STEVE

Student Evaluation of Telemedicine

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1. Introduction

This report is the result of the course *IT in Society* held during the autumn of 2005 at Uppsala University. *IT in Society* is a project course aimed at giving the students insight into the interplay between technology, constructors and users, focusing on group dynamics and cooperation between groups.

The topic for the course was the use of information technologies, primarily for telemedicine, at Uppsala University Hospital.

Participants in the course were fourteen students from Uppsala University, Sweden, and four students from the Rose-Hulman Institute of Technology in Indiana, United States. The students come from different academic disciplines such as software engineering, computer science, technical physics and socio-technical engineering, mostly at a master's level.

1.1 STEVE

The name chosen for the project was STEVE – Student Evaluation of Telemedicine. The general purpose of STEVE was to examine the use of telemedicine within a project called SPEX, Spreading Excellence in Healthcare. SPEX based on cooperation between hospitals in Italy, Spain and Sweden with the goal to market validate a business model for spreading expert knowledge from specialized hospitals to smaller healthcare units. Chapter 2 provides a more thorough description of the SPEX project.

The idea of STEVE was to take advantage of an outside perspective to create an unbiased picture of how SPEX works. In doing so new strengths, weaknesses, problems and possible solutions could be identified. Thus, STEVE will hopefully support SPEX in reaching its goal of a more efficient and cost effective healthcare.

Specific goals for STEVE

Even though the general purpose and idea of STEVE have remained the same, the more tangible goals have changed as the project has progressed. In the early stages of STEVE the purpose was to examine the SPEX project with regard to four topics, with the ambition to come up with suggestions for future changes that would improve the way the project worked. The four topics were:

- Technology solutions for telemedicine
- Evaluation of the medical record system
- Efficiency, rationalization, expansion and increasing profit
- System expansion

About halfway through the project, the focus changed to an examination of three more distinctly defined parts of SPEX, with the goal of producing three reports to be handed in to the European Commission, which provides funding for SPEX. These reports will be part of the basis for assessing the success of the SPEX project. The new areas of interest, as well as the titles of the reports, were:

- Quality of Care
- Trial Evaluation Report
- SPEX Business Plan

This STEVE report reflects the results of both sets of goals.

1.2 Method

The method for reaching the general purpose of the STEVE project is to apply a socio-technical viewpoint that focuses on how technological, organizational, financial and other aspects have to work together in order for SPEX to be a success.

The method for obtaining specific information about SPEX, and information needed for the three reports for the European Commission, has been to study all internal documents describing SPEX. This was done in order to compile relevant information from questionnaires handed out to patients and doctors, and to perform interviews with the following:

- Participating healthcare professionals (i.e. doctors and nurses)
- Medical technicians
- Technical partners
- SPEX administrative personnel
- SPEX managers

1.3 Outline of this report

The report will start with an explanation of SPEX and background information about the Swedish health care system including workflow at two Swedish hospitals involved. All this is found in chapter two. In chapter three technical solutions used in SPEX will be explained both in a case scenario and in separate sections. An explanation of the network Sjunet, which constitutes the backbone of SPEX will be thoroughly given. A short summary of the trial evaluation (Appendix 1) is also given in chapter three. Chapter four contains an outline of possible improvements of the quality of care, both by establishing a national medical record system and by the use of SPEX. In chapter five economical aspects of SPEX are examined. The chapter gives a background to economical consequences of SPEX and principles for calculating costs. It also explains shortcomings of the methods and how new economical models can lead to a reimbursement model. In chapter six we explore how SPEX can be spread in the future and how alternative technical solutions can be incorporated to improve the system. We also present a suggestion for a new SPEX environment prototype. Finally, we finish with a summary and conclusions, were we discuss technologies, quality of care, economical aspects and future perspective.

2 The SPEX project

SPEX, Spreading Excellence in Healthcare, is a telemedicine project funded by the European Union. The objective is to market validate an organizational/business model for spreading specialist healthcare knowledge using Information and Communication Technology (ICT). Hospitals from Italy, Spain and Sweden are participating.

2.1 General idea

The idea is to transfer knowledge through a network (both technically and ideologically speaking) from a highly specialist Center of Excellence (CoE) to a smaller healthcare unit that is called a Point of Care (PoC).

The SPEX network model, with a CoE as the hub and a PoC as spoke, has four general purposes[1]:

- Avoid misuse of specialized clinical resources by treating ordinary cases at the PoC
- Improve service offered to patients by, whenever possible, treating them where they live to avoid costly and unnecessary travels
- Expand the CoE:s catchment area for clinic cases that fall inside their mission
- Enhance the financial performance of the CoE:s by focusing on the most complex cases

The idea is thus that smaller hospitals, the PoC, access to specialist knowledge from the expert hospitals, the CoE, within some particular area. This is accomplished by the use of ICT and telemedicine.

2.2 Pilot sites and field trials

To validate the SPEX prototype for spreading knowledge, field trials have been performed in pilot sites in Italy, Spain and Sweden. In each such pilot site one CoE and one PoC have started to cooperate in different clinical areas. During the project the pilot sites increased with one PoC, Kyrgyzstan, with Uppsala as the CoE. This report will focus on the Swedish pilot site, where the CoE is represented by the Department of Plastic Surgery at Uppsala University Hospital, and the PoC is represented by the Department of Surgery at Mälarsjukhuset in Eskilstuna, a county hospital.

2.3 Methods used

The methods used for spreading the knowledge in question are primarily tele-consultations and tele counseling. Tools include live streaming video, videoconferences and shared patient records.

To set up the technological solution needed, each pilot site has at least one technical partner; usually an IT company specialized in healthcare. A technical partner in SPEX has two distinct roles:

- To evaluate available tools on the market and choose the ones most suitable for standing up to the functional needs of SPEX.
- To implement the chosen tools and provide service when needed.

In Italy the technical partner is called Telemedicina Rizzoli, in Spain TB Solutions and in Sweden SYSteam.

2.3.1 Dissemination of Information

The main goal of SPEX is to spread excellence in healthcare, which has lead to the need for dissemination of information. This could be done by guidelines or newsletters. The guidelines would be a collection of clinical cases published by the CoE, where the PoC would have access to the latest published version. To ensure that the consulted version is the latest, the guidelines will be held centrally at the CoE and the PoC would be notified when an update is

[1] SPEX, Technical Annex, page 4

done[2]. The newsletters could contain updates on different interesting subjects from the CoE. None of this has been tried in the Swedish part of SPEX since so few people were involved.

2.3.3 Training & Accreditation

One of the best ways to improve knowledge of personnel at the PoC is through training and accreditation. The training could be a form of e-learning with tools like Explanograms and Marratech[3] but could also be traditional classroom training. In the training process the network in SPEX could be used to broadcast operations and medical examinations done at the CoE, thereby provide a unique teaching tool for the PoC:s.

When several hospitals are involved in the future, much can be gained by scheduled clinical case discussions. A fairly simple videoconference system allows specialists from the CoE to discuss cases with many PoC:s simultaneously. This forum could also be used to discuss specific cases and other problems encountered.

Accreditation of staff at the PoC could also be done with support from the network, which allows specialist at the CoE to watch the staff development and progress through already established communication paths. Neither training nor, accreditation have been tried in the Swedish trial of SPEX since so few staff members at the PoC were involved in the trial.

2.4 The Swedish health care system and market

The Swedish population exceeded nine millions in the year 2004. Geographically Sweden is divided into 21 counties, which are a municipalities with county responsibilities. Each county is comprised of municipalities and there are 290 such municipalities in Sweden

The Swedish health care system can be divided into a public and a private sector. Together the private and the public sector provide 1050 General Practitioners surgeries. The public health care is responsible for about 99% of all care given in Sweden and is financed through taxes and, to a very small extent, patient fees. The health care system can be divided into three different levels: primary care, local hospitals and university hospitals at a regional and national level. This division is made due to regional purposes and different responsibilities for different bodies of government. The county councils are responsible for Swedish public health care.

The primary care is where the patient enters the health care system. It consists of everything from general practicing doctors to work therapists and counsellors. The doctors alone receive more than 12 million visits every year, and the total number of visits is even greater. Nine out of ten patients with a pressing need is given an appointment with a doctor. A special part of the primary care is the elderly care. In difference to most other areas of care, the local municipalities are responsible for this area, both for elderly people living at home and those in nursing homes. However, the county councils are still responsible for all treatment made by doctors.

Sweden has more than twenty county hospitals and about forty minor county hospitals that take care of patients that can't be treated in the primary care. The county hospitals have

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[2] SPEX, Technical Annex, page 6

[3] Chapter 6

expertise to cover most of the health care.

The Swedish healthcare market divides the country into six regions. There are eight regional hospitals in Sweden. The regional hospitals are also called University hospitals due to close cooperation with medical universities in areas of education and research. Two regions, Uppsala/Örebro and Skåne have two University hospitals each. Uppsala and Örebro is a SPEX pilot site region. Uppsala University Hospital (UUH) is a Centre of Excellence to Eskilstuna Hospital as a Point of Care.

The regional hospitals treat all rare and complicated diseases and injuries. In order to save money and to keep a high level of competence the most advanced expertise and most expensive techniques are only located to a few national care hospitals. UUH has, amongst other areas, specialized in complicated wounds and burn treatment. Through SPEX Eskilstuna hospital can learn from and use excellence of UUH.

County councils and regions may buy services from private companies. Activities that are carried out by private companies through municipalities or county councils/regions are still financed using public funds. Due to the Swedish legislation the private companies are not allowed to charge higher patient fees than government run care facilities, and they must offer their services on the same term as their counterparts in the public sector.

2.5 Info on Workflow and the two Hospitals

This chapter will briefly give some information about Uppsala University Hospital and Mälarsjukhuset in Eskilstuna. However, focus is on information that is important and interesting for SPEX. The information will begin with general facts about the hospitals as a whole followed by a description of the departments involved in the project. The chapter also addresses the workflow before and after SPEX was introduced.

2.5.1 Uppsala University Hospital

Uppsala University Hospital (UUH) is the oldest university hospital in Sweden. The first department was established in 1708. Today the hospital has around 40 departments and more than 8000 employees. UUH accepts patients from the county of Uppsala, the Uppsala/Örebro health care region and in special cases, from all of Sweden. The hospitals activities include medical care, teaching and research. Education and research are done in cooperation with the *Medical Faculty of Uppsala University*. The hospital has recently gone through a complete reconstruction of its organization. The purpose of the reorganization was to get a more efficient decision making process to reduce the hospitals overall costs and to get a more efficient organizational management.

The Department of Plastic Surgery

The department that is involved in SPEX is the *Department of Plastic Surgery*. Its main tasks are plastic surgery and burn wound treatment. The department has its focus on reconstructive procedures on patients where there is a very high medical need. This includes, amongst other, children with malformations, reconstructive surgery and removal of malignant tumours.
The burn unit at UUH is one of two centres in Sweden that can provide advanced care for patients with major and complicated burns. It also includes a research department headed by the only professor in intensive burn care in Sweden. The gathered competence in the areas of

both pressure wounds and burn wounds makes the department a good choice for a "Centre of Excellence" in SPEX.

2.5.2 Mälarsjukhuset

Mälarsjukhuset in Eskilstuna is Södermanland[4] County's largest hospital and all citizens of Södermanland have the right to be treated here. However, the hospital mainly treats people living in the northern part of Södermanland County. For some medical fields the hospital has a county function which means that because of their expertise within these fields the hospital provides the health care for the entire county. The hospital works closely together with the Kullbergska hospital in Katrineholm and they have some joint departments. Mälarsjukhuset offers:

- Non-institutional specialist receptions
- Intensive care unit
- Institutional health care units
- Departments for diagnostics and treatment
- Surgical units
- Rehabilitation centre

The hospital offers medical, surgical and psychological health care, planned and acute, around the clock. The northern part of the county (Eskilstuna and Strängnäs) constitutes the main part of the hospitals business and has 118000 citizens. Collaboration with the Kullbergska hospital in Katrineholm in the western part of the county, with its 58000 citizens, make people in this part of the county clientele to lesser extent.

Some statistics:

- 412 hospital beds
- 21346 treatments per year
- 141493 consultation per year
- 2500 employees (fulltime and part-time)

The Department of Surgery

The surgical department is the unit in Eskilstuna that is involved in SPEX. They are responsible for performing emergency operations and more complicated planned surgical procedures. Their main focus comprises of reconstructive surgery, surgical care, treatment of malignant tumours, cardiology, endocrinology, urological and internal diseases.

2.5.3 Critical wounds

In this chapter the importance of patients with complicated wounds receiving correct treatment by experts is described. At first there will be a short description of what critical-, complicated- and problem-wounds can be and why these occur. Furthermore there will be a short description of some routines in the treatment of critical wounds.

What are critical wounds?

Patients are referred to the CoE due to having critical, complicated, or problem wounds.

[4] A province governed as an administrative and political unit of Sweden

These wounds are characterized by not healing within a decent time period after a routine treatment and there is a risk that wounds becomes chronic. Patients that are predisposed to get these critical wounds are e.g. elderly, and diabetes patients.

A chronic wound starts as an acute wound, but its inflammatory phase is prolonged, and the healing becomes a non-healing wound[5]. It is further desired that there will not be oedema around the wound, as this will hinder a healing of the wound[6]. The ordinary wound care routines contain some of the following assessment of the wound with regard to:

- outward appearance
- size
- alterations
- localization
- smell
- secretion
- pain

After assessment wounds are cared for in accordance with specific clinical guidelines. An example of a critical/complicated wound can be seen in Figure 2.1.

Figure 2.1 An example of a critical wound.

2.5.4 Work flow with and without use of SPEX

In this chapter there will be a short description of the work flow at the Centre of Excellence (CoE) which is the Department of Plastic Surgery at Uppsala University Hospital, and the Point of Care (PoC) which is the Department of Surgery at Eskilstuna Hospital. There will be a short description of the work flow before and after the use of SPEX.

Procedures without use of SPEX

The Department of Plastic Surgery at the CoE is the department to which all patients, from other hospitals, are referred if the wound of a patient is classified as a problem wound or

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[5] Akademiska Sjukhuset, http://www.akademiska.se, last accessed: 21th September 2005.

[6] Universitets Sjukhuset Örebro, http://www.orebroll.se/uso/pagewide____14187.aspx, last accessed: 16th September 2005.

critical wound. It is an appreciable number of patients that belongs to this category of referrals, and these patients are therefore occupying beds at the department at CoE[7].

The patients are admitted at the Department of Plastic Surgery and treated according to appropriate clinical procedures and guidelines dependent on the specific patient situation.
In Figure 2.2 the clinical processes without use of SPEX are illustrated.

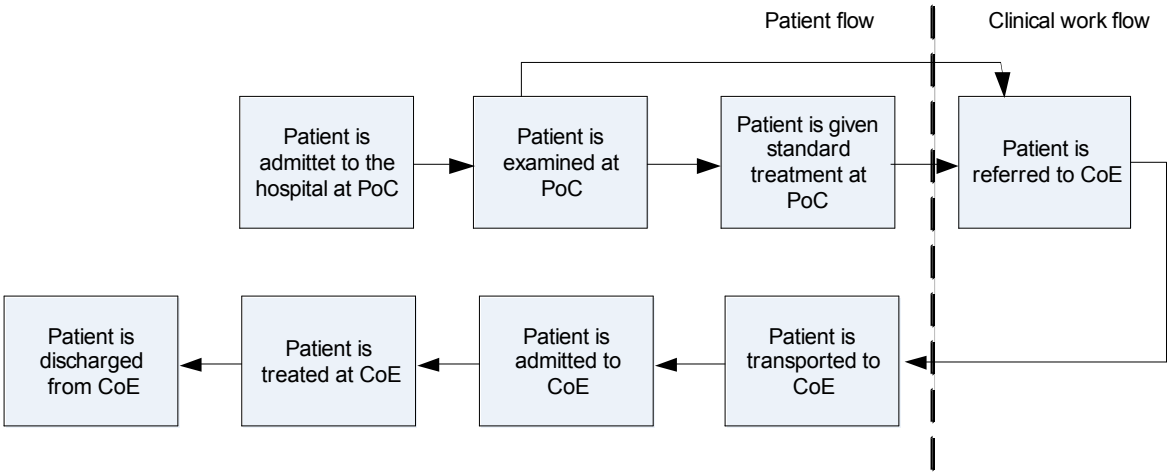

Figure 2.2 Clinical processes in a situation where SPEX is not used. The existing processes for referring a patient from the Point of Care, PoC (Eskilstuna) to the Centre of Excellence, CoE (Uppsala) is illustrated.

Procedures with use of SPEX
A patient that would previously be referred to Uppsala University Hospital from Eskilstuna due to a complicated wound will be a candidate for SPEX[8].

Dependent on the specific situation, clinical personnel can choose either to get advice from the experts by tele-consultation (synchronous) or tele counseling (asynchronous)[9].

2.5.5 Tele-consultation

Tele-consultation is used so that an expert at the CoE can help a person at the PoC with advice and opinions about a patient. The clinician at the PoC can book a time with a specialist at CoE. Before the consultation the clinician at the PoC will update the shared patient record with the patient anamneses and pictures of the patient condition. In tele-consultation an interactive video link is set up between the PoC and the CoE. With the use of a portable camera, pictures and video can be captured for the doctors and patient to view. The video can be seen by both doctors at the same time so they can discuss the footage. The computer that is used together with the camera has specially designed software. This software is used so that the doctor together with the video can send information that can be useful in treatment. This

[7] Albert Alonso, Lorenzo Cammelli, Benny Eklund, SPreading Excellence in Health Care, Deliverable D3.1, User Needs version 2.0, SPEX, 3rd February 2005.

[8] Albert Alonso, Lorenzo Cammelli, Benny Eklund, SPreading Excellence in Health Care, Deliverable D3.1, User Needs version 2.0, SPEX, 3rd February 2005.

[9] Market Validation and Support Action Review Report (MPRR), eTEN, Project Review Guidelines and Forms - Annex I, January/February 2005.

information can be time, date, personal information about the patient etc. The video can either be stored and viewed later or seen directly but in the course of SPEX the direct viewing was the only method used. This was due to problems that occurred when the doctors tried to save and edit video. However it could be possible to watch the videos later and store them on the local workstation and later on a server. Before storing it the doctor would be able to add information and do some editing of the video. In this method when the video is ready for viewing, the doctor at the PoC marks it ready and the server then notifies the doctor at the CoE.

Another kind of tele-consultation frequently used in SPEX is See& Share where doctors use the phone when discussing the patient. During the discussions software is used so that the doctors can draw on still images. These images will be seen by both doctors at the same time and are available to help finding the right treatment for the patient[10].

2.5.6 Tele counseling

Tele counseling is very similar to tele-consultation. The difference is that tele-consultation is synchronous and counseling is asynchronous. In synchronous sessions communication is done in real-time, i.e. both doctors are at their work stations at the same time which is not required in an asynchronous session. In tele counseling the person at the PoC doesn't have to be present at the same time as the expert from the CoE. Tele counseling is usually via e-mail, where doctors can send digital images and questions to experts and receive a reply in the same form.

Emergency consultation

An emergency consultation is planned and performed within 24 hours, with the same procedure as a planned consultation. A further possibility is to contact the CoE clinician by 3G mobile phones.

In Figure 2.3 the clinical processes, with regards to examination and treatment of a critical wound patient, with use of SPEX is illustrated.

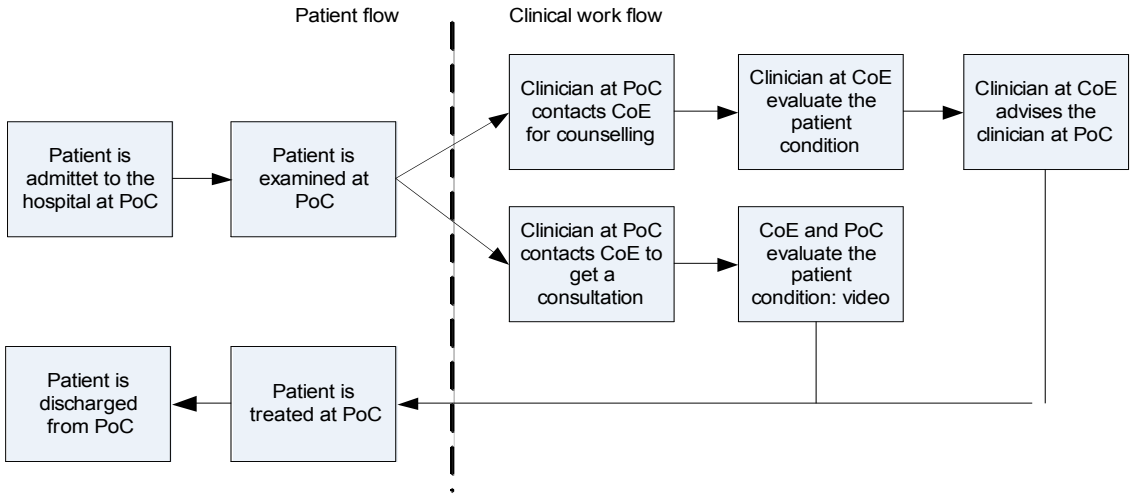

Figure 2.3 Clinical processes in a situation where SPEX is used. The processes that exists when a clinician from the PoC contacts a specialist from CoE is illustrated.

[10] SPEX Deliverable D3.2 Prototype Functional Specification. David Menasci. p 21-22

2.5.7 Comments

It should be remarked that to get a deeper understanding of how the personnel and their work flow is influenced by use of SPEX at the Department of Plastic Surgery a complete work flow analysis must be performed.

A complete work flow analysis can only be performed if the influenced participating hospital department is involved and an observational study of the actual work flow is carried out.

3 Technical solutions

In this chapter description of tele-consultation, tele counseling and the six tools used to achieve this communication is described.

To provide the services which are the foundation of SPEX, the Centre of Excellence (CoE) need to be able to communicate with the Points of Care (PoC). This is accomplished by the use of a distributing knowledge centre, where the CoE acts as the distribution centre and the PoC as the receivers.

To be able to carry out tele-consultation and tele counseling, six tools have been identified and used. These are: video streaming, videoconferences, video calls using 3G mobile phones, shared desktops, shared patient records and IP-telephony. These are implemented using mostly commercially available technology from various sources[11].

3.1 Case Scenario

The tools in SPEX are used as flexibly as possible. In the trial the only fixed time was a video streaming meeting scheduled once a week. The reason for the fixed time in which the video streaming is used is the two-doctor-problem, which is that two doctors have to be online at two different locations simultaneously. The other tools can be used outside of the fixed office hours and some are even available from the doctor's home. The patient's consent is needed in order to perform any kind of tele-consultation.

A typical consultation with SPEX makes use of the tools in the following way:

- At emergencies or at a follow up an evaluation can be made with the use of 3G mobile phones. The technology provides high flexibility and the possibility to save moving images to a computer, but lacks the details and image quality found in video. The big advantage with this technology is that the specialist doctor in Uppsala has no need to use his computer, only his phone. This makes the session more flexible and easier to administrate.
- During the patient's first visit to the PoC doctor, digital images are taken of the wound. These images are included in the patient's medical record and also available as a basis for possible consultation through e-mail. At this point consultations can be done through the shared patient records or See & Share desktop where the doctors can discuss the photos asynchronously (shared patient records) or synchronously (See &

[11] SPEX brouchure, Fridén et al p.1-2

Share). In the case of e-mail consultations the doctors can do this from their home computer which is both flexible and convenient.

- When video streaming is concerned, the patient is briefed about the method and asked if she/he is willing to participate in the study.
- If the patient agrees to tele-consultation a meeting takes place through video streaming in a time slot decided by the doctors and patient. In the trials in SPEX a weekly appointment was booked for this type of consultation. From Eskilstuna the streaming is sent to Uppsala so the specialist can see the wound. In return a teleconference image is shown in Eskilstuna so the patient can see the doctor. A speakerphone is used parallel to the two tools in order to convey audio.
- Usually the shared patient record is created after the video consultation, but problems with saving both the video and the conclusions made in See & Share sessions has resulted in the record being mostly made up of images and text.
- If needed a follow up meeting can be done via phone or email

3.2 The primary tools used

The tools for communications used in SPEX have, at Mälarsjukhuset, been developed by the department of Medical Physics and Technology in close collaboration with the surgeon clinic. The department is responsible for the purchase, installation, repairs and service of machinery and equipment at the hospital. The collaboration between Eskilstuna and Uppsala started after an initiative from the surgeon clinic. Dr Peter Gustafsson at Mälarsjukhuset had good relations with Dr Morten Kildal at Uppsala University Hospital (UUH) and they together thought of new technical solutions and ideas that they thought they needed to perform their job better.

The idea behind the system was that it would be:

- Mobile and flexible
- User-friendly, require limited technical support
- Consisting of consumer electronics

The plan was also that every consultation would be summarized and used in the training of doctors and also possibly district nurses, but since only one doctor from Eskilstuna participated, training has not been attempted.

3.2.1 Shared patient records

The first major problem before SPEX was that the doctor in Uppsala needed to see the wound, so they developed a system where you could send digital photos through Sjunet[12] (see 3.3.5) and have as a part of the shared patient records. Since there was no standard for patient records the technical staff at SYSteam created a file area at Sjunet were the doctors could add photos and notes about patients. The system with "shared patient records" was used at all consultations and formed the backbone in the communication along with e-mails, since these combined solutions allowed the two doctors to work asynchronously but still get much information. The patients were referred to by means of unique codes on the Sjunet server, and

[12] Sjunet is a network that connects the Swedish health care system. See 3.3

the area was protected with a password check. The system is both safe and efficient but not a permanent one. If a standard system for digital patient records would be implemented, a complete solution is thought to take at least three years to get up and running.

3.2.2 Video-streaming

It was discovered that a still photo in the shared patient record did not give that much information, it was better to see the wound via video streaming. Then you could get information as to how the wound reacted when touched. In order to set up a video streaming system between the PoC and the CoE a carriage with a PC, a video camera, a video server and a speakerphone was set up at the PoC. A digital video camera was used and plugged into the AXIS video server which converted the signal to MP2. The video server has an IP-address which is connected both to the CoE and an FTP-server. The advantage of a video streaming system is that it can be used in the doctor's office or an operation room, since the equipment is mobile.

The biggest drawback is that the doctors, the nurses and the patient all have to be present at the hospitals simultaneously and therefore a specific time has to be reserved in order to coordinate a time for consultation.

3.2.3 Videoconferences

The system with videoconference has only been used in combination with video streaming as a complement. The quality of the picture shown by the conference system was too poor to give further information about a wound, but could be used to show an image of the doctor in Uppsala to the patients. The conference system used in Eskilstuna is mute and only gives a picture presented on the PC screen. In early trials the system contained both picture and sound, but problems with echoes due to the bare hospital environments resulted in the solution with a mute conference system. Instead the solution concerning sound was to make calls on speakerphone during the conference, and several different phones were tested. Finally an IP-phone was used and the echo and distortions were minimized and was no longer a distraction to the system. A positive feature with the conference system is that the system is one-to-many and several doctors can therefore take part in the same conference meeting and help asses a patient. Instead of a conventional conference system, used in large companies, software was installed in the PC and a web camera was mounted on the screen.

3.2.4 Shared desktops using "See & Share"

The system with See & Share desktop was created after a request from the doctors. This technology can be used to retrieve fast information since doctors can talk on the phone while simultaneously illustrating on a joint screen image. However, the discussions and sketches done during the See & Share session can not be saved directly but have to be summarized and written into the shared patient record.

3.2.5 3G mobile phones

Use of 3G mobile phones was not included in the first version of the prototype, but added after initiatives from the doctors themselves. Thus the doctors already possessed the necessary knowledge for using the tool.

This tool could possibly replace the video streaming system but it was soon discovered that the picture quality was poor and could not be used for tele-consultation. The 3G phones were instead used as a communication link between the doctors outside office hours. The possibility to use 3G phones could still be possible if the technology improved, and the doctors considered the 3G phones had sufficient quality for emergency consultations and follow up visits.

3.2.6 IP-telephony

When Kyrgyzstan entered the project as the second PoC, the possibility for communicating through "Free calls over the Internet" using the program Skype was also introduced.

3.3 Sjunet

In 1998 a project named Sjunet started as a cooperation project between seven county councils. Sjunet connects the Swedish healthcare sector into a single private network for data communication. Being connected to a mutual network makes collaboration easier within the healthcare sector and resources can be optimized. Moreover, enhanced collaboration improves the overall quality and provides better access to both general and specialised healthcare services at considerably reduced costs. What started with a network consisting of only seven nodes has now expanded to a nationwide coverage.

The network has the potential to make healthcare routines more efficient through e-health and telemedicine. It also makes it easier to provide healthcare that focuses on the patient, since transports can be minimized and the patient can be treated locally. Furthermore, the mutual network creates opportunities for collaboration between different geographical regions as well as across clinical boundaries, thus enabling optimization of healthcare resources and a possibility to reduce the cost of care[13].

3.3.1 Traffic on Sjunet

All information that comes from county councils, municipalities and private caregivers can run through Sjunet. Many different actors can traffic the network providing that the availability and security of the caregivers are not interrupted. That also includes information that regards schools, real estates etc. When using a service within Sjunet the caregivers are prioritized over the other traffic.

3.3.2 Technical description

The purpose with the infrastructure behind Sjunet was to build a platform between the county councils and other parts of the healthcare sector where useful information can flow through different services and applications.

The infrastructure is an IP-based computer net solution that is constructed on Ethernet VLAN-technology. The network is a fibre-optical network, separated from the public Internet. This enables a secure and reliable exchange of confidential data, such as patient records, that is not suitable for transfer over the Internet.

[13] http://www.carelink.se/files/doc_2005629161019.pdf

The network can manage capacities up to 1 Gbit/s and can therefore handle advanced real-time critical solutions to problems. The technology enables an almost unlimited transmission capacity which is necessary for services that requires lots of capacity, like downloading of sound and images in real-time which is becoming more popular in healthcare. For Sjunet, this means reliable transmissions for teleradiology, video conferencing, file transfers and electronic prescriptions.

The nodes in the network are all connected to each other. Due to this structure there are always alternative ways for the information to flow even if a cable is down. This also makes it easy to connect for example a new hospital to the network.

3.3.3 Available services within Sjunet

Several examples of Sjunets' services can be found within the field of telemedicine, including the secure transmission of patient information, clinical rounds and teleradiology. Another example is the vast number of prescriptions that nowadays are being transmitted electronically to pharmacies. In addition, Sjunet is also used for IP telephony, file and media transmissions and access to knowledge databases. These services are possible because Sjunet is based on IP technology which makes all tools that are available for the Internet usable. The technology means considerably enhanced availability, security and capacity. It also enables Sjunet to continually be developed for future needs and services. Sjunet makes telemedicine simpler and more flexible. If used correctly, telemedicine can improve the quality of care in certain fields and lower costs through the more efficient use of limited resources.

3.3.4 Security

The network has to be exceptionally secure because of all the confidential information about the patients that is being transmitted on it. According to tests there are very few losses of information packets and small time delays on the network. The risk for outsiders to interrupt and get hold of the secret information has to be very small. To obtain secure network different precautions has been made:

- A security group with different capabilities has been established.
- Regular delivery tests are being made to keep the security high.
- Every user connected to Sjunet is obligated to have some kind of security device on their computer, i.e. a firewall for the connection with Sjunet that checks incoming and outgoing traffic.
- All the users have to sign an agreement where security questions are being regulated[14].

3.3.5 Sjunet's role in SPEX

In SPEX, Sweden had a great advantage having a network like Sjunet, where all hospitals were connected, at the start of the project. This makes it easy and secure to communicate between doctors at different locations. Due to the high transmission capacity on the network, video conferencing can be made with medical accuracy and the doctor at CoE can see the wound clearly.

[14] http://www.carelink.se/files/doc_2005629161019.pdf, page 6.

One obstacle for the technical staff has been that there was no standard for patient records so they had to create a file area on the Sjunet server where the doctors could add parts of patients' journal and photos. Though Sjunet is a secure network there are always risks that the information about patients gets in the wrong hands. Therefore the patients are referred to by a unique number and their name is never mentioned on the Sjunet sever, or in the e-mails sent between the doctors. This is not a permanent solution but it is working well for this project. There is an ongoing project named Nationell Patientöversikt (National Patient Summary) that is implementing a solution for the shared patient record problem.

3.4 Summary Trial Evaluation Report

The Trial Evaluation Report, or document D7.3[15], is part of the deliverables that the SPEX project is to hand in to the European Commission for evaluation. The report summarizes the field trials of the SPEX prototype that have taken place in the three pilot sites in Italy, Spain and Sweden. The purpose of these field trials is to test the SPEX system for spreading knowledge from a Centre of Excellence to a Point of Care using technologies for telemedicine. The purpose of the Trial Evaluation Report is to give a picture of how the prototype and the field trials have evolved, how the system works and how it has been used, what lessons have been learned and what changes these lessons have implied.

3.4.1 Method

The input to the document is based on other project deliverables (i.e. D3.1 "User Needs" and D3.2 "Prototype Functional Specification"), questionnaires answered by participating healthcare professionals and interviews with both participating healthcare professionals and technical partners.

The document is structured so that each pilot site gives their view on a number of relevant topics, including:

- SPEX System Testing
- User Training
- Real-Life Use of the Prototype
- User Feedback Collection

STEVE participation in creating the Trial Evaluation Report is limited to the Swedish pilot site.

3.4.2 Prototype general idea

The general idea when developing the prototype for the Swedish pilot site has been that the system should be easy to use for doctors and nurses and that it should require a minimum of service. The prototype thus consists of tools that require very little development, i.e. consumer electronics like an ordinary digital video camera and software for sharing desktops. The task of the prototype is to make sure all functional specifications are fulfilled in as simple a manner as possible.

[15] Appendix 1

This approach seems to have been successful during the development of the prototype; neither the users of the system nor the technical partners can identify any significant problems when the technical solution was implemented.

3.4.3 Use of the prototype

When learning to use the prototype, the fact that it was the doctors themselves that identified the functional demands was a great advantage. In this way the doctors had an initial understanding as to why certain tools were used, which facilitated the learning process.

Judging by how little time was spent on practice, the goal of developing a system that is easy to use has most certainly been achieved. The users also seem to agree that all tools have been fairly easy to learn, the hardest being the tool for sharing patient records.

A total of 59 patients have been treated and the most commonly used tools are e-mail, shared patient records and voice over IP. It is interesting to note that these "simple" tools are often favoured over more powerful ones, like streaming video. This could suggest that the doctors find it difficult to use the more complex tools or that practical and organisational reasons keep the use down. However, it could also mean that a lot of patients can receive proper care by the use of simple technological tools.

3.4.4 Problems encountered

No major problems have occurred that has obstructed the development of the system or rendered the system temporarily useless while running. During the development a few minor problems was identified and taken care of, but nothing out of the ordinary seems to have occurred.

The functionality of the prototype also seems to be fulfilled without any serious problems. The biggest problem with respect to functionality has been the sharing of patient data, which is too time-consuming and not user-friendly enough. This task has therefore been transferred from doctors to medical secretaries.

It is worth pointing out that the underlying infrastructure of Sjunet has been a prerequisite for the design of the Swedish prototype. Without the ability to send secure data with high speed, another approach probably would have had to be adopted to fulfil the functional demands.

3.4.5 Results

The main goals of SPEX are to provide better healthcare to patients on place at the PoC, and to improve knowledge and experience of the doctors at the PoC by granting them access to the CoE. Both of these goals seem to have been achieved. The patients are generally satisfied (see ID2.7 Quality of Care Impact Assessment) and the doctors feel that they have gained new competence.

3.4.6 Comments

When taking all input into this document into account (i.e. interviews, questionnaires, and project deliverables) everything seems to point to the conclusion that the Swedish pilot site has made a successful evaluation of the SPEX prototype. The opinions of the users and the patients are coherent with the indicators that have selected for measuring in the areas of clinical impact, technical functionality and economic balance.

More treated patients and a higher overall use of the tools in the prototype would have been desirable for making conclusions with higher certainty, but there is no indication that the SPEX prototype has not been able to reach its goals.

4 Quality of care

This chapter is about evaluation of quality in the health care which is a complex task. Two parties have to be taken into consideration, patients and staff. The patient's view is relatively easy to assess, but a patient without clinical experience might not be the best to decide quality of a certain treatment. On the other hand, staff will generally regard their work as well done and therefore attaining their joint opinion should be the aim of an evaluation. To evaluate the care, questionnaires have to be filled out by both doctors and patients. These questionnaires should also be based on known methods and experiences. From statistics from these questionnaires conclusions could be drawn and thereby the result will be as adequate as possible. This chapter also handles the issue of electronic medical records, a feature that is hoped to increase quality of care by allowing any physician to access a patient's medical record.

4.1 Shared Medical Records

In Sweden today, there are many different systems for electronic medical records and there is no standard for which system or application that should be used. Most systems that are in use in hospitals and clinics are not compatible with each other.

When SPEX started to evolve in Sweden there were no electronic medical records implemented neither in Eskilstuna (PoC) nor in Uppsala University hospital (CoE). All medical records were paper based. Both hospitals implemented electronic medical records during SPEX. Today the CoE is using an electronic medical record called Cosmic that is provided from Cambio. The PoC is using another electronic medical record called SYSteam Cross, which is now owned and supported by SYSteam, but formerly built and owned by IBM.

These two different medical record systems that are used within SPEX in Sweden are not compatible with each other. Communication issues between the record systems have been one of the problems for SPEX. SPEX has not tried to integrate these two systems since the introduction of the electronic systems was carried out during SPEX. Because there were no electronic records when the project started, a temporary solution was designed for the purposes of SPEX only.

Many ongoing projects are trying to solve the problem with medical record system, but so far very few have succeeded. The biggest project in Sweden is the National Patient Summary (Nationell patientöversikt), with the aim to build an infrastructure where all medical record can connect. This project is evolving right now, but it will still take years before this system will solve all integration issues. The SPEX technical partner in Sweden (SYSteam) have decided to wait until better solutions are available on the market before trying to integrate the two different medical record systems.

The doctors in Uppsala, the specialists, need some information about the patient before making a solid appraisal of the situation, especially in the asynchronous case when it is not a video conference. The doctors in Uppsala need to read the patients medical record in order to make a judgement in the case.

4.1.1 Temporary Solution

The technical solution designed by SYSteam for shared medical records consists of the use of standard editions of; Word or Excel, a Quickplace server and a Lotus Notes Database. Documents used during a session are first uploaded to the server and then shared by doctors.

This is a temporary solution that was implemented only for this project. It is not a permanent solution that will be used in a future extension of SPEX. The reason why not more work has been invested in this area is that funds are not intended for developing an advanced technical solution to this problem, and also that the National Patient Summary (described later), is already doing well funded research on exactly this problem.[16]

The temporary solution used in SPEX is good enough for the moment, even though it did not fulfil all technical specifications given. In this solution the same work is done twice, as the doctor must write the same thing first in the shared document, then in the patient's medical record. The preferred solution is that doctors should be able to read and write to the same file, the same record. However, this is not possible for the moment, because of restricting laws in how to handle personal data of this sort. The laws that regulate this issue are not so flexible and very limiting; they are not adapted to the technology available today. Many of these laws are now about to be revised and changed to better suit the possibilities of modern technology.

Another problem is that existing electronic medical record systems are not built for sharing information; on the contrary they are designed for protecting data.

4.1.2 National Patient Summary

"Nationell Patient Översikt", NPÖ, which would be translated "National Patient Summary" is a Swedish governmentally funded project in the area of electronic medical records.

NPÖ started their pilot in October this year in the north of Sweden and it will be evaluated in December. The doctors will continue working in their own medical records systems and the idea is that other doctors will be able to access the information through a web interface. There will only be read permission on the data, no one will be able to write or delete anything trough the web interface.

NPÖ has much bigger funding than SPEX and that gives them a better possibility to find a solution to this problem both quicker and better than would be possible for SPEX. There is no reason for trying to integrate the systems and it is not what the hospitals want. The Swedish law for medical records clearly states who may write what in the records. In the case with telemedicine two separate records will be used, all caregivers write in their own systems even though it is only the doctor at the PoC that is responsible for the treatment.

[16] Interview, Mats Forsberg, Uppsala 05-10-07

4.1.3 Shared information within SPEX

In the specification for SPEX the need for sharing information about patients is stated and a protocol based system for sharing data is defined. This is what is shared:

Shared text

Information that is transferred from the patient's medical record to the shared web space:

- *Anamnesis*, the case history. This is double documentation since this information is already available in the medical record.
- *Measures*. What measures will be taken.

Shared pictures

- Digital still pictures of wounds that doctors are examining.

Shared video

- A copy of video from sessions where streaming video was used. These clips can be rather long.

The users must save and upload these parts; documentation and pictures, to the server. The doctor in Eskilstuna has a secretary to help him with these things.[17]

Today it is not possible to save pictures and video in the hospital electronic medical records. But this is something that will be available in future versions of Cambio and Cross. The staff do not want to have a separate system for pictures and video. However the problem is that more technical knowledge will be required from users when more things are added to the already knowledge demanding new tools. In SPEX this part has worked out well. It is possible that doctors involved have a positive view on technology, and that this helps. Technology easily becomes an obstacle.

4.1.4 Saved Video Session

Previously, it has not been possible to save video sessions. However, after the summer this was implemented. A problem with the video sequences is that they are very long, which makes it difficult to use them later. Generally, doctors does not have time to watch through a 10min video to see 30 s of interesting material. The problem then is who could edit the videos after sessions. There are standard tools available, but they are not considered easy to use, and mistakes may ruin an entire video.

Use of video clips has been questioned, but we believe that use of video may be more useful than users think. Therefore, we believe that use of video is an important educational issue.

4.1.5 Comments

Research within SPEX has shown that there is no actual need in for shared patient records between the two hospitals. However, doctors within the SPEX project need to open and read medical records at other hospitals. There is no need for functionality to write in medical records from other hospitals. If the solution only involves an "open and read" function, this eliminates many of the problems with shared records. In the field of "open and read"

[17] Interview, Erik Fridén and Peter Gustafsson (Eskilstuna: 05-10-25)

successful projects, which have solved similar issues, have been found. Consequently, we believe that the best solution for SPEX would be that SYSteam Cross medical record opened up and let the Uppsala doctors read records for patients that will be treated though SPEX. This could save both time and money.

Since the patients are in Eskilstuna it is natural that Eskilstuna hospital has the responsibility for the patient's medical record. Uppsala is still required to have a separate journal where all recommendations that are given are written down.

It is obvious that shared medical records will improve healthcare once it is installed and doctors have learned the system. In the meantime when the system is being installed, the shared system can be an obstacle in the working process for doctors.[18] Problems like these are very important when evaluating health care. In the SPEX project evaluation of quality of care has been very important and an entire document was written due to this.

4.2 Quality of care in SPEX

One part of the STEVE project was to evaluate the Quality of Care[19] in SPEX and write a document about it. This document will be a part of the final EU report that the SPEX project will present for the European Commission. The document will show that the SPEX project improved the quality of care in the three countries involved.

4.2.1 Purpose

The purpose of the document was to evaluate how SPEX has affected the quality of care in the three countries involved (Sweden, Spain and Italy). It has been of high importance to ask the patients and physicians what they think of the treatment in the context of SPEX. This has mainly been done by means of questionnaires for both patients and physicians. These questionnaires have then been compared and conclusions from these have been made.

The document is also about both how the care was delivered before and after the introduction of SPEX. Therefore one chapter states what clinical alternatives that were available before SPEX. Another chapter looks into the clinical alternatives that SPEX has made possible. The last of these two chapters also looks into other things that the SPEX project has made possible. The possibilities vary between the different countries and therefore the chapter is divided between the different countries.

The methodology used for the evaluation is also described in the document. In both of the two chapters "methodology" and "Literature and experiences", methodologies and different evaluation factors have been discussed. As well as the possibilities when evaluating has been taken into consideration the limitations have also been of high importance.

4.2.2 Comments

SPEX has been very helpful for the patients involved. It is due to the SPEX project that the patients have been treated more closely to where they live. The patients now have two physicians that have been involved in the treatment instead of one, which was the case before

[18] Göran Karlsson, Uppsala nya tidning (9 december, 2005)

[19] Appendix 2

SPEX. This has showed to be a positive aspect from the patient's point of view. In the cases where the patient still needs to go to the CoE due to severe injuries the rehabilitation part could be done at the PoC, and that has been highly appreciated by the patients. The patients have also appreciated the good communication between them and the physicians and therefore felt as they have been actively participating in the treatment. Not only the patients have felt that the care has been of a high quality, also the physicians have felt that the delivered care has kept good quality.

The SPEX project has created new channels for networking, communications and collaboration. The physicians are more likely to work together after SPEX while they already know who they are collaborating with and can trust them. The rehabilitation possibility, with help from the techniques used in SPEX, will bring different hospitals and staffs to work together and thereby increase the quality in more geographical areas.

Evaluation outcome from the three countries should be kept apart, while evaluation is strongly related to the environment where the evaluation took place. Differences between environments should be clearly lined out for the comparison. No conclusions regarding other countries should be taken from the evaluation from another country.

Patient satisfaction is often strongly influenced by expectations of care. Patients treated in SPEX are much likely to be affected by their own expectations of the quality of care in SPEX. For example, how much did they know of SPEX and the care delivered by SPEX before and how did they think about it before they went to the first session?

Another aspect of SPEX is that a fourth country also was involved, Kyrgyzstan. The majority of patients participating in the Swedish pilot of SPEX have been treated in Kyrgyzstan, with Kyrgyzstan as the PoC and Uppsala as the CoE. Kyrgyzstan was added as a PoC in SPEX later than the PoC Eskilstuna. In Kyrgyzstan the need for consulting was and still is very high because of the high number of patients. After the and of SPEX, Kyrgyzstan will still need help with the treatment of their patients.[20] How this will work and how it should be funded are still open questions. Perhaps an organisation like SIDA could be interested in this project and help Kyrgyzstan with funding money.

5 Economical impact

5.1 Economic consequences

The economic gains at the PoC, Eskilstuna Hospital, are primarily concerned with eliminationg costs of sending the patient to Uppsala University hospital (CoE). These costs are both concerned with costs of transporting patients, and level of care being lower and thereby lowering cost burden for patient treatment.

[20] Interview, Morten Kildal (Uppsala: 05-10-28)

Furthermore the municipality[21] will experience an economic gain. This is due to patients getting treatment early in the sickness stage, and the wound therefore will not have to be redressed for many years after. Economic consequences for the CoE are restricted to only being costs, as patients are now treated at the PoC.

5.2 Present principles for calculating costs

When developing a reimbursement system for a telemedicine project it must be based on a win-win situation otherwise the business should not take place.

There are three basic principles for calculating costs for the CoE and the PoC; these are described in the following text. At the end of the description there will be a discussion of shortcomings of the methods.

1. **Subscription agreement on hospital level**

Uppsala University Hospital is paid an amount of 10 SEK per inhabitant in the municipalities that the hospital has a bilateral agreement with. This payment should cover consultations over the phone, mail and further development.

2. **Subscription agreement between: CoE, PoC and municipality**

Here an agreement should be made with the CoE and the PoC that can have a sub- agreement with the municipality about the elderly home care.

3. **Fixed patient costs for accomplished health care jobs**

Here there will be a fixed cost to pay dependent on the health care service that is delivered. This could for example be that the CoE is paid a fixed price for a patient consultation.

5.3 Shortcomings of the methods

The advantage of the subscription methods are that the CoE is ensured compensation, and the disadvantage is that this form of payment will not stimulate further telemedicine development. The problems with the subscription agreements are that it will not lead to further development as the agreements are made for a longer period e.g. a year.

Regarding the third method of paying per used health care service, this might have the consequence that the PoC will stop using the system at the end of the year if the budget is low, the consequences may be that patients will not get the best treatment, or will have to wait for treatment.

The problems with the methods mentioned above have led to a combination model: that is on its way of being implemented in a contract between Uppsala and Eskilstuna. This method combines a lower fee for service combined with a subscription fee. The combination will hopefully lead to a solution that is beneficial for both parties. A future development of this deal between the two hospitals could be to make it possible for the municipality to buy faster care for its wound patients.

[21] A political unit, such as a city, town, or village, incorporated for local self-government.

5.4 Economic models

Seen from a scientific point of view SPEX is useful and developing. Knowledge is spread and patients get better treatment. However the economic point of view is somewhat more difficult to measure.

5.4.1 Socioeconomic impacts of SPEX

To evaluate economic costs of SPEX we have chosen to look at socioeconomic aspects of SPEX. This means that we are estimating impacts of SPEX on society, and are evaluating these effects against economic costs, by using defined socioeconomic analysis models. This makes us capable of assessing costs against for example patient satisfaction and effects of treatment against costs.

We have chosen to use a cost-effectiveness analysis to evaluate the effect of the new treatment method with SPEX. It is chosen to evaluate costs against the number of days the patient needs home care of their wound, before and after treatment with SPEX. As the cost effectiveness method states that new technology should be implemented without further analysis if the cost of new technology is less and if the effect of new technology is better. Using this we have come to the conclusion that SPEX should be implemented. For a further description of the cost effectiveness analysis see Appendix 3.

Regarding an evaluation of patient satisfaction against costs, we have chosen to use a cost utility analysis. In the analysis we evaluated three patients' health states before and after treatment with SPEX, based on a health utility classification system. This was performed by making the patient classify their health state in a questionnaire. The questionnaire showed that the three patients improved from a health state of 0.59 to 0.72 on a scale where 0 indicates the worst possible health state, according to the questionnaire, and 1 indicating a perfect health state. To see a further description of cost utility analyses see Appendix 3.

5.4.2 Different economic models

Uppsala university hospital gains roughly 30% of its revenue from selling treatment to other hospitals. With the usage of SPEX, and thereby making it possible to treat difficult injuries in a hospital closer to the patient, Uppsala looses some of this. The solution is to let the PoC to pay CoE for help they get from SPEX. This can be done by different means.

1. Subscription agreement on hospital level: Using this model the PoC pays an annual fee to the CoE. This fee should cover consultation by phone, mail and further development. The drawback with this method is that it could create an over usage of the system and thereby costing much more for the CoE than gained from the fee.
2. Fee for service for accomplished health care jobs: Using this model there will be a fixed cost to pay dependent on the health care service that is used. While this method will cover the CoE:s costs and not create an over usage of the system there may be reluctance from the PoC to use the system at the end of a year when budget is strict, even if the CoE can offer better treatment.
3. Combi method: When using Combi method there will be an annual fee and a patient cost these will be split so each covers 50% of the expense. This is the model most likely to be used in Sweden.

5.4.3 Reflections on socio economic analysis

What can be difficult to measure with a socioeconomic method is if you want to measure multiple effects against a cost. Then you will need to perform multiple socio economic analysis for example cost effectiveness analysis.

We chose to measure patients' health state by means of questionnaire based on a modified version of health utility index. As we chose to look at only four aspects of patients' health state: Mobility, emotion, self care, and pain, we get a restricted view of the actual patients´ health condition.

Furthermore the results of the questionnaire we got, were only based on three patients and can therefore be used as a template for how to do a real statistically correct analysis of results, when more patients can be involved.

What is interesting is the idea of cost utility analysis, to evaluate health of patients, and trying to state when a treatment is expensive or when it is inexpensive.

In an article in "Aftonbladet" Olle Svenning discusses aspects on the price of improving health state of patients. How much is society willing to pay? It is a common opinion among health economists and "Läkemedelsbranschen" (translate= Medical industry) that society is willing to pay 900.000 SEK for improving the health state of a patient to the perfect health state. A more expensive treatment is not profitable for society.

5.5 Reimbursement problems

By treating patients at the PoC and thereby increasing competence of doctors working there, it is unavoidable that at the same time the CoE looses some of its competence due to lack of new patients. It is calculated that 25% of a physician's time is made up by competence development and traditionally this cost is imbedded into treatment of a patient coming from another municipality. This imbedded cost will disappear when utilizing SPEX and must be remedied. Due to mentioned shortcomings of existing principles for calculating costs for reimbursement a new and more effective model is needed. The new model for reimbursement should take the following obstacles into consideration:

- Inhibit telemedicine development
- Consider low budget situations at the PoC

There should also be a focus on the following areas:

- Stimulate use of telemedicine in general,
- Promote use of SPEX in Eskilstuna.
- Make it a win-win situation for both the CoE and PoC.

5.6 Economics versus technology perspectives

Economy is very important in the use of any technology. It doesn't matter if technology is new or old. An introduction of new technology into a project takes time and costs are usually high. Economy is typically an issue and the question asked is: "Will use of this technology help to make or save money?" If it will not then there is often no real incentive to introduce technology.

The main thing to consider when introducing new technology into a project like SPEX is that the needs of users must be the guiding principle. If users do not want/need new technology then usage may be very limited. As seen in the evaluation of SPEX, usage of technology is reversed proportional to the difficulty level of the technology, i.e. the user prefers easy-to-use technology.

6 Ideas and suggestions for the future

This chapter goes into what the project can become in the future. First economic aspects areconsidered. Further on it takes a look at different technologies that would aid the SPEX project. An evaluation of different collaborative software is done. Finally the Explanogram technology and the Marratech system are presented and the possible uses they have for the project are discussed.

6.1 Spreading SPEX

6.1.1 Acceptance of SPEX

For the SPEX project to continue running in the future, it has to be considered a success from several aspects. One of the main things is the economical point of view. If SPEX doesn't create an economical incitement in both the CoE and the PoC, it will not survive for long. The first thing that has to be done is to close the first deal between the Uppsala CoE and the PoC in Eskilstuna. Due to the combination of a subscription and fee for service method in the contract, it would lead to treated patients and therefore a real start for SPEX without EU funding. To gain additional patients actually treated in SPEX, some sort of agreement for economical reimbursement from the municipality is needed.

Another important factor for the survival of SPEX is a general acceptance of the technologies used among doctors. This is important from two points of view; the maintaining and expansion of the project. If doctors and nurses currently working with the system do not feel that it's adequate for their needs it will be hard to find people that are willing to invest their time in an expansion of the system It is therefore important to keep on improving the system, especially the audio and video quality, as well as make it simpler and simpler to use. This will in time save both time and money.

6.1.2 Competition and future expansion

Even if SPEX turns out to be economically effective and spreads worldwide, it could meet increased competence as well as competition. Uppsala University Hospital could in the future be a Centre of Excellence to several other hospitals and departments in Sweden and internationally. The Hospital could also be a Point of Care to an international Centre of Excellence. When the cost of healthcare and travelling expenses is a more economic alternative, patients could be referred to Sweden from other countries, as well as from Sweden to other countries. That is to a Centre of Excellence *or* Uppsala University Hospital accredited hospitals, for safety, hygienic and trusty reasons. The Swedish healthcare market in the Baltic States is presently small, but will increase since the Baltic States are now members of the European Union. In the future SPEX may be used in addition to the present techniques. There

are eight University Hospitals in Sweden. Each of them is a potential competitor to Uppsala University Hospital on the telemedicine market. In Sweden (in particular the northern parts) the population is widely spread out. This together with the fact that Sweden is a world leader in Internet usage makes it a perfect country for telemedicine. A CoE that can convince a large amount of small communities to use their knowledge will have an advantage over other CoE:s. Sweden has however strict rules of who is responsible for the healthcare in different stages of a disease, making it difficult to compete. The hospitals are not supposed to make a profit but rather to reach break even. With projects like SPEX a hospital can hopefully reach break even with less effort than without it. The university hospital that finds the best model for a win-win situation will win this race. In multi-professional organizations such as healthcare, attitude and collaboration issues will be most important.

6.2 Alternative technical solutions and tools

6.2.1 Development into other fields

A natural development of this system would be to expand it into different areas of practice: dermatology, peephole surgery, stroboscopic examinations, ultrasound and other real time examinations. The only limitation is that the video server only can handle

S-video format. If the organization around shared patient records is developed further, this will probably minimize the need for the other technologies. Such a project is currently in development in Sweden.

In the future it may be possible to put video file from streaming directly into patient records. Today it is possible to insert still photos and x-ray photos.

6.2.2 Another approach to the SPEX Prototype

Improved to SPEX prototype

Through the analysis of the SPEX we have found some areas which can be improved and will suggest possible solutions. One area in which several doctors had problems was transferring files about patients from PoC to CoE and vice versa, this was both difficult and limiting. One example is that files had to be uploaded to a central server in order to share them a task that required both time and technical knowledge. The current process is not flexible or intuitive for users; a more lifelike way of sharing documents is preferred by staff.

Tests of several “off the shelf”-products found a better solution for file sharing using Groove Networks. For the full collaboration software evaluation, see Appendix 4.

Groove software integrates most of the needs of SPEX as well as other functionality. Integration makes SPEX easier to learn, use, and set up, as it is only one program instead of several. We believe even this software can be improved upon however. Several ideas include integration of video conferencing, like Skype Video that goes beyond Groove’s text and voice chat. Other future improvements include marking sections of video files and dynamically storing shared sketches. The SPEX model can be improved by moving towards an all software system with one simple interface for real time and static collaboration tools, and with data stored locally. This would make the system less complicated, easier to learn, and an ability to spread faster to new CoE:s and PoC:s.

Current SPEX prototype

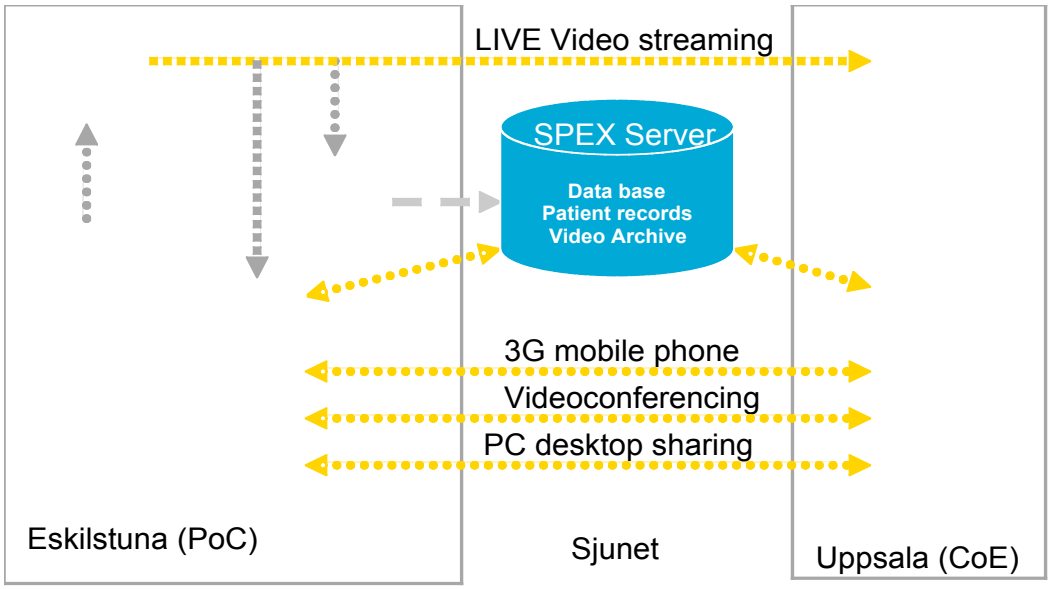

Figure 6.1 Current SPEX prototype communication scheme. A central server is used for sharing of patient data.

Alternative SPEX Prototype

In the alternative SPEX prototype instead of uploading files to a central server they are transferred directly from the doctors PCs at the Point of Care to the centers of excellence. This eliminates complexity from the system making it easier to quickly set up an easy to learn "drag and drop"-file sharing system. New locations using the SPEX prototype would not have to go though the process of setting up a server for file sharing. This solution would also be cheaper to implement.

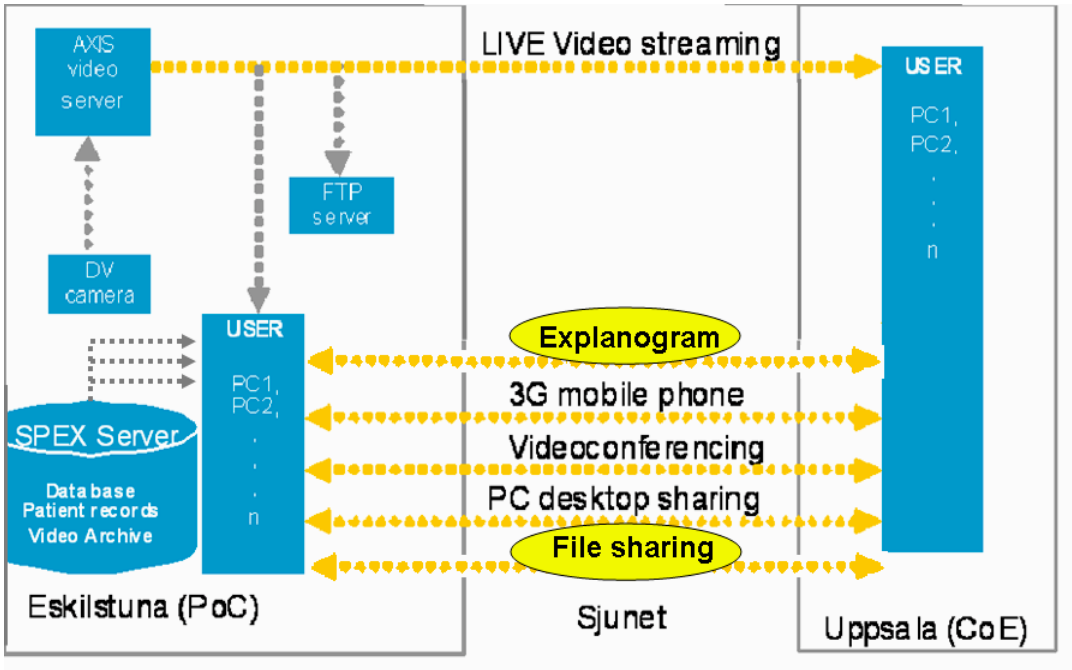

Figure 6.2 An alternative SPEX prototype communication scheme. Here the central server is moved inside of the PoC and the sharing of patient data is directly user to user.

Collaboration tool

The collaboration tool we choose to use to demonstrate an improved SPEX model is the off the shelf Groove Networks program called Groove Office. The program was the easiest to learn and use. Its direct file sharing system and integrated application sharing tools were improvements over the current system. It is not a perfect program however and with future versions and competitors bound to improve on it with integration of video conferencing, and other features. It does however demonstrate that greater integration and simpler file sharing will make the SPEX model more viable. Several other off the shelf tools were experimented with and the tool by Groove was the best for this application. For the full collaboration software evaluation, see Appendix 4.

Differences from Old Prototype

- Faster and easier to use as it is integrated into a singel easy to use windows program.
- Stores and transfers videos, images, text, etc. instead of just a few file types.
- Previously separate features now integrated to make it easier to install, learn and use. Currently video conferencing is not integrated.
- No central server allows for easier and faster data transfer that sidesteps privacy issues involved with storing data off site.

File sharing

To share files, doctors can simply "drag and drop" the file they want to share onto a workspace. The file is automatically transferred onto the workspace of the doctor on the other side of the connection where they can simply click on the new file to view its contents. This is possible with all file types; audio, video, text and others.

Sketch tool

The sketch tool has the same capabilities as the "See & Share" program currently used in the SPEX prototype. It allows doctors on both sides of a connection to draw on an image at the same time. Both doctors can see what the other doctor is drawing in real time. The advantage over the previous system is that it is integrated with the file sharing, chat, and other tools. By increasing the integration of the software the system becomes easier to set up, learn, and use. Only one program has to be installed, learned, and used instead of several.

Cons to the new approach is that sketches still can not easily be saved and are not recorded in real time for future viewing. The shortcomings of this program will be addressed in the next major section that presents the Explanogram technique.

Future Features

There are further improvements to the current SPEX prototype that could be suggested:

- Adding indexes and using indexes in video clips
- Ability to save dynamic sketches
- Ability to save and index voice chats;
- Integrated video conferencing, as can be demonstrated with the newest version of Skype.
- Ability to easily mark important sections of videos inside the integrated environment.
- Ability to mark on 3D-images and video.

6.3 Explanograms

6.3.1 Background

Explanogram was developed at Uppsala University by Arnold Pears and associates in purpose of complementing existing educational resources for teaching computer science.

Explanogram is a new way of being able to save an explanation that was written on a sheet of paper together with a synchronised sound recording of what was discussed at the time. The explanation can then be saved as an animated online presentation that later can be played back in chronological order of creation of the written material. Using an Explanogram makes it possible to rewind, skip forward, and examine specific areas of an explanation.

Teachers can easily explain something using pen and paper during a lecture or an office hour consultation and simultaneously record the explanation which can be stored on the Explanogram homepage. The teacher could now refer to the homepage when a student needs an explanation instead of explaining the same thing over and over again.

6.3.2 The technology behind Explanogram

The technology behind Explanogram is rather simple. The only thing required is a special pen, and paper with a special pattern based on a technology by Anoto AB. The pattern that is printed on the paper consists of a grid of dots which has to be printed with carbon-ink due to the infrared spectrum that the digital pen operates in. With this pattern, the camera inside the pen easily can detect and locate its position on the paper. While writing, the pen stores the user's pen strokes and their positions on the paper. When writing is completed data is transmitted from the pen to a web server by marking a send box on the sheet of paper. The transmission of the information is either sent through a computer with a USB cable or through a telephone with Bluetooth.

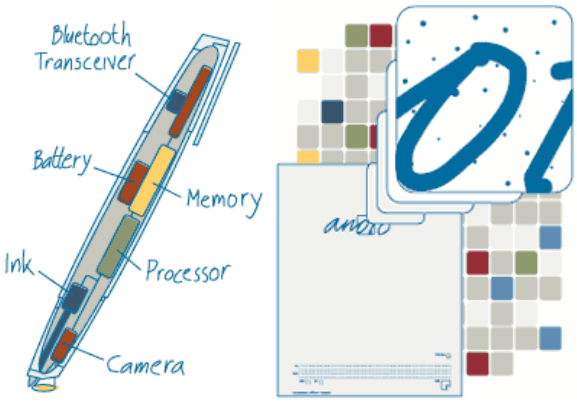

Figure 6.3 The Anoto pen and the Anoto paper.

Information is then automatically forwarded to a Paper Lookup Server at Anoto AB where the pattern on the paper is recognized and sent to the right destination, e.g. a database on a server at Uppsala University. A user can now through a web browser easily get hold of the Explanogram and replay it.

The beauty of an Explanogram is that it not only shows you the final image, but it shows you the process by which that image was created. This dynamic drawing makes it very useful in showing a process and is something that is very useful.

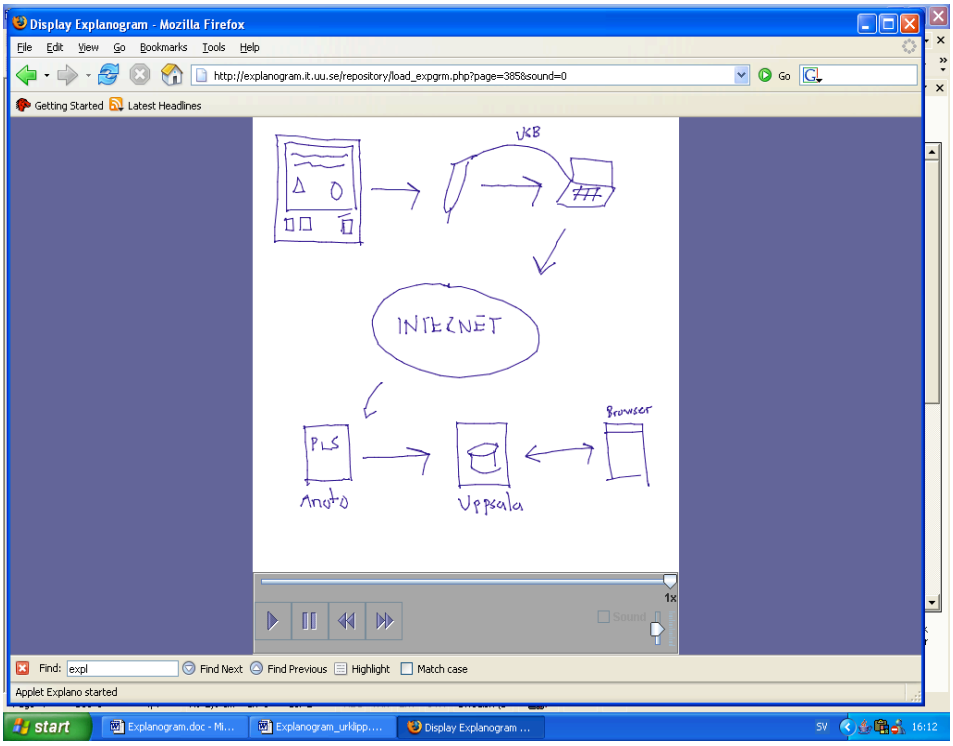

Figure 6.4 The Explanogram shown in a browser.

6.3.3 How can Explanogram be used in healthcare?

Explanograms could be used in healthcare in two different areas, in telemedicine and for teaching medical students.

Today the doctors involved in SPEX have expressed a lack of function of saving the explanations of a procedure from the Centre of Excellence (CoE). Explanograms could be used as a complement in the project to the already existing technologies. With this technology the doctor at CoE could draw directly on an image with the injury while explaining. The drawing on the picture together with the sound could then be saved and uploaded in a database and reached by the doctor at the Point of Care. This database could be used as a complement in tele counseling or as a reference for later use if a similar case shows up. Additionally, these saved Explanograms could then be referenced when the doctor goes to perform a surgery on the person from which they were created.

Unfortunately, the way Explanograms are designed, it would be time-consuming to use them in a real-time consultation.

Figure 6.5 Explanogram demo

6.3.4 Improving adding sound and pictures

Today it is difficult to synchronize sound and pictures with an Explanogram if you do not have a technical background. An easy application at the homepage for adding sound and pictures would make it easier to use it, instead of putting the sound and picture file through a terminal in the right directory as the Explanogram. This could be aided by a better user interface.

Additionally, it would be much easier if a digital pen were developed that incorporated sound recording into it. This could easily be done by adding a microphone to the pen. Unfortunately, this is something that we have no control over because we are not the manufacturer of the pens.

Another obstacle is that in order to write on a picture, you have to print the picture on the special paper with an ink printer. Additionally, the possibility of printing the Explanogram paper on an overhead project sheet, and then putting that overtop of the image would also allow the use of a background image. This too is not efficient though. Ideally, you would be able to combine background image with the Explanogram paper.

6.4 Marratech

Marratech is a tool for web based meetings (e-meetings). An e-meeting is a special environment, available via internet, which provides possibilities to transfer speech, images, communication through text, availability to share documents and be visible to the other

participants in the meeting. It works just like a telephone conference but with image and text included. In order to use Marratech, a server is needed in the network and a client has to bee installed on the computer. The user also has to have a microphone and headphones or a speaker and preferably also a web camera (USB-camera). Marratech is currently used for meetings in research and development projects, as a way for supervisors to provide instructions for doctoral students while away and as a complementary way of communicating with students taking distance tuition.

A Marratech server is already installed within Sjunet and a client is available to download from Marratechs web page. The problem however is that the firewall on the computer, and possibly at the hospital, has to bee disabled in order to make the program work, something that is too uncertain to try at a hospital. If the technology was allowed, or the problems could be solved Marratech could replace See & Share with an interactive platform that allows recordable consultations from the doctor's home computer.

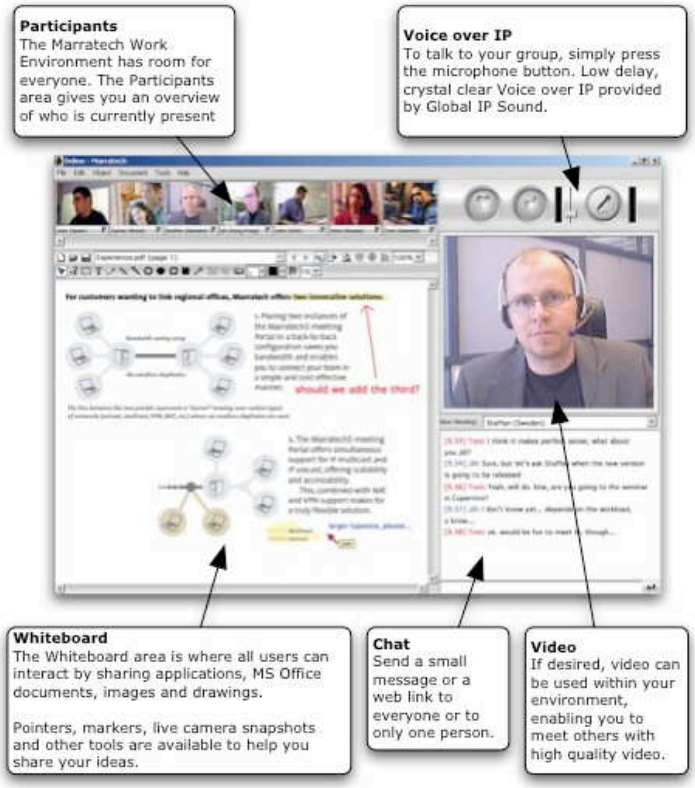

Figure 6.6 A picture of Marratech with explanations.

7 Summary and Conclusions

The objective of the STEVE project was to give an outside, independent view of the EU-funded telemedicine project, SPEX. We aimed at being capable of giving an objective view on the SPEX project that might inspire later telemedicine projects in the same area as the SPEX project.

The objective of the SPEX project is to market validate an organizational/business model for spreading specialist healthcare knowledge using information and communication technology.

In our outside view of SPEX we decided to analyze aspects we found had an impact on telemedicine in general. We therefore chose to analyze areas of impact of technology, quality of care and economic impacts.

When a treatment is changed to be performed with telemedicine, it involves an implementation of new technologies that doctors need to use to perform their job. We therefore decided to analyze technologies that are being used in SPEX, and doctors' impressions of working with these technologies. This helped us getting an understanding of health care professionals and their way of working. As patient and treating doctor are no longer in physical contact, it is of great importance to analyze patient experience of the new treatment method, and thereby the patient satisfaction. At last we chose to look at what is needed to make a telemedicine project run and be economically beneficial for all involved parts. We therefore decided to perform an economic analysis where we looked at both economic perspectives together with social aspects.

7.1 Technologies

The technologies that it was chosen to use in SPEX in order to be able to provide tele-consultation and tele counseling were analyzed regarding getting an impression of how usable the different technologies are in the treatment of a patient. The concerned technologies are as follows: Shared patient records, video streaming, videoconferences, shared desktops, 3G mobile phones and IP-telephony.

Regarding shared patient records we found that shared patient records together with e-mails provided a sufficient amount of information even though communication was asynchronous.

The advantage of using video streaming turned out to be the visual impression doctors had when examining doctors for example pressed the wound. A shortcoming of this method was that doctors, nurses and patients had to be present at the same time, which turned out to be a practical problem when arranging a consulting time.

A positive aspect of videoconferencing was that several doctors can take part in the same conference meeting and help assess a patient. 3G mobile phones turned out to have too poor picture quality, and was therefore not widely used in SPEX. It was only used in situations where doctors at the PoC needed a fast answer from the CoE.

7.2 Quality of care

When evaluating a telemedicine project it is important to look at the patient level of satisfaction with the treatment. This is especially important as ordinary treatment with face-to-face communication is substituted by a technology that mediates communication. As

communication is not any longer direct, we found it of great importance to analyze consequences by evaluating both patient satisfaction, and patient perception of the patient-doctor communication together with the doctor's perception of the quality of the treatment.

To get a measure of quality of care, it was chosen to use questionnaires, both for doctors and patients. The questionnaires were based on an evaluation of how treatment was in the context of SPEX. The greatest advantage, according to the questionnaire, is that patients have the possibility to get treatment closer to their home. It was further found that patients felt they took part in the treatment due to good communication between themselves and the doctors.

The questionnaire indicates that patients were satisfied with quality of care, and felt they had received an optimal treatment. The doctors felt that they had provided quality of care that was sufficient. This is a positive aspect of SPEX, as both the patient and the doctor find the treatment sufficient.

7.3 Economic aspects

When looking at economic perspectives of SPEX, we decided to evaluate the economic situation by performing a socio-economic analysis, where we took both economic costs and impacts of technologies in society into consideration. By performing a cost effectiveness analysis, it was possible to either calculate the price of switching from one technology to another, or to state that the new technology should be implemented without further analysis, due to cost of new technology being lower and due to new technology being more effective. To evaluate costs against patient satisfaction of treatment we chose to perform a cost utility analysis. By use of questionnaire and established health utility index we measured patient satisfaction and found that patients improved their health state compared to their health state before treatment with SPEX.

7.4 Future perspectives

Doctors indicated a lack of being able to save explanations during a session between the PoC and the CoE. In this relation it was chosen to analyze whether the *Explanogram* could be a support for that problem together with existing technologies e.g. tele counseling.

A further expansion of SPEX could be to other areas of medicine, for example in the field of dermatology, peephole surgery, stroboscopic examinations, ultrasound and other real-time examinations.

To ensure that SPEX could run in the future, when funding from the EU commission ends, it is relevant to have a reasonable model for reimbursement. The model should ensure that none of the involved parts will have the majority of costs, and none will benefit economically on the business concept.

Such a model is necessary in order to promote development of SPEX, but also telemedicine projects in general.

Several reimbursement models have been discussed in the SPEX project, but none was yet found to be sufficient.

Acknowledgments

We wish to acknowledge and express our appreciation to the many people who contributed to the outcome of this report and the three reports for the European Commission. We would especially like to thank Benny Eklund, Charlotta Lindberg, Leif Lyttkens, Åsa Cajander, Mats Daniels, Inger Boivie, John Oates, Dr Bengt Gerdén, Dr Morten Kildal, Dr Peter Gustafsson, Mats Forsberg, Erik Fridén, Mats Sjöquist, Albert Alonzo, Viviana Biagioli, Mayte Hurtado and Maya Wuensche.

References

Documentation

SPEX, Technical Annex

Albert Alonso, Lorenzo Cammelli, Benny Eklund, SPreading Excellence in Health Care, Deliverable D3.1, User Needs version 2.0, SPEX, 3rd February 2005.

Market Validation and Support Action Review Report (MPRR), eTEN, Project Review Guidelines and Forms - Annex I, January/February 2005.

SPEX Deliverable D3.2 Prototype Functional Specification. David Menasci. p 21-22

SPEX brochure, Fridén et al p.1-2

Göran Karlsson, Uppsala nya tidning (9 december, 2005)

Medicinsk Teknologivurdering, Statens Institut for Medicinsk Teknologivurdering, Sundhedsstyrelsen, ISBN: 8790951034, 2000. (for intro of socioeconomic models)

Primer on Cost-Effectiveness Analysis" Effective Clinical Practice, September/October 2000. 5:253-255. (for description of cost effectiveness analysis)

Beräkning kostnader Akademiske. SPEX unofficial document. (for calculation of CE ratio)

Dexter, Franklin, Application of Cost-Utility and Quality-adjusted Life Years Analysis Monitored Anestesia care for sedation only. Journal of Clinical Aenestesia, 8:286-288, Elsevier, 1996. (for intro of cost utility analysis)

Ingolf Griebsch, Joanna Coast, and Jackie Brown, Quality-Adjusted Life-Years Lack Quality in Pediatric Care: A Critical Review of Published Cost-Utility Studies in Child Health, Pediatrics Vol. 115 No. 5, May 2005. (for intro of cost utility analysis)

John Horsman, William Furlong, David Feeny, and George Torrance, The Health Utilities Index: Concepts, measurement properties and applications, Health and Quality of Life Outcomes, 2003, 1. (for the description of the HUI)

Nord, E., The QALY – a measure of social value rather than individual utility?, Health Econ, 3-89-93, 1994. (shortcomings of the cost utility analysis)

Hyperlinks

Akademiska Sjukhuset, http://www.akademiska.se, last accessed: 21th September 2005.

Universitets Sjukhuset Örebro, http://www.orebroll.se/uso/pagewide14187.aspx , last accessed: 16th September 2005.

http://www.carelink.se/files/doc_2005629161019.pdf

http://explanogram.it.uu.se/

http://www.learninglab.uu.se/svenska/forlarare/index.jsp

Interviews

Mats Forsberg, SYSteam, Uppsala 05-10-07
Erik Fridén, Medical technician, Eskilstuna 05-10-25
Peter Gustafsson, Surgeon at Mälarsjukhuet, Eskilstuna 05-10-25
Morten Kildal, Surgeon at Uppsala hospital, Uppsala 05-10-28
Bengt Gerdén, Senior physician at Uppsala hospital, Uppsala 05-12-06
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Appendix 1: Trial evaluation report

eTEN – eHealth Programme

SPEX

SPreading EXcellence in healthcare

(Contract No 510866)

Document D7.3

Trial Evaluation Report

Version 0.5

Work Package:	WP7
Version & Date:	v0.5 / 13th December 2005.
Deliverable type:	Report
Distribution Status:	Confidential
Author:	Erik Bråvander, Andreas Kjellgren, Peter Gustafsson, Benny Eklund
Reviewed by:	John Oates
Approved by:	Marco d'Angelantonio
Filename:	SPEX D7.3 v0.5 Trial Evaluation Report.doc

Abstract

This document etc etc.

Key Word List

Standards

Executive Summary

Change History

Version History:

0.1	8th November 2005	Initial Version
0.2	24th November 2005	First draft
0.3	12th December 2005	Second draft
0.4	13th December 2005	Swedish draft completed
0.5	13th December 2005	Final revision before circulation to Spain and Italy

Version Changes

0.1 Table of Contents
0.2 Table of Contents, Chapter 2.3, 3.3, 4.3 and 6.3
0.3 Chapter 1, 5.3, 6.3.4, 7.3
0.4 Minor changes following review by QM
0.5 Minor changes following review by LoL and BE
0.6

Outstanding Issues

The executive summary – one for each pilot or one for the entire document?

Table of Contents

Introduction

Document D7.3 covers a late phase of the SPEX project timeline. It summarises and evaluates the field trials of the prototype that have taken place in the three pilot sites. It is thus part of WP7 "Field Trials", which is aimed at testing the SPEX system with real-life users and evaluating their acceptance and satisfaction of the concept. This document covers tasks 7.1, 7.2 and 7.3, which correspond to the field trials in Italy, Spain and Sweden respectively.

Purpose of This Document

This document gives a picture of how the prototype and the field trials have evolved, how the system works and how it has been used, what lessons have been learned and what changes these lessons have implied.

To achieve this, the document takes as input other project deliverables (i.e. D3.1 "User Needs" and D3.2 "Prototype Functional Specification"), questionnaires answered by participating healthcare professionals and interviews with both participating healthcare professionals and technical partners.

The document is structured so that each pilot site gives their view on a number of relevant topics, including:

- SPEX System Testing
- User Training
- Real-Life Use of the Prototype
- User Feedback Collection

The contents of this document are to be considered a direct input to WP2 "Impact Assessment and Business Plan", which will allow the SPEX Consortium to move from a theoretical business plan at the beginning of the Market Validation phase to a business plan based on the experience gathered from the field trials.

Glossary

PoC	Point of Care
CoE	Centre of Excellence
CCU	County Council of Uppsala
ESH	Eskilstuna Hospital

DV camera	Digital Video camera
Quickplace	An electronic shared workspace to support a task, project or initiative.
Skype	Program for making free calls over the Internet
Sjunet	A national broadband communication network in Sweden

SPEX System Testing

Italian Pilot Site

Spanish Pilot Site

Swedish Pilot Site

This section focuses on the technical solution used in the Swedish pilot site. Issues that are addressed include the ideas behind the solution, what the resulting system looks like and what technical problems the project has run into.

System development

To provide the services (teleconsultation, e-learning) that are the foundation of the SPEX project, the Centres of Excellence need to be able to communicate with the Points of Care through a high speed IP network.

In Sweden, a network of the required type was already in use before the SPEX project started. It is called Sjunet, and it connects hospitals with each other and with county councils, private providers of Care, pharmacies and suppliers. Thus, in Sweden, all SPEX communication and data transfer takes place on Sjunet.

The general idea behind the technical solution in the Swedish pilot site was that the system should be:

- Mobile and flexible.
- Usable and require little technical support.
- Consisting of consumer electronics and “off the shelf” technology.

An initial evaluation of the functional demands that doctors had on the system showed that tools were needed for sharing information about patients between the PoC and the CoE, as well as the ability to send video images from the PoC to the CoE.

The first version of the system consisted of a shared online information depot for pictures and patient records, and a videoconference system. However, due to low resolution and poor image quality, the videoconference system was not able to convey useful information about specific wounds from the PoC to the CoE. The system was therefore completed with a proper DV-camera and a video server from AXIS, allowing streaming video of high quality.

After a request from the doctors, a software solution for shared desktops called "See & Share" was added to the system in a late phase. This allows users to make illustrative drawings on a joint screen image and thus enhances the explanatory possibilities within the system. Another feature that was also introduced by the doctors is the use of video calls through 3G mobile phones. This is used in situations where the doctor at the PoC needs a fast answer from the CoE, and as a way of contacting each other outside of office hours. The video quality is of course reduced, but still deemed by the doctors to be good enough in many situations.

When Kyrgyzstan entered the project as the second PoC, the possibility for communicating through "Free calls over the Internet" using the program Skype was also introduced.

Very little development of technology has taken place in the Swedish pilot site. The role of the main technical partner, SYSteam, has instead been to explore what tools are commercially available, evaluate these and implement the tools chosen to be most suitable for solving the specific tasks.

Overall system architecture

As the above description of the development of the system shows, there are six primary tools that are used within the Swedish pilot site:

- Shared patient records. Gives the doctors access to synchronized information about each patient. Implemented as a secure web page using a Quickplace server and a Lotus Notes database.
- Videoconference calls. Allows for several doctors to discuss and assess a patient. Implemented using relatively simple software and a webcam mounted on the PC screen. Mostly used to allow the patient at the PoC to see the doctor at the CoE.
- Video streaming. The primary tool for conveying information about specific wounds from the PoC to the CoE. The set up includes a DV camera, video- and ftp servers.
- "See & Share" PC desktops. Commercially available software.
- Video calls using 3G mobile phones.
- Free calls over the Internet. Implemented by the use of Skype.

All voice communication between the doctors is done with an IP telephone. Other solutions, such as using the sound from the DV-camera, were also tried but the sound quality was not good enough.

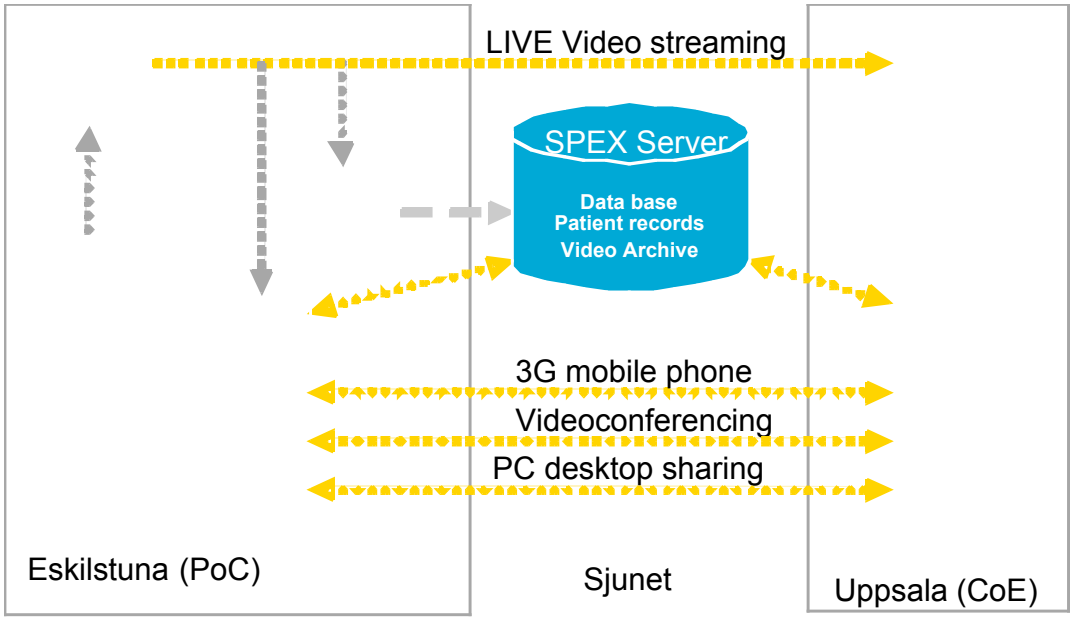

Figure 1 - A schematic view of the system

Figure 1 shows a schematic view of the system. Note that this does not apply for the second PoC, in Kyrgyzstan. The primary tools used in the communication between Kyrgyzstan and Uppsala are e-mail and voice over IP (Skype).

Figure 2 - The set-up at the PoC

Figure 2 shows how the system is set-up at the PoC. Basically it is an ordinary PC equipped with a webcam and suitable software (i.e. MS Word, MS Excel, See & Share) that is connected to a DV camera that sends streaming video to the CoE. There is also an IP

telephone with speakerphone features and some additional equipment for the AXIS video server. The set-up at the CoE is slightly different; there is no need for a DV camera for streaming video from the CoE to the PoC, and the CoE uses a headset rather than a speakerphone.

Problems encountered

Neither the users of the system nor the technical partners can identify any significant problems with the technical solution that occurred during the development. There are however a few smaller issues worth mentioning:

- The quality of the videoconference system was not sufficient for the user needs, as described above.
- Agreeing on a satisfactory level of quality for the video streaming solution that replaced the videoconference system took some time, and required testing of different hardware and software equipment.
- SYSteam had to make minor changes in the configuration and the user interface of the AXIS equipment for streaming video to make the tool more manageable for the doctors.
- The sound quality of the speakerphone used at the PoC was problematic. The examination rooms produced echoes that disturbed the communication with the CoE, and it took some time to find a suitable solution using an IP telephone.

Preconditions and dependencies

Neither the CoE nor the PoC used a digital system for medical records when the SPEX project started. This is why a temporary solution had to be created for the doctors to be able to share patient information. If such a digital system had been available it would have been a simpler and more comprehensive alternative to the custom-made solution that is an integral part of the system today.

The prototype used in the Swedish pilot site requires safe and fast data transactions. Sjunet supplied an adequate solution to these otherwise costly demands. The video-streaming solution would have been hard to implement without such an existing infrastructure and it is likely that the Swedish pilot site would have taken another direction had Sjunet not existed.

User Training

Italian Pilot Site

Spanish Pilot Site

Swedish Pilot Site

This chapter addresses how the technicians and users were involved in developing the systems, and how they learnt to use the different technical tools available.

General approach

As previously mentioned, before any technical tools were considered, the doctors identified a number of functional demands on the prototype. This procedure led to a better understanding from the doctors' side as to why certain tools are used.

When evaluating which tools fulfilled the functional demands, the degree of difficulty when learning to use a specific tool was regarded as most important, along with the price of the product in question. Whether the tools were specifically designed for use in healthcare was of less importance.

The extensive evaluation also allowed the technicians who were involved to gain a lot of knowledge about the tools and learn how to use them efficiently. This knowledge was then passed on to the users. Before the first patient session the doctors and nurses had time to learn the tools under guidance from the technicians. This was especially true for the video streaming tool.

There have also been similar arrangements continuously throughout the project, to inform the doctors and nurses about changes and improvements to the prototype. This ad-hoc form of teaching was used instead of creating a simulator or some sort of training system; the fact that not all tools were implemented at the same time made the learning easier.

An estimated three hours per user was spent on training before the prototype was tested in real situations with patients.

Learning to use the specific tools

Shared patient records

The temporary kind of solution that is used (see section 0) could have had negative implications on the usability of this tool, but it has not been any harder than the others to learn. However, the doctors and medical secretaries have experienced a few problems while using it, mostly related to it being too time-consuming.

See and Share

This is the tool that is considered to be the most efficient by the doctors. It is fast to start up and allows users to interact with each other in an easy manner. No long learning curve.

3G Mobile Phones

Use of 3G mobile phones was not included in the first version of the prototype, but added after initiatives from the doctors themselves. Thus the doctors already possessed the necessary knowledge for using the tool.

Free calls over the Internet

This technique is only used in the communications between the PoC in Kyrgyzstan and the CoE. It is considered easy to learn and use by the doctors.

The time to start up and begin using a tool is of course intended to be minimal. In most cases, what takes most time is to gather all the users that need to be present before the consultation can begin. The start-up times for the actual tools are comparatively short. To make the doctors use a specific tool it has also been important to minimise load times, a task which has been carried out successfully in the project.

The general technical knowledge amongst the participants in the project has been assessed to be slightly over the hospital average. The same goes for their attitude towards using new technical tools. This, and the fact that the users participated in SPEX by their own free will, most likely made the learning phase easier for the users.

Real Life Use of the Prototype

Italian Pilot Site

Spanish Pilot Site

Swedish Pilot Site

This chapter summarizes the number of patients who have been treated using the prototype solution and shows to what extent the different technological tools have been used.

Number of patients treated

In the Swedish pilot site, 59 patients have been treated using the prototype. 25 of them are from the PoC in Eskilstuna and 34 from the PoC in Kyrgyzstan. Some of these patients have been treated more than once, and more than one technical tool may have been used in each such session.

Use of the technical tools

Table 1 shows which tools have been used, by whom and how many times.

Table 1 - Use of technical tools

Tool	User(s)	Number of sessions
E-mail, shared records	Doctors, medical secretaries	44
Free calls over the Internet	Doctors	34
Streaming video	Doctors, nurses	12
3G mobile phones	Doctors	11
See and Share	Doctors	10

In addition to the information in Table 1, all sessions carried out at the PoC in Eskilstuna have used the custom-made solution for sharing patient records. This tool is not available at the PoC in Kyrgyzstan. The tools that are available in Kyrgyzstan are those that do not rely on the underlying infrastructure of Sjunet, which are e-mail, 3G mobile phones and Free calls over the Internet.

The task of input data to the shared patient records was transferred from the doctors to the medical secretaries at the respective wards, because it was too time-consuming. This is the only tool that does not demand that one person on each side work simultaneously.

Free calls over the Internet is the primary communication method between the PoC in Kyrgyzstan and the CoE. This, in combination with the fact that Kyrgyzstan has a relatively large number of patients, makes this tool the second most used in the pilot site.

Streaming video, used between the PoC in Eskilstuna and the CoE, has only been used in 12 sessions despite being the most powerful tool for conveying information about a specific wound. One reason might be that video streaming requires four persons to be available at the same time; one doctor and two nurses at the PoC and a doctor at the CoE. With more experience and training, it might be possible to reduce the number of nurses needed to one. This was also suggested by a participating nurse in one of the interviews conducted.

3G mobile phones have been used 11 times, proving that the suggestion from the doctors turned out to be valuable.

The special “See and Share” software has been used 10 times, mostly to prepare a doctor at the PoC before a consultation.

Comments

It is interesting to note that many of the “simpler” tools, such as e-mail, Free calls over the Internet and shared patient records, are the ones most commonly used. This could suggest that the doctors find it difficult to use the more complex tools or that practical and organisational reasons keep the use down. However, it could also mean that a lot of patients can receive proper care by the use of simple technological tools.

Indicator Measurement Collection

Italian Pilot Site

Spanish Pilot Site

Swedish Pilot Site

This chapter briefly summarises the most important indicators for measuring prototype performance that are identified in ID2.1 Economic Impact Indicator Definition and ID2.2 Quality of Care Impact Indicator Definition. These indicators are measured at the start and the end of the validation phase. For a complete record of the indicator measurements please refer to ID7.1 Indicator Measurement at Validation Start and ID7.2 Indicator Measurements at Validation End.

General network indicators

The status of the contractual relationship between the CoE and each PoC:

- Negotiations are being carried out between CCU and ESH for further cooperation when the SPEX project ends.
- The question of prolonging the cooperation with Kyrgyzstan will be raised with the Swedish Agency for International Development Cooperation (SIDA).

Clinical impact indicators

See chapter 4.3 of this document for detailed data on consultation volumes and nature.

CI2 - Profiles of care implementation during the project

There has been a continuous increase of clinical competence at the PoC. More structured clinical treatment rules have been adopted.

CI3 - Long distance clinical updating meeting implementation

The e-learning has taken place via lectures on the internet, not via web-conferences.

Technical function indicators

TF1 - Indicators to assess viability of implementation

All clinical referrals within the SPEX project are available in an electronic format. PC workstations are available in every visiting room at the PoC (ESH). Computer literacy is

regarded as high, since the computer is a tool that is used in the daily work at the hospital by the participating healthcare professionals.

TF2.3 - Advanced Clinical Service Indicators

Video streaming has been used in 14 sessions at ESH, and 3G mobile phones have been used in 11 sessions.

Economic balance indicators

See ID7.2 and D2.9 Business Plan.

Health system economic indicators

See ID7.2 and ID2.7 Quality of Care Impact Assessment.

User Feedback Collection

Italian Pilot Site

Spanish Pilot Site

Swedish Pilot Site

This is a summary of the technical evaluation of the Swedish pilot site. It is based on the questionnaires listed below, in which the participating physicians from the CoE (CCU) and the PoC (ESH) evaluate in detail the technological solutions that were used.

The three questionnaires addressed the following topics:

- Tele-consultation technical evaluation.
- Tele-consultation general benefits.
- Tele-consultation organisational aspects.

All questionnaires were answered by the physicians, Peter Gustafsson (ESH), Bengt Gerdin (CCU) and Morten Kildal (CCU).

Tele-consultation technical evaluation

This evaluation form is used to evaluate the physicians' point of view on the SPEX trials.

Data/protocol sharing

This area is evaluated with regard to three general issues:

- The design and the accuracy/completeness of the data collection.
- The process of adding new data.
- The process of retrieving data.

The overall picture seems to be that the design and accuracy of the data collection is acceptable, and the ways of retrieving data are good. The problem with data sharing lay with the process of adding new data. Two out of three physicians described the time to complete data entry as "very long". When asked about whether they had encountered any non-critical errors in the service, one physician commented: "Complicated to input data. This is too time consuming."

Biomedical images management

The evaluation reveals no apparent problems with the quality of the images and the rate of transfer. The quality and transfer rate are regarded as "good" or "very good".

Videoconference issues

The quality of video and audio are deemed "good" or "very good". The same applies for the frame rate (image continuity without "steps" in the image). However, one physician regarded the synchronisation of audio and video as a slight problem. Overall, though, the technical quality of the videoconference system used for tele-consultation services is regarded as high.

The usability also seems to be acceptable. The average time to start a tele-consultation is 2-5 minutes, and the system is almost always available and running. However, some problems have occurred, though rarely; one physician has encountered network problems and audio problems that have reduced the reliability of the service.

eLearning tool

Only two physicians have used this service, and no apparent problems are discovered in the evaluation.

Other comments

"Storage of video images must be improved."

Tele-consultation general benefits

This questionnaire is used to assess the physicians' point of view on the general benefits provided by tele-consultation and e-Learning services in SPEX trials.

Tele-consultation services

It is clear that the participating physicians think rather highly of the tele-consultation system. They all think the system meets their professional needs, is user friendly and makes their work easier. There is also consensus that the service decreases the patient stay time.

One comment, though, is that it is the patient that is the real winner and not the doctor from the CoE.

When asked what clinical tasks were improved, and how the quality of the treatment was affected by the use of tele-consultation services, the primary answers were these:

- More patients treated at the PoC.
- Early expert evaluation and a better basis for a good clinical decision.
- Earlier screening of patients.

All physicians thought they would use the services on a weekly basis, and also thought that the hospital would probably use it daily if only the services were properly implemented in the organisation.

e-Learning tool

The e-Learning tool does not get quite as high grades as the tele-consultation service, but there does not seem to be any direct problems with the usage.

The most important benefits are identified as follows:

- Better wound care in general; early identification of wound healing allows for more aggressive interventions.
- Improved knowledge among students, who get the chance to see more examples of problem wounds.
- Optimised contact between different healthcare providers.

Tele-consultation organizational aspects

This questionnaire is used to assess the physicians' point of view on the organisational aspects related to tele-consultation and e-Learning services in SPEX trials.

All physicians answered the question of how the tele-consultation and e-Learning services meet the organisational needs with either "very good" or "excellent". There were however some suggestions for improvement: "On the way in an interactive mode between CoE and PoC" and "Further development of 3G technology to computer".

When asked if the organisation is ready for the services, the only problem identified is the financial issues. The objective of the services is regarded as clear.

The values that the new services add are identified as fewer patient transports, faster consultations and improved educational aspects. "Optimised spreading of excellence, in order to allow for equal quality care irrespective of location of patient".

Additional comments from interviews

In addition to the questionnaires, interviews were carried out with participating doctors and nurses. The results from these interviews underline the problem with the shared patient records being too time-consuming. One comment was that it is the doctor's medical knowledge that should be used and that the technological tools are needed to support this.

The doctors also noticed a slight over-use of the video streaming tool at the beginning of the project. Now it is only used when needed; simpler technologies are enough in many situations.

An important general benefit that was identified is the new experience and knowledge that the doctor at the PoC has gained. Both the new medical knowledge and the experience of using new tools to treat patients are regarded as very positive.

Summary and Conclusions

Italian Pilot Site

Spanish Pilot Site

Swedish Pilot Site

Prototype general idea

The general idea when developing the prototype for the Swedish pilot site has been that the system should be easy to use for doctors and nurses and that it should require a minimum of servicing. The prototype thus consists of tools that require very little development, i.e. consumer electronics like an ordinary DV camera and software for sharing desktops. The task of the prototype is to make sure all functional specifications are fulfilled in as simple a manner as possible.

This approach seems to have been successful during the development of the prototype; neither the users of the system nor the technical partners can identify any significant problems when the technical solution was implemented.

Use of the prototype

When learning to use the prototype, the fact that it was the doctors themselves that identified the functional demands was a great advantage. In this way the doctors had an initial understanding as to why certain tools were used, which facilitated the learning process.

Judging by how little time was spent on practising, the goal of developing a system that is easy to use has most certainly been achieved. The users also seem to agree that all tools have been fairly easy to learn, the hardest being the tool for sharing patient records.

A total of 59 patients have been treated and the most commonly used tools are e-mail, shared patient records and Free calls over the Internet. It is interesting to note that these “simple” tools are often favoured over more powerful ones, like streaming video. This could suggest that either the doctors find it difficult to use the more complex tools, or that practical and

organisational reasons keep the use down. However, it could also mean that a lot of patients can receive proper care by the use of simple technological tools.

Problems encountered

No major problems have occurred that have obstructed the development of the system or rendered the system temporarily useless while running. During the development a few minor problems was identified and taken care of, but nothing out of the ordinary seems to have occurred.

The functionality of the prototype also seems to be fulfilled without any serious problems. The biggest problem with respect to functionality has been the sharing of patient data, which is too time-consuming and not user-friendly enough. This task has therefore been transferred from doctors to medical secretaries.

It is worth pointing out that the underlying infrastructure of Sjunet has been a prerequisite for the design of the Swedish prototype. Without the ability to send secure data at high speed, another approach probably would have had to have been adopted to fulfil the functional demands.

Results

The main goals of SPEX are to provide better healthcare to patients in the PoC, and to improve the knowledge and experience of the doctors at the PoC by granting them access to the CoE. Both of these goals seem to have been achieved. The patients are generally satisfied (see ID2.7 Quality of Care Impact Assessment) and the doctors feel that they have gained new competence.

Final comments

When taking all input into this document into account (i.e. interviews, questionnaires, and project deliverables) everything seems to point to the conclusion that the Swedish pilot site has made a successful evaluation of the SPEX prototype. The opinions of the users and the patients are coherent with the indicators that have selected for measuring in the areas of clinical impact, technical functionality and economic balance.

More treated patients and a higher overall use of the tools in the prototype would have been desirable for making conclusions with higher certainty, but there is no indication that the SPEX prototype has not been able to reach its goals.

Appendix 2: Quality of care

eTEN – eHealth Programme

SPEX

SPreading EXcellence in healthcare

(Contract No 510866)

Document ID2.7

Quality of care impact assessment

Version 1.4

Work Package:	WP2
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Abstract

The SPEX project has imposed changes to the chain of care and changes to how the patients are treated. This document aims to explain these changes and to show how the quality of care has improved during this project. Both the patients and the physicians have answered questions regarding the treatment in SPEX and how the use of telemedicine has improved the chain of care. This document will cover how the treatment was performed before SPEX and how this changed. To get the patients' view, each patient has answered a questionnaire. For the physicians' view, there are three questionnaires that have covered the users' assessment of SPEX and this information has been complemented with interviews.

Key Word List

Standards

Executive Summary

This document describes the quality of care and how SPEX have changed and enhanced the care provided at the involved hospitals.

Change History

Version History:

1.1	03 November 2005	Initial Version
1.3	12 December 2005	STEVE deliverance to CCU
1.4	13 December 2005	LoL and BE first revision

Version Changes

0.1 Table of Contents

Outstanding Issues

Executive Summary

Table of Contents

Introduction

Purpose of this document

The purpose of this document is to evaluate how the SPEX project has affected the healthcare in the three countries involved (Sweden, Spain and Italy). To evaluate the healthcare it has been of high importance to ask the patients and physicians what they think of the treatment in context of the SPEX project. This has mainly been done by questionnaires for both patients and physicians. The questionnaires have later been compared and conclusions from these have been drawn. The document also contains both how the healthcare was before and after the introduction of SPEX. Therefore this document includes two main parts, one about which clinical alternatives that was available before SPEX and one about which clinical alternatives SPEX has made possible. This chapter also looks into other things that the SPEX project has made possible. SPEX is different in the three countries. For example the project has been introduced in different fields of medicine among the countries. Therefore this document will discuss the three countries separately.

In the document the methodology is described, and the importance of having a well defined methodology when evaluating the quality of care. In both of the two chapters "methodology" and "Literature and experiences" methodologies and different evaluation factors are discussed. Both the possibilities and limitations when evaluating have been taken into consideration.

Limitations

In the time frame of the Project it will not be possible to compare clinical outcomes of the treated patients. The quality of care will have to be assessed through interviews with health professionals and questionnaires answered by participating doctors and patients.

The intention was to evaluate the perceived quality of care before and after the introduction of the SPEX services. However, the questionnaires have only been answered in the end of the trials and not before, hence there is no reference data to compare with. While no questionnaires have been done before the SPEX project initializing, the evaluation of quality of care will by all means be difficult. It should be kept in mind that there exist no approach for evaluation that is suitable for all cases and circumstances. Questionnaire in the way they have been used in SPEX is a methodology that is cost-effective and easy manageable.

There are a limited numbers of patients that have completed the questionnaires, hence the outcome is not fully representative and there are difficulties to draw statistical conclusions from these.

We do not have access to any information about the patient's perception and expectations of the care delivered regarding these patients. Hence the evaluation will not consider these aspects that might influence the perception of the care. The perception also affects positively if the patients feel that they are participating actively in the health care.

Glossary

Name	Description
CoE	Centre of Excellence
PoC	Point of Care
SIP	Sickness Impact Profile
PS-RESKVA	Patient Satisfaction, Results and Quality
Skype	Program for making free calls over the Internet
SIDA	Swedish Agency for International Development Cooperation
HSDPA	High Speed Downlink Packet Access

Methodology

The SPEX project aimed from the beginning for a methodology that should have been well suited for a research project where focus is on the statistical outcome. While SPEX utilities a telemedicine concept on three different CoE-PoC arrangements, in three different countries, it is not defined as a research project. Instead this project is a validation project, with the main goal of achieving spread of the excellence. Therefore is the common indicator strategy too rigorous and time consuming for this project.

The indicator strategy defined for both patients and doctors is described in ID.2.2. The idea for the patient assessment was to conduct a Sickness Impact Profile (SIP), at the initial state of SPEX. SIP is a behaviourally based, health status questionnaire that describes everyday activities in 12 different categories. Patients approve activities that describe themselves and are related to their health. Patient's satisfaction with the care provided, should then have been assessed after finalising their care within the SPEX system. This should have been done using a specially designed instrument, based on relevant questions extracted from the PS-RESKVA instrument, which is a validated instrument for assessment of patient satisfaction with care[i22].

The described outline for methodology has not been conducted in the frame of this project, as pointed out before this is a validation project where the primary goal is to achieve spreading of the excellence. Focusing on spreading knowledge and new types of communication using telemedicine tools does this.
The methodology used for evaluating quality of care has been conducted from five different questionnaires. Four of them designed for users, i.e. doctors and one for clients, i.e. patients.

User

User satisfaction has been assessed through completing open questions. These questions have been designed into questionnaires for evaluate the users' perception of SPEX. Four different questionnaires have been used, all developed and designed by TB-solutions in Spain.

- SPEX Services Evaluation Form in the technical domain
- SPEX Services Evaluation Form in the professional domain
- SPEX Services Evaluation Form in the organizational domain

[22] Sorlie T, Sexton H C, Busund R, Sorlie D. Int J Qual Health Care 12: 31-40, 2000

- SPEX Services Evaluation Form in the economical, ethical and legal domain

Two of these questionnaires will be evaluated within this report, SPEX Services Evaluation Form in the professional domain and SPEX Services Evaluation Form in the organizational domain. The doctors on both the CoE and on the PoC side have answered these questionnaires.

The information gained from the questionnaires has been complemented with interviews with the doctors. These interviews have been open ended and the doctors have been able explain their view of advantages and disadvantages with the project.

Patients

The questionnaire used for the patients consists of twelve questions. The questions have been designed from a "common sense" on what the projects quality of care should evaluate. The patients have been completing the questionnaire at the end of their treatment or up to a few months afterwards.

The questionnaire have only been asked to the patients that been treated during a video session, not where only pictures have been shared among the different doctors. This has been done by telephone interviews with a nurse from the PoC.

The result of the questionnaires has been analyzed to get an understanding of the patients' opinion of SPEX. No interviews has been conducted with the patients, however the interview with the doctors provided important insights of the attitude of the patients and how they experienced the telemedicine sessions in SPEX.

Literature and Experiences

Assessment of clinical impact with scientifically unequivocal means is difficult. This is something that all literature and experiences in this field agree upon. There is no methodology that suites all cases, one has to look for the individual case and then adapt the best methodology for the situation. Kept in mind should also be that the meaning of quality is diverse and influenced by a number of factors. Quality is not a predefined quantity that one can measure and easily compare to other results.

Many times the best adjustment to an evaluation is to use more than one method[23]. To have a mixed approach with more than one methodology limits the result from being biased. A mixed approach would of course be more time-consuming and the effort would be bigger but as well the result would be more reliable.

Irrespective of the approach taken, a key issue is that the chosen goals to be assessed must be well described and rather detailed, so that the evaluation results may be easily compared with the goals. Preferably, the goals should have a close connection to the evaluated system; in order to assure that positive evaluation results may be definitely attributed to the system. In the SPEX context, focus on goals such as effect on patient care is questionable because many other factors will influence such goals. Also to remember is that the SPEX projects main goal is not to show statistical outcome from the quality of care assessment.

Patient satisfaction regarding the quality of care is determined of a number of factors and strongly influenced by the quality of contact with the medical staff and nurses. Factors as interpersonal skills are highly likely to affect the outcome of the evaluation. The patient's satisfaction is also often strongly influenced with the expectations of care[24]. The patients treated in SPEX are much likely to be effected of their own expectations of the quality of care in SPEX. I.e. how much did they know about SPEX and the care delivered by SPEX before and how did they think about it before they went to the first session.

Patients are more likely to give a positive answer to the questions, if the feel that their care is being discussed fully and they are active patients. Hence, civil status an important factor, as well as the patients overall health condition can influence the perception.

[23] Burkle T. J Eval Clin Prac 7:373, 2001

[24] Sorlie T, Sexton H C, Busund R, Sorlie D. Predictors of satisfaction with surgical treatment. *Int J Qual Health Care* 2000, 12: 31-40

The chain of care – and it's complexity (How will SPEX influence the way doctors are working)

Clinical Alternatives Before SPEX

Italy

We have just given a brief summery of what the treatment looked like before SPEX. Since there was no information through questionnaires we did some interviews with the participating physicians. We added no information about the quality of care in this section.

Spain

We have just given a brief summery of what the treatment looked like before SPEX. Since there was no information through questionnaires we did some interviews with the participating physicians. We added no information about the quality of care in this section.

Sweden

The questionnaires evaluating the quality of care were not filled out before SPEX was introduced. Therefore it is difficult to make any conclusions about the situation before SPEX. To be able to give an overview of how the treatment worked, a couple of interviews have been performed with the physicians at both the CoE and the PoC. The interviews were constructed by a couple of students at Uppsala University.

Before SPEX, when the patients arrived at Eskilstuna, the PoC, there were a couple of different options of how to treat them. Either the physician decided to treat the patient himself at the PoC, or the patient got a referral to Uppsala, the CoE. The patient got referred if the physician considered the injuries to be too severe for treatment at the PoC. There are many patients that receive a referral to Uppsala and hence the patients might have to wait for a long period of time before a treatment is possible. The surgeon in Uppsala only has access to the information provided in the referral and this does usually not included any pictures of the

wounds. In some cases, once the surgeon in Uppsala sees the wound, the diagnosis could be made right away. If the patient received the treatment at the PoC, the treatment would take place without a second opinion from another physician. Another option for treating the patients at the PoC was to reschedule the patient to a time when a physician from the CoE came to the PoC for consultations. In this case a physician from the CoE would come to the PoC to help treating patients with a second opinion. The injury of the patients who were treated this way did not need the help from the CoE immediately.

Clinical Alternatives After SPEX

Italy

Here comes some information how we choose to write the part of the physicians' perception of the quality of care from the Swedish side.

First there is an introduction about which techniques the physicians work with and how it is to work in a project such as SPEX. Then there is a section that contains a short summary of the physicians' perception of the care provided within SPEX. We have described some trends that we have seen in the evaluations.

The next section describes some important "need to know" concerning the questionnaire and how it was performed.

We have then described more about the outcome of the questionnaires and information based on the interview with the physicians. We have included some of the questions from the evaluation and written more about result of these questions and how it could be explained. The areas that have been covered are:

- How the care has improved for the patients
- How the work has been improved for the physicians
- How SPEX has an impact on the organisation

Spain

Here comes some information how we choose to write the part of the physicians' perception of the quality of care from the Swedish side.

First there is an introduction about which techniques the physicians work with and how it is to work in a project such as SPEX. Then there is a section that contains a short summary of the physicians' perception of the care provided within SPEX. We have described some trends that we have seen in the evaluations.

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- How the care has improved for the patients
- How the work has been improved for the physicians
- How SPEX has an impact on the organisation

Sweden

Although the number of physicians participating in SPEX is low, it is possible to discern some trends from the answers. The questionnaires will together with interviews be used to make overall assumptions of the perceptions of the participating physicians.

The usage of SPEX has imposed changes to the chain of care and in many cases the patients can be treated faster than they could have before. The purpose of SPEX was as the name suggests to: spread excellence and in this sense the project is successful. With help from the techniques used in the project, the surgeon at the PoC has been able to treat patients at the PoC which earlier had to be sent to the CoE.

Some patients with severe injuries cannot be treated at the PoC and have to go to the CoE to get the right treatment. These patients could be hospitalized for a long period of time. With the methods used in SPEX it is possible for the patient to be discharge from CoE earlier. The patient will then rehabilitate at the PoC with help both from the physicians at PoC and the physicians from CoE. This follow up can easily be done through video conferences.

Some of the techniques used within the project have been very useful for the surgeons involved and hence these techniques have been frequently used. The physicians in Sweden are most content with the usage of shared desktop ("See and Share"). The See and Share makes it possible for the physician at the PoC to see the same desktop as on the computer that the physician at the CoE is using. The physician at the CoE can then consult by drawing on a digital picture and the physician at the PoC gets the same image on his or her computer screen. By printing this image into a file it can be uploaded to a database where physicians can see the pictures at any time. This enables them to use the time in a better way since both physicians do not have to be working at exactly the same time. In some cases it is useful for both the doctors to be present at the same time to discuss the patients. By using the See and Share and a phone, the surgeons can go through several patients and discuss the treatment in a much more efficient way then they could before.

Another important tool in SPEX was video conferencing. One disadvantage with this has been that the technicians had to be present during the session due to some technical difficulties. For some wounds it is essential to see the structure of the wound and to see how the tissue reacts when touched upon. In these cases, video conferencing is very helpful. Except from the advantages at the actual consulting moment, the big advantage from this, according to the physicians, is that the videos could be used for educational purposes later.

The physicians in the Swedish part of the SPEX project already knew each other from earlier collaborations, and the SPEX project has made the connections even stronger. Therefore, the collaboration between the physicians in the project has run really smoothly, and in the future these physicians will probably work even more closely to each other. The experienced gained from the collaboration can be very useful for larger groups of physicians working together and thereby tele-consulting can be used in a much larger community. Some physicians might have a problem with forced collaborations with physicians they do not know from earlier, both in the context of communication and in the context of hierarchy between the physicians. Therefore, to get a good collaboration in the future it is important that physicians

meet at conferences and building new networks for the future. Another method to make new connection is through the patients that have to come to Uppsala for treatment. Rehabilitation could then be done at the smaller hospital performed by the physicians at the smaller hospital. The physicians in Uppsala could then consult with the techniques used in SPEX and at the same time establish a personal contact to the physician at the PoC.

To be able to show the physicians' point of view regarding the benefits provided by the use of SPEX, the physicians have answered questionnaires. The physicians' opinions were captured in three different questionnaires,

- General benefits of SPEX
- Organisational benefits of SPEX
- Satisfaction questionnaire

The questionnaires have been filled out by both physicians in Uppsala, the CoE, and in Eskilstuna, the PoC. Areas that are covered in the questionnaires are how working with tele-medicine fits the organisational needs, if the quality of care given has improved and if the physicians feel that they provide better care and if it has facilitated the physicians work. To be able to give a wider view of how the physicians have experienced SPEX, interviews have been performed with the physicians at both the CoE and the PoC. All the physicians participating in SPEX in Sweden have worked within the same medical field and they have all used almost all of the technical solutions within SPEX.

The general impression from the physicians participating in SPEX is that they are overall satisfied with the treatment that is provided in SPEX. With SPEX, more patients can be treated at the PoC with the help of tele-medicine. This is of interest for both the patients and the physicians. Another positive aspect within SPEX is the impact on the organisation. SPEX helps starting a communication between different working groups and between the different hospitals.

The questionnaires were sent to the physicians by e-mail, answered and then again sent back to the administrators. If the questions would have been asked in person the outcome of the questioners would probably have been higher. All the physicians answered the questionnaires,

but the questions were fairly few and most of the questions were of type “multiple choice”. The questionnaires were answered at the middle of the summer 2005. No questionnaires were answered to evaluate the quality of care before SPEX. To be able to measure the difference, the physicians have through interviews been asked questions about the difference of quality of care before and after SPEX.

As mentioned before, all the participants were overall satisfied with SPEX. The physicians all agree that they are able to provide higher quality of care with SPEX. The three different areas where the improvements are most obvious are the patient’s quality of care, the knowledge gained by the physicians and the increased communication within the profession.

> A big part of the questions evaluate the use of different techniques. The different techniques work very well both for the physicians and the patients. An improvement would be to add techniques that have a more interactive mode between the physicians at the CoE and PoC. Also the user friendliness of the different tools used in SPEX, and the effect it has on the quality of care is evaluated. The global opinion on the SPEX services is that everyone is very satisfied. Another opinion is that the SPEX services improve the quality of the physicians’ knowledge significantly. More knowledge often leads to better care.

The physicians at the CoE agreed that the treatment in SPEX is more improved for the patients than it is for the physicians. The time that the patients spend in the hospital decreases with the help of SPEX. The decreased time that is spent in the hospital is due to different factors, early expert evaluation, early screening of patients and more treatment of patients at the PoC. The patients do not have to travel long distances to the get the care they need. More and better surgery at the PoC is also a result when working with SPEX. More patients get the opportunity of treatment at the PoC.

As written before, more patients get treated at the PoC then before. All this can happen because the physician at the PoC gets a second opinion from a physician at the CoE. Another reason why it is possible to treat more patients at the PoC is because the physicians gained more knowledge in the methods of treatment. This knowledge was gained throughout the time working in SPEX together with the physician at the CoE. The physicians’ impression is that

there is a two way communication where both the PoC and the CoE can exchange experience and knowledge.

Also the organisation can gain a lot when working with tele-medicine. It is of importance to have a good communication between both the employees at a specific hospital, but also between different hospitals. Better and more frequent communication often increase the exchange in knowledge between the physicians. Working in a project such as SPEX can help starting this communication. The physicians have the opinion that the collaboration between them will work better if they know each other before starting treating patients together. They also find it important that the initiative to start a project such as SPEX is taken by the physicians and not by employees higher up in the organisation. It can be hard for the organisation to accept certain changes that can occur when starting new ways or working. The physicians agree that new schedules have to be made for scheduling tele-consultations when working with tele-medicine.

Kyrgyzstan

The majority of the patients participating in SPEX have been treated in Kyrgyzstan, with Kyrgyzstan as the PoC and Uppsala as the CoE. Kyrgyzstan was added as a PoC in SPEX later than the PoC Eskilstuna. In Kyrgyzstan the need for consulting is very high because of the high amount of patients. The physician at the CoE and the physician at the PoC knew each other since before SPEX started. This is also a reason why Kyrgyzstan became a part of the SPEX project. The communication between the two countries has so far been made with e-mail and free calls over the Internet through the program Skype. Since no questionnaires have been filled out by the physician in Kyrgyzstan it is hard to evaluate the quality of care. The questionnaires have not been filled out due to lack of time. Conclusions have been drawn from interviews indicating that the number of patients that have been provided care has increased. Another conclusion is that the quality of care has been improved. In addition, improvement in the communication between the physicians at the CoE and the PoC was established. Since the knowledge at the PoC is high, the communication between the two physicians has been of great interest even for the physician at the CoE.

After the SPEX project, Kyrgyzstan still need help with the treatment of their patients, but how it should be funded will be a problem. An organisation like SIDA could maybe be one way to solve this problem since the hospitals in Kyrgyzstan are very poor.

The result from the patient's perspective (Patient's assessment).

All patients participating in a telemedicine session within SPEX have been asked to fill out a questionnaire in order to evaluate the care provided within SPEX. The areas covered in the questionnaires are how the patients experienced being treated with telemedicine at PoC instead of being transported to CoE, how they perceived the care provided, how they assessed the attitude of the participating medical staff and how the experienced the issue with integrity.

Limitations

It is not a sufficient number of patients have completed the questionnaires; hence, it is hard to make any statistically conclusions from the result. The questionnaires will be used to make overall assumptions of the general perception of the patients.

The patients have only answered these questionnaires at the end of the treatment and no evaluation was done before these patients were introduced to SPEX. This makes it more difficult to make any kind of conclusions, since we do not have access to any reference data.

There was no available information of the overall health condition of the patients before the treatment within the SPEX project. The overall health status of a patient might influence how they perceive the care and hence the result of the questionnaires.

Italy

Here comes some information how we choose to write the part of the patients' perception of the quality of care from the Swedish side.

The first section is a short summary of the patients' perception of the care provided within SPEX. We have described some trends that we have seen in the evaluations.

The next section describes some important "need to know" concerning the questionnaire and how it was performed.

We have then described more about the outcome of the questionnaires and information based on the interview with the doctors. We have included some of the questions from the evaluation and written more about result of these questions and how it could be explained. The areas that have been covered are:

- How the patients perceive the care provided during the SPEX session and how they feel about communicating with a doctor over the phone or over a videoconference.

- How the patients perceive telemedicine session and how they feel concerning their integrity.
- How the chain of care have changed with SPEX and how the patients gain from this.
- how the patients assess the medical staff during this session

We have also included the questions where several patients have answered “do not know” and we have tried to explain the cause of this.

Spain

Here comes some information how we choose to write the part of the patients’ perception of the quality of care from the Swedish side.

The first section is a short summary of the patients’ perception of the care provided within SPEX. We have described some trends that we have seen in the evaluations.

The next section describes some important “need to know” concerning the questionnaire and how it was performed.

We have then described more about the outcome of the questionnaires and information based on the interview with the doctors. We have included some of the questions from the evaluation and written more about result of these questions and how it could be explained. The areas that have been covered are:

- How the patients perceive the care provided during the SPEX session and how they feel about communicating with a doctor over the phone or over a videoconference.
- How the patients perceive telemedicine session and how they feel concerning their integrity.
- How the chain of care have changed with SPEX and how the patients gain from this.
- how the patients assess the medical staff during this session

We have also included the questions where several patients have answered “do not know” and we have tried to explain the cause of this.

Sweden

Although the numbers of respondents are not very high, it is possible to discern some trends from the questionnaires. The general impression is that the patients are overall content with the treatment provided in SPEX. The patients have been overall content with the attitude of the staff that was taking care of them. One of the purposes of SPEX is to spread health care in the sparsely populated areas of the country and to provide specialized care at the local PoC. From the answers provided in the questionnaires, the patients very much appreciated being treated at the local hospital instead of being transported to the CoE. There is no available information whether the participating patients have been participating in any other

telemedicine project prior to this. However, most of the patients felt very content with outcome of the telemedicine session and they would recommend the service provided in SPEX to others.

The questionnaires were conducted over the phone in October 2005 by the nurse who participated in the SPEX session together with the surgeons. Some of the patients were out of the country during this time, hence the questionnaire was sent by mail to these patients. Since some time had passed since the treatment, some patients needed an explanation of SPEX before answering the questions.

The nurse who conducted the evaluation had met all of the patients during the SPEX session, and some of them at a previous occasion as well. This could have affected the result of since the patients have been dependent on this nurse during the treatment. However, the evaluation took place in October 2005 and for some of the patients this was a long period of time after the treatment took place. The nurse did not explain that she had participated in the treatment and some of the patients might not have recognized her. It would have been preferable if the evaluation was performed by a person who did not have any prior relation to the patients in order to get an independent view of the project.

As mentioned above, a majority of the respondents were very content with the fact that they were treated at the Eskilstuna Hospital instead of going to Uppsala University Hospital. All patients participating in SPEX still had the option of going to the centre of excellence to receive the care. However, none of the patients in the project choose to do so. The patients perceived the quality of the care received at PoC as very good, which is a good outcome of a very important aspect of this project.

In some areas within health care, telemedicine could save both costs and time however there are not many hospitals that provides this kind of care today. Telemedicine is more frequently used within the primary health care than at the hospitals. For most of the patients if not for all, this was the first time they were being treated with telemedicine. A majority of the participating patients were very content being treated with telemedicine, and they answered very good or excellent to the question “How would you assess being treated with telemedicine services”.

The legislation within health care is very strict since the information regarding the patient and their medical condition is information with many privacy aspects. In the telemedicine session, information concerning the patients is being shared among the two hospitals. It is very important that this information is not accessible by any unauthorized person. It is also very important that the patients feel comfortable with the situation where they are being recorded by a video camera. One central factor within the Swedish health care is the questions concerning privacy. A majority of the patients responded that they felt excellent or very good concerning their privacy during the SPEX session.

One thing that is very important that contributes to the patients’ well being, is their ability to actively participate in the treatment and to understand what the physicians are talking about. In the first pilot in Sweden between the CoE and the PoC in Eskilstuna, the physicians were using a ordinary phone, where

only the physicians at the two hospitals could communicate. Since this negatively affected the patients' ability to hear and to communicate with the physicians at the CoE, a speaker phone was used instead.

On the question "How was you experience talking to a physician only by telephone and video several of the respondents answered "Do not know". However, some comments are given that they did appreciate to hear the opinion of the other physicians. The second consultant made the patients feel safer and more secure. One reason to that several of the patients answered: "don't know" to this question could be that the evaluation was done a long time after the session and that the patients were not sure what to answer. The physicians' perception is that the patients didn't apprehend the situation as their doctor asking another doctor for advice. They considered the video conference as a second opinion from an expert, complementing the opinion of the physicians at the PoC.

Another positive outcome was that the patients are content with the fast answers during the teleconference sessions. The decisions have been made fast, which have been very much appreciated by the patients. The way it worked before, the patients with complicated wounds gets a referral to the CoE. Some of these patients can now be treated at the PoC with consultation from CoE instead. Hence one step of the chain has disappeared and the patients in some cases get treatment much faster than they would have before. This is not only to a great advantage for the patients, but also for the health care system in general.

The patients with more complicated wounds that have to be treated at the CoE also have a lot to benefits from SPEX. These patients may be discharged from the CoE earlier than was possible before, and the continuous treatment takes place at the PoC. These patients are often hospitalised for a long period of time and it's beneficial if they can then receive adequate care closer to their home.

Kyrgyzstan

The biggest patient group for the Swedish CoE has been the patients from Kyrgyzstan. Due to language difficulties and time constraints, there are no available evaluations from these patients. Some of these patients have participated during the SPEX session however most of the session with Kyrgyzstan have only involved the two physicians. They have communicated using Free calls over the Internet and they have sent pictures via e-mail.

Many of the patients in Kyrgyzstan have severe injuries and the fast decisions that can be made using the techniques in SPEX are to a great advantage. In Kyrgyzstan they have very limited resources and many of the patients have been helped within this project. Since it has worked very well, the number of patients have increase significantly which could be seen as the service has worked very well. However, as mentioned above, there is no information available how the patients have perceived the treatment. There has not been any videoconference with Kyrgyzstan due to technical constraints, hence the patients have not actively participate nor been able to communicate with the surgeon in Sweden. The two surgeons in Sweden and Kyrgyzstan have communicated using English which most of the patients in Kyrgyzstan don't understand.

The Quality in SPEX

SPEX has been very helpful for the patients involved and it is thanks to the SPEX project that the patients have been treated more closely to where they live. The patients now have two physicians that have been involved in the treating instead of one, which was the case before SPEX. This has showed to be a positive aspect from the patient's point of view. In the cases where the patient still needs to go to the CoE due to severe injuries, thanks to SPEX the rehabilitation part could be done at the PoC, and that has been highly appreciated by the patients. The patients have also appreciated the good communication between them and the physicians and therefore felt as they have been actively participating in the treatment. Not only the patients have felt that the care has been of a high quality, also the physicians have felt that the delivered care has kept good quality.

The SPEX project has created new channels for networking, communications and collaboration. The physicians are more likely to work together after SPEX while they already know whom they are collaboration with and can trust them. The rehabilitation possibility, with help from the techniques used in SPEX, will bring different hospitals and staffs to work together and thereby increase the quality in more geographical areas.

The evaluation outcome from the three countries should be kept apart, while evaluation is strongly related to the environment where the evaluation took place. The differences between environments should be clearly lined out for the comparison. No conclusions regarding other countries should be taken from the evaluation from another country.

The patient's satisfaction is often strongly influenced with the expectations of care. The patients threaded in SPEX are much likely to be effected of their own expectations of the quality of care in SPEX. I.e. how much did they know of SPEX and the care delivered by SPEX before and how did they think about it before they went to the first session.

Appendix A – Swedish Forms