, infrastructure, innovation can coexist with current infrastructure	14	Fit of the ATISS with existing systems and practices
NPT, differentiation, innovation differs from current practice	9	Description improvement with ATISS
	10	Description of all the important information on the ATISS
	15	Description quality of the ATISS
NPT, skill set workability, work division with the new practice	16	Person to maintain the quality of the ATISS
	18	Person to update the ATISS
	25	Using the ATISS in daily routine
Sense making, enactment, change in the routine because of innovation	12	Effect of the ATISS during treatment
	15	Description and person checking the quality of ATISS
	25	Using the ATISS in daily routine

Does the ATISS connect to the available systems, applications, protocols, etc?

Theories used	***Question number***	***Explanation for connection between theory and question***
Diffusion, compatibility, innovation can coexist with existing technologies	14 25	Fit of the ATISS with existing systems and practices Using the ATISS in daily routine
Diffusion, infrastructure, innovation fits in the existent infrastructure	14 25	Fit of the ATISS with existing systems and practices Using the ATISS in daily routine
Diffusion, norms, roles and social networks, influence of rules, hierarchies and communication on the innovation	16	Person to maintain the quality of the ATISS

Innovation/service (3)

Does the ATISS meet the values/ expectations?

Theories used	***Question number***	***Explanation for connection between theory and question***
Diffusion, relative advantage, value of innovation versus current practice	12 13 15 17	Description of effect ATISS Usefulness of the ATISS Quality of the ATISS Content of the ATISS
NPT, internalization, understand the value and importance of the innovation	11 13 27 28	Description of the importance of the ATISS Usefulness of the ATISS General opinion ATISS Most important aspects of ATISS
NPT, individual appraisal, the effect the innovation has on the individual participant	12 25	Description of effect ATISS Using the ATISS in daily routine
Voice of costumer, opinion of costumer, opinion about the innovation and will the costumer use it in practice	11 13 25 27 28	Description of the importance of the ATISS and will it be used Usefulness of the ATISS Using the ATISS in daily routine General opinion ATISS Most important aspects of ATISS

Dissemination (4)

How should the ATISS be introduced?

Theories used	*Question number*	*Explanation for connection between theory and question*
Diffusion, trainability, testing the innovation before implementation	7	Testing the ATISS (during the interview)
	22	Description of introducing the ATISS
	23	Introduction in other hospitals
	26	Stakeholders that should be considered during introduction
Diffusion, pace of innovation/ reinvention, diffusion pattern of the innovation	22	Description of introducing the ATISS
	23	Introduction in other hospitals
	24	Possible problems with introduction
	26	Stakeholders that should be considered during introduction

By whom should the ATISS be introduced?

Theories used	*Question number*	*Explanation for connection between theory and question*
Diffusion, homophilous groups, groups with similar characteristics	22	Description of who should introduce the ATISS
	23	Introduction in other hospitals
	24	Possible problems with introduction
	26	Stakeholders that should be considered during introduction
Diffusion, norms, roles and social networks, the rules, hierarchies and communication regarding the innovation	22	Description of how and who should introduce the ATISS
	23	Introduction in other hospitals
	24	Possible problems with introduction
	26	Stakeholders that should be considered during introduction
Diffusion, opinion leaders, the opinion of individuals that are highly respected	22	Description of who should introduce the ATISS
	23	Introduction in other hospitals
	24	Possible problems with introduction
	26	Stakeholders that should be considered during introduction
NPT, initiation, key participants drive innovations forward	22	Description of who should introduce the ATISS
	23	Introduction in other hospitals
	24	Possible problems with introduction
	26	Stakeholders that should be considered during introduction
Computer technology principles, essential people, leaders and opinion leaders are essential for implementation	22	Description of who should introduce the ATISS
	23	Introduction in other hospitals
	24	Possible problems with introduction
	26	Stakeholders that should be considered during introduction

Trough what kind of (communication) channels should the ATISS be introduced?

Theories used	*Question number*	*Explanation for connection between theory and question*
Diffusion, communication channels, the way people communicate about the innovation	22 23 24	Description of how and who should introduce the ATISS Introduction in other hospitals Possible problems with introduction

How should the training/observability be managed?

Theories used	*Question number*	*Explanation for connection between theory and question*
Diffusion, observability, end users see others adopting the innovation	19 21 26	Users need to be trained and supported before implementation Description of who will organise the training Stakeholders that should be considered during introduction
Computer technology principles, training and support, support while first use of innovation	19 20 21 26	Users need to be trained and supported before implementation Description of why the training is useful Description of how the training should be organised Stakeholders that should be considered during introduction

Effect (5)

When/ in what kind of situation is the ATISS used?

Theories used	***Question number***	***Explanation for connection between theory and question***
NPT, activation, participants use the innovation and need to sustain it	11	Importance of the ATISS during treatment
	13	Usefulness of the ATISS
	14	Fit of the ATISS with existing systems and practices
	25	Using the ATISS in daily routine
NPT, systematization, effectiveness and usefulness of the innovation	12	Description of the effect of using ATISS
	13	Usefulness of the ATISS
	25	Using the ATISS in daily routine
	27	General opinion ATISS
NPT, communal appraisal, evaluation of the worth of the innovation	8	Description of ATISS buttons that will be used often
	11	Importance of the ATISS
	13	Usefulness of the ATISS
	18	Person to evaluate the ATISS
	25	Using the ATISS in daily routine
	27	General opinion ATISS
NPT, reconfiguration, could result in changes in practice	25	Using the ATISS in daily routine
Voice of costumer, opinion of costumer, opinion about the innovation and will the costumers use it in practice	8	Explanation of ATISS buttons that will be used often
	11	Importance of the ATISS
	13	Usefulness of the ATISS
	25	Using the ATISS in daily routine
	27	General opinion ATISS
	28	Most important aspects of ATISS

Appendix 4 Interview

Beneath the interview questions and the scenario used during the interview will follow.

Dieses Interview dauert ungefähr 30 Minuten. Der Inhalt des Interviews richtet sich auf die Implementation des ATISS´s. Während des Interviews wird zuerst ein Szenario durchgespielt ohne das app. Dann folgen Fragen über die Behandlung von Patienten mit einer Infektionskrankheit (immernoch ohne app). Danach wird dasselbe Szenario gebraucht um die Situation durchzuspielen mit dem app und werden folglich wieder Fragen gestellt.

Mit Einverständnis des Befragten, wird das Interview aufgenommen. Die Namen der befragten Personen werden bei der Ausarbeitung der Interviews nicht genannt werden. Dadurch ist es eine anonyme Studie. Auβerdem möchte ich Sie bitten, dieses “informed consent” zu unterzeichnen, dass Ihnen bestätigt, dass die gegebenen Informationen nicht misbraucht werden.

Wir beginnen mit allgemeinen Fragen: Falls irgendetwas undeutlich ist, möchte ich Sie bitten, dies kenntlich zu machen.

1. In welcher Abteilung des Krankenhauses arbeiten Sie?
2. Wie lange arbeiten Sie schon in dieser Funktion/in diesem Krankenhaus?
3. Wie alt sind Sie? Zu welcher Alterskategorie gehören Sie? 20-30;30-40,40-50,50-60
4. Wie würden Sie Ihr technisches Know-How beschreiben?
5. Gebrauchen Sie Internet oft? Für die Arbeit oder privat?
6. Haben Sie ein Smartphone? Benutzen Sie Apps?

Der Patient wird mit einem feuerroten Unterbein (erysipelas) und einem Cellulitis Bild eingeliefert. Er bekommt schon einen Tag lang Penizillin und hat überall Hautausschlag, wahrscheinlich eine allergische Reaktion. Was machen Sie? (Szenario)

1. Kommt so eine Situation manchmal vor?
2. Wenn ja, kommt dies oft vor?
3. Können Sie mir sagen, wie Sie in diesem Fall (Szenario Fall) reagieren würden, und was Sie alles tun würden?
4. Welche Informationen über den Patienten denken Sie während des Behandelprozesses zu brauchen?
5. Wo können Sie diese Informationen bekommen?
6. Wie könnte man das ATISS bei dieser Suche nach Informationen einbeziehen?
7. Können Sie dasselbe Szenario noch einmal durchspielen mit dem ATISS?
8. Können Sie sagen, wie das App eingesetzt wird? (Welche Funktionen des ATISS´s werden Sie während und nach der Behandlung des Patienten gebrauchen?) (Warum speziell diese Funktionen? Und warum nicht/wohl z.B. die Kommunikationsfunktionen?) (Verschiedene Funktionen des Apps zeigen)(Welche Funktionen fehlen eventuell noch?
9. Welche Verbesserungen könnten durch den Gebrauch des ATISS´s stattfinden? (wird es überhaupt Verbesserungen geben?) (Was ist der inhaltliche Unterschied zwischen dem ATISS und den Brunnen, die davor gebraucht wurden (wird es überhaupt eine Verbesserung sein)?

10. Ist alle wichtige Information in dem Prototypen des App zu bekommen? (warum ja, warum nein)(Welche Informationen fehlen gegebenenfalls noch) (die Sie ohne das App auf die alte Art und Weise wohl bekommen hätten)? Wie können Sie dennoch an diese Informationen kommen?)
11. Wird das ATISS während einer Antibiotikumbehandlung eines Patienten wichtig sein?
12. Welchen Effekt hat der Gebrauch des ATISS´s auf eine Behandlung mit Antibiotikum? (Wird das app einen Effekt auf den Entscheidungsprozess über was mit einem Patienten passiert haben? (wenn ja, welcher Effekt könnte dies sein, z.B. schneller oder besser informiert?) Wie hilfreich ist das App in so einem Fall?)
13. Sind Sie überzeugt, dass das ATISS gut anzuwenden sein wird? (warum ja, warum nein?) (Wie kann das System anwendbar gemacht werden? Was ist dafür nötig?)
14. Passt der AITSS zu den verfügbaren Informationssystemen, Anwendungen, Protokollen usw.? (warum ja, warum nein? Wo passt es wohl zu und wozu nicht? Wozu muss es passen?)

15. Wie kann die Qualität des Systems am besten garantiert werden?
16. Wer kann das am besten verwalten?
17. Wie kann der Inhalt des ATISS´s am besten bestimmt werden? (durch wen)
18. Wie kann der Inhalt am besten bewertet werden? Und von wem? (und Updates?)

19. Sollten die Gebraucher des ATISS´s vor Ingebrauchnahme geschult werden, oder können sie sofort damit arbeiten?
20. Wofür wäre eine Schulung nötig?
21. Wie kann dies am besten organisiert werden? (zum Beispiel zyklisch oder nur 1 Mal am Anfang)?

22. Wie sollte das ATISS bei den hygienebeauftragten Ärzten und bei anderen Gebrauchern eingeführt werden? (Langsam mit vielen Besprechungen, oder gerade schnell? Warum auf diese Art und Weise? Durch wen? Welche Kommunikationskanäle?)
23. Kann das ATISS auf ähnliche Art und Weise in anderen Krankenhäusern eingeführt werden? Warum ja, warum nein?
24. Welche Probleme könnte dies mit sich bringen und warum? (Wie könnten die Probleme gelöst werden?)
25. Würden Sie das ATISS in der täglichen Routine gebrauchen? (warum ja/ warum nein?)

26. Gibt es noch andere wichtige Stakeholders, die bei der Einführung berücksichtigt werden sollten?

27. Wie finden Sie das ATISS, allgemeine Meinung?

28. Was sind Ihrer Meinung nach die wichtigsten und die unwichtigsten Aspekte des ATISS´s?

Könnten Sie diesen Aspekten eine Note von Wichtigkeit geben in einer Skala von 1 bis 5? (1 = nicht wichtig, 2 = kaum wichtig, 3 = wichtig, 4 = sehr wichtig, 5 = entscheidend). Können Sie erklären, warum diese Aspekte so wichtig bzw. unwichtig sind?

Jetzt habe ich noch ein paar Fragen zu diesem Interview und die Fragen des Interviews um diese eventuell noch zu verbessern.

- Für wen könnte das ATISS noch interessant sein (wer könnte Ihrer Meinung nach noch Stakeholder/Interessent sein außer hygienebeauftragte Ärzte)?
- Gibt es Fragen, die Sie erwartet haben und die nicht gestellt wurden in diesem Interview?
- Wie haben Sie das Interview erfahren?

Haben Sie noch Fragen oder Anmerkungen?

Vielen Dank für Ihre Mitarbeit.

Appendix 5 Definition of codes

This table shows the codes and the definitions that explain the codes used. Some quotes have been added to clarify the codes and the definitions.

Category	Code	Definition	Quotes
Content	**Current resources/ practice**	Searching for the scenario specific information, or other antibiotic information without the ATISS.	
	Hardcopy	Books, booklets, posters, tables, medication lists from the pharmacy and medical magazines.	Interview 15: "The ATISS is similar to the booklet we have, it is just more up to date."
	Intranet	Participants who use systems on the computer on the Intranet. Programs which are connected to the laboratories, national guidelines and the hospital specific resistance statistics that are saved on intranet. Also one person used a PDA (personal digital assistant) with an antibiotic program he developed himself.	Interview 10: "I use the computer. We have a program that is directly linked to the laboratory where I can find the patients antibiogram."
	Internet	Medical sites on the internet, internet medical search engines. Examples are: the national guidelines, up to date, PubMed and eMedicine.	
	Experience	Physicians have enough experience to treat patients without using external sources (except for the really complicated cases).	
	Asking others	Asking other people like the most senior member of the department, the microbiologist, another colleague from the same or another department or the hygienic staff during a monthly hygienic visit.	
	Interaction features	These are the three lower row buttons on the ATISS. The "Skype-consulting", "Feedback" and "E-consulting" buttons.	
	Telephone	Physicians prefer using the telephone to using Skype.	
	Skype	These are the physicians that would use the Skype function of the ATISS if it was functional.	Interview 20: "I would use it if I could show my findings on camera. In theory, if we could use tablets or smart phones for example."
	Feedback and e-consulting	These are the physicians that would use the feedback and e-consulting function of the ATISS if they were functional.	
	Not applicable	Physicians had no opinion about the subject. A few physicians had not used the ATISS long enough to give an opinion about the specific subject.	
	Completeness ATISS	Participants were asked if the ATISS was missing something, and if so, what was missing.	
	Complete	Physicians stated that they didn't miss anything on the ATISS. The important information was all included in the system.	

Missing content	Some of the physicians stated that they would miss different aspects of the content in the ATISS. These aspects were: missing information for the gynaecologists, a search function, protocols for dealing with multi resistance bugs, a link with the patient files, local resistance statistics, some updates, a 24 hour phone number, certain alternatives and the most common side effects of the antibioti0c treatments.	
Missing features	The lay out of the ATISS could also be adjusted according to some physicians. The main points were: missing links to online price lists for the antibiotics, literature sources, dates of the updates, names of people that decided the content of the ATISS, a link to the ATISS on the home screen of the intranet (only in Herford, in Nordhorn the ATISS already is on the home screen), changing the name of a button (Kalkulierte Initial Therapie/weiterführende Therapy) and placing the content button to the far left (only for Nordhorn ATISS, because this is already the case for the Herford ATISS).	Interview 8: "You should always know where the information is coming from." Interview 6: "It could be dangerous as well, if the information isn't up dated enough. You never know how old the information in the ATISS is."
Missing password	The password needed to change the content of the ATISS. Only the microbiologist had the password at the time of the interview.	
Missing materials	Because there are neither microphones nor boxes Skype is not functional on the computers in the hospital.	
Not applicable	Physicians didn't know how to answer the question because they have not worked with the ATISS before.	
Stakeholders	These are the people that benefit the most from using the ATISS. There were no patients mentioned as stakeholders because the focus was on the end users of the ATISS.	
All physicians	All the physicians could benefit from using the ATISS so all the physicians are stakeholders.	Interview 9: "The users are the physicians."
Assistant physicians	Most of the head and senior physicians already know a lot of the content of the ATISS by heart, so namely the assistant physicians would benefit the most from using the ATISS.	
Primary emergency room physicians	The ATISS holds information about every procedure for every infection. In the emergency room this is very useful as different patients with various infections come through.	
Inexperienced physicians	The viral environment in every hospital is different, so the ATISS is a good tool especially for new and/or inexperienced physicians to treat infectious diseases with the best possible treatment according to the viral environment of	Interview 10: "I think it would be beneficiary for the entrant physicians."

		the hospital.	
	Not applicable	Physicians didn't know how to answer the question because they have not worked with the ATISS before.	
System	**Relevance**	The appliance of the ATISS in practice.	
	Relevant	The ATISS is applicable in practice because it is well structured and a fast way to find information, therefore user friendly. On a tablet or smart phone it would be even better because intranet can be slow. It is great for new physicians.	
	Not relevant	Physicians stated the ATISS was not applicable in practice because the access was too difficult because of missing infrastructure.	
	Not applicable	Physicians didn't know how to answer the question because they have not worked with the ATISS before.	
	Actual use	The physicians that already used ATISS at the time of the interview.	
	Hygienic staff	The physicians that already have used the ATISS and are part of the hygienic commission that decided on the contents of the ATISS.	Interview 2: "I would rather use the ATISS."
	Not hygienic staff	The physicians that already have used the ATISS and are not part of the hygienic commission.	
	Intended use	The physicians were asked if they would use the ATISS in their daily routine.	
	Positive	Physicians who would use the ATISS in their daily routine because of the many advantages it offers.	Interview 11: "I would use it so I don't drown."
	Indifferent	Physicians have no access to a computer near patients, have knowledge from experience, prefer using a booklet or do not have patients who need antibiotics. Therefore they would probably not use the ATISS in their daily routine.	
	Not applicable	Physicians didn't know how to answer the question because they have not worked with the ATISS before.	
	Ease of use	The opinion of the physicians about how easy it is to use and understand the ATISS.	Interview 1: "With the ATISS I can get the information I want very quickly, I can only recommend using it."
	Easy	100% of the participants found the ATISS to be easy to use.	
	Fit of ATISS	The differences between the ATISS and the current practice in the hospitals.	
	Therapy benefits	The therapy benefits include the increased diagnostic security, lower resistance rates and up to date information.	Interview 13: "The most important benefit is the standardisation of the therapy, and the resistance statistics that are taken into account."
	Structural fit	The ATISS is structured and easy to use which	

	was mentioned as difference to the current used practice by some of the participants.	
Costs	The costs will be decreased by using the antibiotic described in the ATISS.	
Difficult patients	Physicians stated they would use the ATISS for patients that were not standard for them in their field, because they would find the needed information in the ATISS easily.	Interview 16: "In those cases I use the calculated initial therapy. That's the main button I use."
Electronic use	The use of electronic tools for work or private purposes.	
Computer	Participants who use the computer for work and at home.	
Tablet private	Participants who use tablets at home.	
Tablet work	Tablets were not yet used at work as there was no WIFI. 6 participants would use tablets if it was made possible.	Interview 6: "Nobody uses the tablet up here. That is the problem, we don't have any WIFI so the tablets are useless to us."
Smart phone private	Participants own a smart phone and use it solely privately.	
Smart phone work	Participants own a smart phone and downloaded work related apps. None of the smart phone users accessed ATISS on their smart phone because of the lack of WIFI.	
Quality ATISS	The participants described different ways to secure the quality of the ATISS and the information in the ATISS.	
Regular updates	Keeping the ATISS up to date on a regular basis by checking the resistance statistics and getting updates from educations. The reminders to do an update come from a higher level in the hospital hierarchy.	Interview 8: "By noting how old a recommendation is, and when it was revised."
Secure content	Secure the content of ATISS so that there are no typos etc. Also show how old the information in the ATISS is (when was the last update) and who is responsible for the update.	
Clinical study	A study should be done, if the initial therapy has more success when physicians follow the ATISS.	
Marketing	Many physicians do not know about the existence of the ATISS. Better marketing could help the ATISS. If more people know about and use the ATISS mistakes will be noticed quicker.	
Updates	The process of updating the ATISS.	
Departmental administration	The updates should be done by the hygienic staff. Each of the hygienic staff members has their own specialty and can update a different area of the ATISS.	Interview 2: "The hygienic staff and the pharmacy should do the maintenance."
Feedback button	The users (mostly assistant physicians) of the ATISS can use the feedback button if they have update suggestions or want changes to the content of the ATISS.	
Update tracking	The date of the last update should be visible in	

		the ATISS. The person responsible for the update should be mentioned.	
	Not applicable	Physicians didn't know how to answer the question because they have not worked with the ATISS before.	
	Every 12 months	The ATISS should be updated once a year in compliance with the resistance statistics that are issued once a year.	
	Every update	The ATISS should be adjusted every time something changes.	
	Every 3 months	The ATISS should be checked four times a year. If nothing needs to be changed the information will stay the same.	
	Not applicable	Physicians didn't know how to answer the question because they have not worked with the ATISS before.	
	System administrator	The person or group of persons that should be responsible for the updates.	
	Hygienic commission	The hygienic commission (staff) should be responsible for the updates, as they are the ones who created the content of the ATISS.	Interview 7: "That is the goal, that this group of people will do the maintenance together."
	Head physician	The head physicians should have the last word about the content of the ATISS. If there are updates that need to be made the head physicians can approve or disprove these before they are implemented in the ATISS.	
	Hospital board	The hospital board should be included in the decision to change the content of the ATISS or not.	
	IT	The IT department changes the contents of the ATISS while the physicians determine the changes of the contents.	
	Not applicable	Physicians had no opinion about the subject. A few physicians had not used the ATISS long enough to give an opinion about the specific subject.	
	Compatibility	The compatibility of the ATISS with the hospitals existing infrastructure etc.	
	Compatible	Physicians stated that the ATISS is compatible but not easily accessible everywhere (because of missing computers) and sometimes it doesn't work at all. This is due to the hospital infrastructure and not because of the ATISS.	Interview 20: "It is compatible because you can find the ATISS on every computer in the hospital on the intranet."
	Not compatible	The ATISS is not compatible because it is its own system and is not meant to be compatible.	
	Not applicable	Physicians had no opinion about the subject. A few physicians had not used the ATISS long enough to give an opinion about the specific subject.	
Innovation/ service	**Expectations ATISS**	The general opinion about the ATISS and how the participants describe the innovation.	

	Good	The ATISS is being described as a (very) good and important innovation because it is a handy aid with a lot of information. It is also a good tool for dealing with the increasing number of resistant super bugs.	
	User friendly	The ATISS was described as being user friendly because it makes antibiotic therapy easier for physicians, it is structured and well-arranged which makes it a helpful innovation.	Interview 20: "The ATISS is really quick and uncomplicated."
	Difficult to implement	The ATISS is described as difficult to implement because the physicians don't always have access to a computer, and there is no WIFI. This means tablets and smart phones can´t connect to the internet, so the ATISS cannot be used.	
	Outdated	The ATISS is a good innovation but it came late.	
	Cause of expectation	Describes the causes that lead to the expectations the participants have about the ATISS	
	Comprehensible	The ATISS was described as being easy to use, structured, a quick way to find information and clearly arranged.	
	Important information	Participants stated that the ATISS had a lot of important information and some stated it was all the information they needed from the system.	
	Quick access	This participant described the quick access of the ATISS.	
	Resistance problem	Because of the problem with multi resistant bacteria, this participant stated that the ATISS could reduce this problem.	
	Out of order	This participant stated that the ATISS didn't work on the computer so the ATISS would be difficult to implement if it didn't work properly.	
	Expectations fulfilled	The expectations the participants had about the ATISS need to be met.	
	Meets expectations	These participants stated that they thought the expectations they had about the ATISS were fulfilled.	
	Doesn't meet expectations	These participants stated that the ATISS didn't meet their expectations. The main cause was because there was no offline version/app of the ATISS which would make the access easier for a lot of people. Also one of the participants stated that the ATISS didn't work at all.	
Dissemination	**Presentation**	The introduction process of the ATISS in the two hospitals included in this study.	
	Top down	A top down introduction would come from the hygienic commission, the head physicians or the senior physicians, there is however an overlap in some of these groups. Almost all of the hygienic staff members are senior physicians, but not all of the senior physicians are hygienic staff	Interview 18: "The head physicians should tell everybody to use it (the ATISS), during a morning meeting for example." Interview 9: "One of the senior physicians could implement it."

	members. Only one hygienic staff member was an assistant physician.	
Snow ball effect	The snow ball effect suggests that the ATISS will be introduced from user to user. The motivation does not specifically come from someone higher in the organizations hierarchy. During the interviews the assistant physicians where mentioned as key participants for diffusion of the ATISS in the hospitals.	
All at once	Introduction to all the physicians at the same time. This can be done during an information market that will have to be held two or three times so all the physicians can attend it.	
Per department	The introduction will be done separately in every department.	Interview 16: "The introduction should be done per department. We have a morning meeting every day."
Other hospitals	The hypothetical introduction of the ATISS in other German hospitals.	
Same	The introduction of the ATISS in other German hospitals can be done in the same way as described for the Klinikum Herford hospital and the Euregio-klinik in Nordhorn, provided the conditions are similar or the same.	
Not applicable	The introduction in other German hospitals depends on the infrastructure and the management structure in these hospitals. A similar introduction method could be realistic in other hospitals but it could also conflict with the existing structures and processes.	
Presenter	The position of the physicians who should introduce the ATISS.	
Hygienic staff member	Consists of physicians that have done training in this field. Every department in the hospital has a hygienic staff member that attends the hygienic meetings (once a month). The hygienic staffs in both hospitals that were interviewed were the ones that determined the content of the ATISS and the implementation strategy. In the hygienic commission an external microbiologist was included to explore the knowledge of infectious diseases and viral environments.	Interview 19: "I heard about the ATISS during a hygienic visit in our department. It´s on the intranet now, and we should use it."
Head physicians	In German they are called "Chefärtzte", and they are the head physicians in the departments of the hospital. Every department has his own head physician who in difficult cases has the last word on infectious disease therapies.	
Senior physicians	Called "Oberärzte" in Germany and they are the physicians that have a lower status than the head physicians but a higher status than the assistant physicians. (Almost) all of the hygienic	

	staff members are senior physicians but not all of the senior physicians are hygienic staff members.	
Strategy	The different channels that can be used to introduce the ATISS.	
Education	Introduction of the ATISS through educational channels. These include the annual general educations all physicians have to attend, and the weekly further educations. The ATISS can be shown during these educations on a computer, tablet or smart phone.	
Morning meeting	The ATISS can be introduced during a morning meeting (which occur every morning). This can be done in two ways, by using the computer and showing where to find the ATISS, how to use it and maybe using a case as example or by telling the physicians where the ATISS can be found and why they should use it.	
Promoting	The hygienic staff, head physicians or senior physicians should support the use of the ATISS. This can be done by telling the physicians about the ATISS or by showing the ATISS on a computer or a portable device, either in combination with another training strategy or on its own.	
Using technology	Introducing the ATISS with the help of technology. This can be on a portable device (tablet, smart phone etc.), by sending an e-mail with a link to the site or an explanation on where to find it on the intranet, by putting a link on the home screen of the intranet (this is already the case in the Nordhorn hospital) or by using an e-learning system.	
Existence notification	Introducing the ATISS by only mentioning where it can be found and why the physicians should use it. This can be done via e-mail, during one of the morning meetings or via promotion (mentioning the ATISS whenever and wherever it is useful). This is different than the other introduction strategies mentioned because the ATISS is not shown, so there is no training involved with this introduction method.	
Issues	The problems that can occur with the introduction of the ATISS in German hospitals.	
User issues	The problems that can occur while using the ATISS. This could be physicians have problems finding the ATISS, they don't know the ATISS exists or forget about it, they don't want to use it or if they use it they don't use it properly.	Interview 15: "People could forget it exists."
Maintenance issues	Problems with maintenance include problems with keeping the ATISS up to date, for example if the resistance statistics change.	Interview 6: "It could be dangerous as well, if the information isn't up dated

			enough. You never know how old the information in the ATISS is."
	Technical issues	Problems with accessing the ATISS because of the lack of computers in the treatment rooms (near the patients) or the lack of WIFI which is why tablets and smart phones can´t be used.	
	Therapy issues	Introduction of the ATISS could lead to loss of competence and a loss of therapeutic freedom because physicians use the ATISS instead of thinking themselves. There is a possibility that patients will not be seen as individuals anymore.	
	No issues	There are no foreseeable problems with the introduction methods as described in the results section.	
	Training	Whether or not physicians should be trained or schooled before they can work with the ATISS.	
	Training needed	Physicians who stated training or schooling would be favourable or even mandatory before using the ATISS.	Interview 20: "Training is obligatory in this hospital."
	No training needed	Physicians stated that training is not needed in order to use the ATISS. Knowing about its existence is enough.	Interview 2: "There is no training needed. I think everybody can handle this system."
	Training strategy	The amount of training session needed to introduce the ATISS and sustain it in practice.	
	Once	Only one training session is needed to explain the ATISS, where it can be found and all the features before the physicians start using it. This training session will be held in each department separately or during an information market with everybody at once.	Interview 4: "I think one training session, going through all the content, and then it´s okay."
	Once a year	One training session a year where the ATISS can be shown. This can be done during the annual general education or during the weekly further education in each department separately.	
	Promotion	The hygienic staff, head physicians or senior physicians should support the use of the ATISS. This can be done by telling the physicians about the ATISS or by showing the ATISS on a computer or a portable device, either in combination with another training strategy or on its own.	
Effect	**Requirements of use**	The kind of patients the ATISS will be used for, the kind of situations or information the ATISS will be used for.	
	Infection patients	The ATISS would be used for infectious patients.	
	Difficult patients	Physicians stated they would use the ATISS for patients that were not standard for them in their field, because they would find the needed information in the ATISS easily.	
	Guidelines	The ATISS would be used to look up guidelines for antibiotic therapy, antibiotic recommendations that are in line with the	

	hospital resistance statistics and antibiotic dosage e.g.	
Changes	One participant stated that he/she would check the ATISS from time to time to see if there were any changes in the antibiotic therapy. The infections he/she treated were mainly the same and therefore he/she did not need the ATISS during normal routine days.	
Quick reference	Because there are no computers in the patient's treatment rooms there is no easy access to the ATISS. Therefore the ATISS is not used.	
Not applicable	Physicians had no opinion about the subject. A few physicians had not used the ATISS long enough to give an opinion about the specific subject.	
Expected effects	The effects of using the ATISS in practice, or the effects that can occur when every doctor uses the ATISS.	
Decreased costs	The costs will be decreased by using the antibiotic described in the ATISS.	Interview 12: "We also have lower costs with the ATISS."
Diminished resistance	The ATISS takes the resistance conditions of the hospital into account which can have a positive effect on the future development of these conditions.	Interview 12: "We hope it will reduce the amount of resistance bacteria in the hospital."
Standardization	When the ATISS is being used by everybody a standard in the antibiotic treatment will become evident. This will have a positive effect on the overuse of antibiotics and unnecessary side effects can be avoided.	Interview 13: "The most important benefit is the standardisation of the therapy, and the resistance statistics that are taken into account."
Time saving	The overall time of the antibiotic therapy will decrease with the use of the ATISS. The time spend on searching for the right antibiotic will decrease, other information can be found quicker, the time of the therapy will be shortened, updates will be sooner and work will be easier.	Interview 3: "For me it´s a good method to get the information in a relative quick and simple matter."
Security	The security that the information on the ATISS is up to date, as well as having a guide for the antibiotic therapy (especially for beginners) can give a more confident feeling about the treatment.	Interview 1: "With the ATISS I know that my recommendations are reliable, I can be sure that it works."
Optimizing therapy	The ATISS can optimize the antibiotic therapy because it will cause workers to work more sovereign, it can optimize the initial therapy which has an effect on the rest of the therapy course (also for special cases) and it gives the physicians more alternatives to choose from.	Interview 5: "I think that with the ATISS the antibiotic therapy will be better because less antibiotics will be used."