HOPE

Health Optimum
Project Evaluation

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Abstract

HOPE, Health Optimum Project Evaluation, will address the County Council of Uppsala's participation in the project and will also take a wider approach to Telemedicine in the departments and wards which are affected by Health Optimum. The report will address how the affected wards are dealing with Telemedicine today, what drawbacks and benefits applies to Telemedicine, and how use of the chosen technologies can be improved. Furthermore, the report will also discuss Telemedicine in Swedish health care on a general level. The Health Optimum project has run for several years and has aimed at improving health care through the use of new technology. Technology has been implemented at several different departments. The evaluation has been carried out by IT students from Uppsala University through interviews, field studies and participatory observations. The services addressed in this report are Tele-counselling, Virtual Referral, Tele-laboratory, Telecare and shared clinical records.

The Health Optimum project has introduced much new technology for hospitals participating in the project. However, with new technology comes new working procedures, and reorganisation of work. HO means several new routines at the hospitals which, during a transition period, might be slow and frustrating to users. However, after this transition period, the new technology will hopefully save a great amount of time and money.

So far, in many of the different departments, the number of available user opinions is limited due to the technology not being implemented yet. At several of the departments, there are still problems with the new technology, which make users dislike it. With work on these issues and proper education, hopefully users will become satisfied with the new technology.
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1 Introduction
For a long time health care in Sweden has used sophisticated technology to diagnose and treat patients. However, while the commercial and industrial world have accepted and taken advantage of the revolution within Information Technology to use tools that facilitate their main business, health care has been left behind and now has to work hard to catch up. Health Optimum is a multinational project approved and co-funded by the European Union. The project deals with Telemedicine and promotes the creation and use of telematic and transeuropean networks. One of the participants in the project is the County Council of Uppsala, Sweden.

1.1 Background
The purpose of the report is to evaluate the Health Optimum project in Uppsala and provide a foundation for an EU report.¹ This report is written as a part of a course named “IT in Society” at Uppsala University, Uppsala, Sweden in collaboration with a course named "Computing in a Global Society" at Rose-Hulman Institute of Technology, Indiana, USA. The report is written by sixteen Uppsala University students and three Rose-Hulman students. HOPE is the final delivery for this course. One purpose is to have the students work with a real environment that can have similarities to their future profession. Another purpose of this report is to give an outside view of the use of Telemedicine in health care.

1.2 Limitations
Telemedicine is a vast area, and Health Optimum is a large project.² This report deals with the County Council of Uppsala's participation in Health Optimum. The Telemedicine is only evaluated in relation to Swedish society. Collaborations with participants outside the Swedish borders have not been taken in consideration.

¹ Appendix M: The EU Report
² Health Optimum , <http://www.healthoptimum.info>, 2007-12-17
Moreover, most of the facts presented in this report reflect data gathered through interviews, field studies and participatory observations made during the fall of 2007. Hence, this report gives a description of the present state of use as well of the experience and opinions of the people interviewed.

Because of a limited amount of interviews this report will not be able to go thoroughly into some areas. Instead the coverage is a general view of the systems and all user dependant problems in some areas might not have been detected. Another limitation is that no large patient evaluations have been carried out, i.e. all patient opinions are taken from a small selection of patients. This is also the case with user opinions.

1.3 The Health Optimum Project

Health Optimum is a European Union project focused on introducing Telemedicine in member countries. There are five countries participating in the project: Italy, Denmark, Spain, Sweden and Romania. These five were chosen because they give a good representation of health care in the union as a whole. They will pioneer the implementation and deployment of Telemedicine in their health care system; if everything goes smoothly then deployment in the rest of the countries within the union should be possible with only minor adaptations necessary.

The services included in the Health Optimum project are Tele-counselling, Virtual Referral, Tele-laboratory, Telecare and shared clinical records. Tele-counselling is used to spread excellence by allowing experts to counsel General Practitioners, or in some cases other specialists, over long distances allowing them to deal with advance cases without having to transfer the patients to the Centre of Excellence (CoE). Tele-laboratory will give faster results and allow for better treatment in the patient’s own home. Normally when a test is to be done the sample needs to be sent to a clinical laboratory which takes resources in form of both time and equipment. With modern technology it is possible to perform basic tests and analyse them with a portable Tele-laboratory and the information is then transmitted to a central database. Telecare makes it possible for a doctor to remotely monitor a patient that suffers from an illness that requires regular monitoring, for example

3 Health Optimum, <http://www.healthoptimum.info>, 2007-12-17
diabetes patients. This means less regular checkups where the patient has to travel to the point of care while still maintaining high quality care. Shared Clinical Records ensure that doctors always have all the medical information of the patient, no matter where she is treated.

Implementation of these services could mean a higher quality of care and a more effective use of resources which are the goals of the Health Optimum project\(^4\). There have been other Telemedicine projects funded by the union, one of them called Spreading Excellence (SPEX) concerning Telemedicine in plastic surgery\(^5\).

\(^4\) EU Document WP1.3-01 – HEALTH OPTIMUM Initial Deployment.
\(^5\) STEVE Student Evaluation of Telemedicine, Uppsala University, 2006
2 Methodology

To obtain the information needed, mainly three different methods have been used. Firstly, interviews with people at the departments have been a very commonly used form for information gathering. Secondly, the Internet as well as other written documentation and reports have been used to gather information in general about different kinds of technology.

Interviews have been done in two different ways. Some interviews have been semi-structured where the interviewing group has prepared a few different topics that they want to discuss and then seen to that every topic is covered. Other interviews have been meetings where the interviewee has briefed the interviewers on a specific topic. During interviews notes were taken and some of the interviews were recorded. Quotations presented throughout this report have not been translated verbatim, but are free translations from Swedish into readable English. Moreover, the majority of the quotes are made anonymously. Sources that have been promised or wished to be anonymous will so be.
3 Views on Communication

Communication has always been an essential part of human life, and within certain fields of excellence, medicine being a major one of these, miscommunication can be fatal. In order to receive a functional Telemedicine solution you need to have some basic communication methods established.

There are several different methods that all have their respective pros and cons and they are suited for different uses. These are usually divided into two different categories: synchronous and asynchronous. For example, if you needed to convey large amounts of information before network communication using computers became common, you had to either fax it or use the postal service depending on the amount information that had to be sent. That could take anything from an hour to several days to arrive at its destination. Nowadays you can do the majority of these things over networks such as the Internet or Sjunet\(^6\), achieving the same results in a matter of seconds. Faxes and postal packages are examples of asynchronous communication methods that are now being largely replaced by new methods. Instead of faxing a document it is now possible to send it using e-mail and instead of sending x-ray pictures using the postal service you can now upload them digitally to whoever needs them.

Synchronous communication has also changed since the old days when it basically meant to go and talk to someone face-to-face or later by using the phone. One of the things that have changed during recent years is that it is now possible to have conversations over a video link. This saves a lot of money thanks to reduced travelling costs, while still keeping the face-to-face interaction.

Both of these are good components to use within most health care systems; asynchronous methods are excellent ways of conveying large amounts of information. However, it is not suited to be the only form of communication. In order to achieve quality it is therefore a good idea to use a mixture of asynchronous and synchronous methods, using asynchronous for large information transfers and synchronous for personal communication. Of course there are many parts of the Health Optimum

\(^6\) Carelink, *Sjunet - Kommunikationsnätet för vård och omsorg*, retrieved 04 December 2007

<http://www.carelink.se/tjanster/sjunet>
project that do not need to use both of these methods, instead settling with one of them. There are systems like Cosmic\textsuperscript{7}, which merely uses asynchronous communication as it is basically a database and booking system. Synchronous systems include video conferences.

\textsuperscript{7} Cambio Healthcare System, retrieved 04 December 2007, <http://www.cambio.se>
4 Technology in Health Care

Health care's main goal is to constantly provide better care for patients. To achieve the best care possible taking advantage of the ever evolving technology is beneficial.

With Cosmic being one of the corner stones, Swedish health care has a great foundation to improve the technology used. Cosmic will mean a fully digitalized environment with no paper referrals. In addition to Cosmic, there will also be a new Picture archiving and communication system (PACS). The PACS will offer an efficient way for all wards to save all their images. Both these systems will only affect the patients in an indirect way. The systems are merely tools for the staff at the hospitals but they will most likely increase efficiency and save a great deal of time.

What really affects the patients in a direct way though, are video conferences. Instead of sending patients to for example UUH, patients are treated at the local hospital with advice from UUH through video conferences. This save patients a lot of trouble going back and forth.

There are however, still problems with using the different systems. For example, the video conference room at UUH is only used by a few departments because of too time consuming relocations. A mobile ad-hoc solution has been made to solve this problem but a general solution would of course be preferred. With faster and faster Internet connections, as well as a growing wireless coverage, there should soon be a cost-efficient general solution to this problem.
5 Economy Aspects

In an interview with Chief Medical Officer Leif Lyttkens on the 14th of November 2007, Leif informed us in more detail how the economy is handled within the project. All statements hereafter are quotes or statements from Leif Lyttkens or taken from the county councils web page\(^8\) for pricing and billing.

5.1 Cost Responsibilities

All counties affected by Health Optimum (HO) have to manage their own budgets and spending as Centre of Excellence (CoE) at UUH does not help the other participants with their economy planning; however, Uppsala County Council (UCC) are involved with some funding as to help smaller hospitals with technology based investments. This, can for example, be that a Point of Care (PoC) is interested in participating in HO but lacks the resources because of tight budgets. UCC can then use some of the funding received from the European Union (EU) to buy the equipment needed at that PoC. This, of course, helps to evolve and expand the project to a better situation\(^9\).

5.2 Funds Division

The main part of the available funds accessible in the HO project comes from the participating counties. These funds are there to mainly cover costs of personnel and administrative tasks that according to one of the project leaders, Leif Lyttkens, are what require the most attention and resources. Since the majority of the technology used in the project is already implemented on site at UUH, most of the new equipment being bought is deployed at the smaller hospitals\(^10\).

Often projects who receive some external funding can decrease the time needed to complete the project\(^11\). This is also true within the HO project. When receiving funds from the EU, the projected time can be cut by approximately two to three years, Lyttkens states. This is a good thing since the


\(^{9}\) Interview, Lyttkens, Leif, Chief medical officer, Uppsala, 2007-11-14

\(^{10}\) Ibid

\(^{11}\) Ibid
county and the hospitals are more interested in rolling out the activities they perform in the daily activity rather than to keep doing projects over and over\textsuperscript{12}.

The funds from the European Union are however not supposed to be used as salaries or cover administrative tasks. That part is handled by the counties within their own budget. Furthermore, there are some rules that need to be bent. Since the administrative load in HO is very high, a dedicated coordinator is hired to handle all of the communication and paperwork needed for a smooth operation. This coordinator is paid for by the county council administrative office but use resources from the EU funding to cover those costs\textsuperscript{13}.

### 5.3 Internal Billing

The pricing of services that UCC and UUH are using comes from locally negotiated agreements over time between the involved parties, according to Leif Lyttkens and the UCC's internal web page for pricing of services\textsuperscript{14}. The specifics of the agreement can be viewed at the web page\textsuperscript{15}, which states that the main objective for the collaboration is to:

- Ensure the accessibility of highly specialised health care a continued positive evolution of health care by support for future projects within the region and its involved county councils.
- Support specific areas with regional organisations.

All other collaboration are encouraged but regulated in specific mutual agreements.

\textsuperscript{12} Interview, Lyttkens, Leif, Chief medical officer, Uppsala, 2007-11-14
\textsuperscript{13} Ibid
Highly specialised treatments are paid for by a patient specific billing list for the UUH, while the more common treatment and health care are paid for from the negotiated pricelist based on Diagnose Related Groups classifying patient care by relating common characteristics\(^\circ\).

When a patient is treated at another caretaker an invoice is generated. These invoices are then sent between each caretakers' economic department for proper processing and booking. An example of how an invoice between caretakers looks like is included in the appendix\(^\dagger\).

When a ward within the UUH are in the need for services of another ward at UUH, the usual referral system is used and thus the regular billing between the hospital's departments are handled in their own system. According to the web page, all costs for transportation of patients and personell are covered separatly from the earlier mentioned price lists.

5.4 EU’s Role

The European Union promotes cooperation between countries within the union. If a project includes at least three countries, the option to seek EU funding becomes available. In 2005 the SPEX (SPreadinG EXcelence) project started up as a small validation project for the larger upcoming Health Optimum (HO) project. As the SPEX project was high risk, the EU stated that they will cover 50% of the costs involved for the participants. The SPEX project was a success and the validation was therefore positively proven.\(^\ddagger\)

When deciding whether to move forward with an upgraded and extended project, a discussion if there exist a need to continue based on the benefit of the activity is held. The decision to move forward with HO was made after the successfully completion of SPEX. In HO the European Union stated that since the validation was performed so well for the SPEX project, there was no need to label HO as high risk. Therefore the funds granted


\(^{17}\) Appendix L: Internal Billing

\(^{18}\) Interview, Lyttkens, Leif, Chief medical officer, Uppsala, 2007-11-14
to the HO project this time became 28% of total costs. This is because the European Unions role in the project is to promote collaboration between countries, but not be funding participants\textsuperscript{19}.

When dealing with the an EU project, the participating doctors and researchers have proven to be eager to be involved when informed that this is a project spanning over many countries. Everyone seems to be interested in contributing to the advancement of medical care when there is the opportunity to enhance one's personal credibility in their field of expertise\textsuperscript{20}.

\textsuperscript{19} Interview, Lyttkens, Leif, Chief medical officer, Uppsala, 2007-11-14
\textsuperscript{20} Ibid
6 Future Expansion of Telemedicine

A nation wide use is needed for Telemedicine in health care to be as efficient as possible. Today Telemedicine is regarded as a helping hand, with a national wide use the Telemedicine would eventually become a natural part of the healthcare itself. Before this can become the reality we have to consider some aspects.

6.1 Considerations

6.1.1 Quality of Care

Telemedicine has several benefits for quality of care. The technology leads to patients getting specialist expertise sooner, as well as easier data handling. One example is the Tele-consultations between the Department of Dermatology at UUH and the Care Centre in Heby, where previous projects have shown that the time for a specialist diagnose can be shortened from one to three months to one week\(^2\). In these kinds of collaborations, knowledge will spread from the specialist towards the non-specialised doctor. In cases that demands a specialist to diagnose, this leads to earlier treatment for the patient, which is a benefit both for the economy and the quality of care. The expansion of Cosmics Medical Records provides easier data handling on a standardised platform.

Time-savings will also be possible thanks to the use of Telemedicine tools. If this benefits the patient directly depends on how health care deals with this new freed time. One scenario is that time saved is spent on treating more patients. This will shorten patient queues but treatment can stay the same. Another scenario is that the time saved is spent on the same patient. A few extra minutes per patient can make the patient feel better taken care of and the social interaction increases trust with their doctor. This is not applicable for every area in health care. The first of these two scenarios have a risk associated with it. The time saved can have been travelling time where the staff could reflect on a patient. An unbalanced, one-sided, removal of these moments take this reflection away.

\(^2\) Interview, specialist at the Department of Dermatology at UUH, 2007-11-12 16/11, Uppsala, Sweden; Interview, general practitionerat Årsta Care Centre, 2007-11-21, Uppsala, Sweden; Eriksson, Leif, Telemedicin HL-Hud, Uppsala County Council
from an already stressed doctor or nurse. This can have negative effects like stress and unfair assessments of how much time really has been saved by a Telemedicine tool.

6.1.2 Technology

New technology is developed rapidly. It may only take months or even weeks before more advanced and better technology enters the market. This leads to two contradicting conclusions. The first conclusion is that it might be unwise to be engaging into a technology race. Always adopting newer technology because it is better than the previous technology purchased, does not give any consistency for the staff and is unnecessarily expensive in education and other hidden costs. If the technology used today works well for the purpose, there is no need to adjust to newer technology unless it has a great benefit of doing so. The following conclusion is almost the exact opposite. A lenient approach towards new technology might make the technology expensive, if the used technology becomes outdated and the corporation in control of the technology has an outdated market and support and maintenance of software and hardware can suffer of stagnating development. Another aspect to keep in mind when dealing with large organisations is the importance of use of stable technology. New technology often has implementation problems; in an important and critical application as health care, such problems could be disastrous. Therefore stable technology can be the better choice even if there is more advanced products on the market.

The current system in Sweden, with public procurement regulations, makes transitions bureaucratic and new technology slow and inconvenient to implement.

6.1.3 Social Effects

New ways of communicating affects the social interaction between co-workers and patients. When communicating through Tele-technology, body language and other senses might be lost. This can be a new experience to individuals and a certain degree of resistance of new technology may be experienced.\(^{22}\) The resistance, can to some extent, be something cultural that will disappear when

more individuals get used to the technology. A higher percentage of the new generations of doctors and nurses will have a natural acceptance to the technology, simply because the technology has become a part of their everyday life and not only their workplace. They have grown up with it.

Another interesting aspect of the social interaction through technologies, is that because people don't have to take responsibility immediately for what they say, or don't have to deal with the atmosphere after a meeting. They can become more aggressive, daring or indifferent to a patient or fellow co-worker.\textsuperscript{23} This is most common with asynchronous ways of communicating. If this becomes a culture between co-workers the collaboration might suffer. This is still an area that needs research and it would be a good idea to have someone study the social aspects in more detail.

### 6.2 Expansion Scenarios

There are several considerations when the Telemedicine technology spreads within the whole country of Sweden. Three different scenarios of how the expansion could be managed and which advantages and disadvantages these have will be described.\textsuperscript{24} These three scenarios are extreme cases and the best solutions are most likely found when mixing the different scenarios.

#### 6.2.1 A Centralised Organisation

The concept with centralised organisations is to have a single decision making authority. This organisation could be a new government authority. The new authority should decide what kind of technology the hospitals in the country should use and how they should use it. The authority should also establish routines. The technical support for all the hospitals could be directed to a common support centre. This centre could also be responsible for the technology education for hospital staff. The authority would buy the technology centrally, which the client hospital could buy or rent.

\textsuperscript{23} Baruch, Yehuda, *Information and Management* Volume 4, Issue 2, 2005

\textsuperscript{24} Brousseau, Eric and Rallet, Alain, *Beyond Technological or Organisational Determinism: A Framework to Understand the Link Between Information Technologies and Organisational Changes*, <http://www.brousseau.info/pdf/1998_B_EBARTelSocEcDev.pdf>, 2007-12-17
This might seem totalitarian but it has its benefits. It is very easy for the hospitals to collaborate with other hospitals because the technology is compatible and they have the same routines. Since the authority buys the technology for all hospitals, and therefore can buy technology in bulk, the prices can be reduced. Another benefit is that each hospital does not have to deal with the process of Swedish Public Procurement Regulations. Also, if hospitals buys or rents from the same source it makes it easier for the hospitals and departments to make a budget. Having the staff in the whole health care system utilising the same routines makes it much easier for the staff to relocate to another county without additional education. When a central support centre takes care of the support and the decision if which technology to use is taken centrally, the demand for technical competence in each hospital is reduced.

This type of organisation has downsides. The risk for this to become bureaucratic is plausible and if the organisation does not work efficiently it will be a hindrance to the hospitals. The cost for the authority might overcome the benefits of a centralised system. The technical solutions that the authority distributes may be unfit for all various applications that the hospital needs. The hospitals in that scenario will have a system that they can not take full advantage of and do not want to use.

6.2.2 A Decentralised Organisation

In this case everyone make their own decisions and hospitals decide what technology they want to use and who to collaborate with. This opens up possibilities of specialised solutions that completely meets the hospitals' requirements. This requires high technical competence on the hospitals' IT departments and health care staff. They need to have the competence to develop and evaluate technology instead of making the technology work.

Because every hospital decides on their own technology, they can change it according to their specific needs faster. A downside with a decentralised system is that it becomes harder to initialise new collaborations. Different hospitals may use incompatible technology or have very different routines for how to use them. Negotiations would have to be carried out for every new collaboration, this is a very serious disadvantage. Relocation of staff will be more difficult since they have to learn new systems and routines. Also, the economical evaluations will no longer be done by a central unit and more administrative work through procurements regulations and technical work will have to be made by senior physicians.
6.2.3 Common Standard Model

A Common Standard Model is something in between the centralised and the decentralised organisation. The idea is a number of common set of standards that the hospitals can choose from if they want to start using new technology, e.g. if they want to use video conferences they should use software or hardware that is compatible with H.323\(^{25}\) audio and video encoding.

This has several advantages. In contrast to the decentralised organisations commencing collaborations becomes easier. For example, if the hospital wants to start a video conference collaboration with another hospital, they know that the other hospitals' interface will be compatible with their own. However, routines around the technology may be different. The hospitals do not have to evaluate the technology itself but they still need some local technical expertise to evaluate if they need it. This organisation type have some disadvantages in common with the decentralised organisation. The individual hospitals have to make all the purchases and engage in Public Procurement Regulations. Hospitals will have to evaluate difficult economical evaluations and different routines make the staff mobility more complicated in relation to routines and different systems. Standards will also be cumbersome to change with the technology advancements. A new standard requires a transition period for all hospitals before the old standard can expire. During this transition period there will be two valid standards. The problem arises of who manage and maintain the standards. One solution could be a standalone organisation to evaluate technology and set standards. It could be implemented as a light-weight government authority or a organisation for standardisation (for example ISO). A more democratic approach could be that county councils together decide all the standards in an organisation where every county council is represented.

At present, health care have most similarities with the decentralised organisation. However, with the Health Optimum project, it has some influences from the common standards organisation. It is difficult to evaluate which of these would be best. The decentralised system has some disadvantages and the use of Telemedicine would benefit if the health care moved towards the other two organisation scenarios. As written previously, these three scenarios are extreme cases and the optimal solution is most likely found somewhere in between.

7 Research Areas

Extensive research has been conducted within the different areas of telemedicine including the COSMIC system\(^{26}\), Dermatology\(^{27}\), Plastic Surgery\(^{28}\), Discharge Conference\(^{29}\), Neurophysiology\(^{30}\), and Radiology\(^{31}\).

7.1 The Cosmic System

Before computers were widely used in health care, all medical records were kept on paper making it a very time-consuming and costly task each time these had to be shared with another point of care. About one decade ago a system named Journal III was introduced for the Primary Care units in Uppsala County Council. The system made it possible to digitally save records instead of handling paper. It also allowed for day-to-day patient administration to be handled digitally, as for example patients' contact information. However, these records were still saved locally on each point of care and in order to send them to another point of care they had to be printed and either faxed or posted. Meanwhile, the hospitals still used papers for their records but had started to use a system named IMx for patient administration.

This was not an optimal solution and Uppsala County Council decided it would be best to use one common system in all parts of health care, ie. at hospitals as well as in Primary Care. The Journal III system that was already in use at the Primary Care units was considered for this purpose but it was decided that it could not fulfil the needs of the hospitals. Instead, a system called Cosmic\(^{32}\) was chosen in 2001 for its ability to suit all parts of the county's health care. Cosmic uses a central database that stores all records and every point of care connects to it using a client. This enables easy sharing of information to all parties.

\(^{26}\) Appendix A: The Cosmic System for Telemedicine
\(^{27}\) Appendix B: Dermatology
\(^{28}\) Appendix C: Plastic Surgery
\(^{29}\) Appendix D: Discharge Conference
\(^{30}\) Appendix E: Neurophysiology
\(^{31}\) Appendix F: Radiology
7.2 Dermatology

The work of the Department of Dermatology is very well suited for Telemedicine. The patient’s condition is rarely acute and the skin diseases make dermatology very suitable for taking photographs for diagnose. With a photograph as the only material an experienced specialist can not only diagnose but also determine if the photograph is of adequate quality for this purpose. This requires a certain quality of the photographs and possibly education or experience from the photographer. At present, when a doctor at the Care Centre has a dermatology case and is uncertain of a diagnosis, the patient is referred to UUH. The time-span between the referral and the scheduled meeting at the Department of Dermatology is usually about one to three months. The idea of this project is that a Care Centre, in this case Heby Care Centre (HCC), will use a digital camera to photograph patients. These photographs will be discussed once a week, during a video conference, with the specialist at the Department of Dermatology at UUH.

In the end of 1998 a similar project was carried out, though at that time an asynchronous consultation method was used. The consultations were performed by taking photographs of patients and e-mailing them to a specialist at UUH for consultation. The project was rather successful and lasted until 2000/2001.

The commencement of the HO project in dermatology has been postponed during the autumn, as a person willing to take responsibility was not found at the Department of Dermatology at UUH. This was due to the doctors work load. However, after a couple of months a person responsible for the implementation of telemedicine at the dermatology department was appointed.

7.3 Plastic Surgery

The Department of Plastic Surgery at UUH has two main tasks; plastic surgery and burn treatments. Within the field of activities of plastic surgery, the department serves as a specialised unit towards the region of Middle Sweden. It also serves the whole of northern Sweden with burn treatment

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33 Interview, specialist at the Department of Dermatology at UUH, 2007-11-12 16/11, Uppsala, Sweden; Interview, family doctor, 2007-11-21, Uppsala, Sweden

34 Eriksson, Leif, Telemedicin HL-Hud, Uppsala County Council
services. Between 2005 and early 2007, the department participated in an EU project called SPEX (Spreading Excellence). This project aimed towards spreading excellence with the aid of Telemedicine. This was achieved with the use of video conferences, shared desktops and mobile phones that were able to send and receive photos. In this project the department acted as Centre of Excellence (CoE) and collaborated with Mälarsjukhuset Hospital in Eskilstuna (MHE) who acted as a Point of Care (PoC). This gave the single plastic surgery specialist at MHE consulting opportunities to discuss and gain experience from. The collaboration between UUH and MHE was a successful project and it is still active as of 2007. With SPEX, an agreement was made concerning economical reimbursements and to secure economical benefits for both parties. For more information about SPEX see STEVE (2006)\textsuperscript{35}.

Prior to the SPEX project, MHE referred plastic surgery patients to UUH when they were unsure how to diagnose or treat them. The result of this was that UUH received referrals from MHE, even though some of the referred patients could be treated locally in Eskilstuna. This led to unnecessary transportation's and an unnecessary workload at the Department of Plastic Surgery at UUH. These referrals to Uppsala have been minimised thanks to SPEX. Because of the success of the SPEX project the Plastic surgery’s part in Health Optimum will be a continuation and expansion of SPEX. The collaboration with MHE will continue to work as before, although one more doctor will be involved at both the PoC and the CoE. In addition, the hospitals in Gävle and Falun will collaborate in a similar fashion. In the collaboration with these two new sites persons responsible for the collaboration has been identified, but the consultations has not been initiated yet. As of now the Department of Plastic Surgery at UUH is preparing a sales pitch package including technological solutions to hand out to the PoC. They are also searching for doctors and other hospital staff to collaborate with.

### 7.4 Discharge Conference

When patients', that needs further care, have been treated at the Uppsala University Hospital (UUH) they are to be transferred to their home municipality. If the discharged patient currently have, or in the future will have, home-help service, a Discharge Conference will take place. This is to ensure

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\textsuperscript{35} \textit{STEVE Student Evaluation of Telemedicine}, Uppsala University, 2006
that the patient will obtain the correct care in their home municipality. When the doctor considers the patient to be fully treated, the home municipality and the corresponding Care Centre in the home municipality is contacted.

Regulations state that when UUH have informed the home municipality, the municipality have five weekdays to transfer the patient to the municipality care. After these five days they will be charged 2,000 SEK per day that the patient is still in the care of UUH.

When a Discharge Conference is scheduled, the responsible nurse at UUH informs the aid worker, district nurse, and aid official from the municipality. Sometimes a physical therapist and/or an occupational therapist also participate. The conference is attended by the patient and next of kin. For each conference the staff from the home municipality travels to the UUH. To reduce this unnecessary travelling, Teleconference is being evaluated. At the beginning of this project only a few of the departments in UUH has participated with the municipalities Heby, Östervåla, and Tierp.

Heby Care Centre (HCC) that will be the focus of this section, has previous Telemedicine experience when it comes to Discharge Conference. When Heby municipality belonged to the county of Västerås they had video Discharge Conferences with Västerås hospital. When Heby, at the turn of the year 2006/2007 changed county, the Care Centre expressed a wish to also have Teleconferences with UUH. Hence, Video Discharge Conferences, now referred to as VDC, has been used three times during the spring of 2007 between Heby Care Centre and UUH Emergency and Rehab. In November 2007 they have had two VDCs. The Orthopaedic Department had approximately 6 conferences.

36 Interview Lyttkens, Leif, Chief Medical Officer, 2007-10-16, Uppsala, Sweden
37 Interview, District nurse and technician at Heby Care Centre, 2007-10-19, Heby, Sweden
38 Interview, Health care planner at UUH, 2007-11-06
39 E-mail conversation, Health care planner at UUH, 2007-11-26
7.5 Neurophysiology

Neurophysiologic examinations aim at mapping functions in the central and peripheral nervous system. They are designed individually depending on symptoms and modified depending on the acquired results. The diagnosis aims at being a description and an interpretation of the acquired results. It also contains a summary which should act as guidance to the referring doctor\textsuperscript{40}.

One examination method used at the Department of Neurophysiology at UUH is electroencephalography (EEG). The examination is performed by attaching a number of silver electrodes to the patient’s head. Brain activity is then registered at rest and during provocations, such as hyperventilation for a period of three minutes, and flashing light for a period of five minutes. Total registration time is usually about 40 minutes. If there is a suspicion of epilepsy, sleep is also used as a provocation, which prolongs the examination time\textsuperscript{41}.

The Department of Neurophysiology at UUH currently consists of ten doctors, ten biomedical analyzers, four secretaries, one assistant, two engineers, and one attendant. University employees, such as scientists, secretaries, and engineers, are also a part of the ward. Patients are referred to the ward from both the hospital’s other wards and non-institutional care sites, called satellite labs. When a patient at a satellite lab is referred to the Department of Neurophysiology a biomedical analyzer at the satellite lab performs the EEG registration, which is then accessible to the Department of Neurophysiology via Sjunct\textsuperscript{42}. Patients are only referred to the Department of Neurophysiology at UUH when they can not be diagnosed at the satellite lab\textsuperscript{43}.

\textsuperscript{40} Brochure “Metoder och Indikationer” - Department of Neurophysiology at UUH
\textsuperscript{41} Ibid
\textsuperscript{42} Carelink, Sjunct - Kommunikationsnätet för vård och omsorg, retrieved 26 November 2007
<http://www.carelink.se/tjanster/sjunct>
\textsuperscript{43} Brochure “Metoder och Indikationer” – Department of Neurophysiology at UUH
Current satellite laboratories:
- Gävle (Hudiksvall)
- Falun (Säter, Mora)
- Karlstad
- Örebro
- Västerås
- Eskilstuna
- Stockholm
- Mariehamn

When performing an examination where there is a suspicion of epilepsy it is sometimes difficult to separate artefacts, such as the patient moving, from real epileptic activity. The new project will evaluate the use of embedding video with the EEG in order to address this issue. All EEG registrations with embedded video are analysed at the Department of Neurophysiology at UUH\textsuperscript{44}.

An EEG registration requires about ten megabyte and a video recording about ten megabyte per minute. Video is recorded with a standard MPEG-4 codec which makes it easy to play in other applications at other locations relating to educational purposes. It can also be edited allowing only video containing interesting information to be kept. This allows for faster analysis if the registration has to be reviewed\textsuperscript{45}.

The project is, as of 8th of November 2007, active as a pilot project between the satellite lab in Hudiksvall and the Department of Neurophysiology at UUH. This pilot project will hopefully be accomplished before 1st of January 2008 and consist of about fifty EEG diagnoses. Negotiations are currently also in progress to include the satellite lab in Örebro. The pilot projects will then be evaluated and one will decide whether to incorporate satellite labs in the rest of the country. If incorporated, the satellite labs need to be convinced that this solution is worth the investment\textsuperscript{46}.

\textsuperscript{44} Interview, Flink, Roland, Uppsala, Sweden, 2007-10-16
\textsuperscript{45} Interview, Flink, Roland, Uppsala, Sweden, 2007-11-16
\textsuperscript{46} Ibid
Expectations are that the project will result in better diagnostics and fewer patients brought back for the complementary registrations needed to distinguish artefacts from real epileptic activity. It is also expected that it will be possible to use a smaller amount of registrations to diagnose the patient’s condition\textsuperscript{47}.

7.6 Radiology

The radiology department at UAS has been using a digital system, called RIS/PACS\textsuperscript{48}, since 2001. Before this, the x-rays and other picture materials were handled in paper form and stored in large underground archives. The digitalization meant storing x-ray data in digital form on disk, and implementation of both fast short-term storage and slower long-term storage. The short-term storage was designed to give quick access to recent examinations from the last six months. The capacity of the short-term storage was matched to the number of expected examinations at the time, while the long-term storage was supposed to act like an archive and provide storage for old examinations. Since the data in the long-term storage should not be as frequently used, a capacity oriented solution, rather than accessibility oriented solution, was selected.

Today the amount of pictures taken in each examination is much greater than when the system was first introduced. Some examinations may generate a hundred times more data than before or even more. This gives higher resolutions and a better base for making decisions, but it has also put a lot of strain on the system. The growing quantities of data do not only make the short-term storage insufficient, but is also affected by bandwidth limitations within the long-term storage. A high load on the long-time storage results in waiting times far greater than those intended when the system was built.

Aside from the increased need of data capacity there has been incompatibility issues between some interfaces. This has resulted in image being lost due to them being renamed when migrated to the

\textsuperscript{47} Interview, Flink, Roland, Uppsala, Sweden, 2007-11-16

\textsuperscript{48} Appendix G: Technical Annex
long-term storage\textsuperscript{49}. This has resulted in wishes for a more unified system in order to solve the issue\textsuperscript{50}.

In late 2004, the decision to invest in new RIS/PACS systems was made. The ambition was to be done with implementation of the systems in March 2005. After a while the project size increased. The systems were not only for the radiology department any more but for a few more departments, all with varying needs. This led to an extensive requirement specification, which in turn led to a thorough search for systems meeting the requirements, thus delaying the project further. The new system has been seen as close at hand for a while. This has led to the old system missing out on upgrades, making it even slower. Recently an upgrade to of the systems was made, since it was no longer possible to continue working without an upgrade\textsuperscript{51}.

\textsuperscript{49} Interview, doctor at UUH, Uppsala, Sweden, 2007-11-16
\textsuperscript{50} Ibid
\textsuperscript{51} Interview, doctor at UUH, Uppsala, Sweden, 2007-11-16
8 Overall Conclusions

To conclude, we found the aspects of health care that we have investigated would benefit from using Telemedicine. Many of the services that Health Optimum (HO) includes are already working to some extent, and we can already see the benefits. For instance, break even for the Cosmic project is expected to occur as soon as 2008. The idea is to expand the use of this system and by doing so freeing even more resources that can come to better use in for example, the Emergency Room (E.R.). Cosmic is also a system that increases the quality of care if used properly. If the system could be used as intended, patients would receive better and faster treatment and lives could possibly be saved.

Departments still having problems with their projects or departments starting up, despite having problems now, are expected to prosper in the near future. One department with good prospects is the Neurophysiology, where the procedure to diagnose patients goes very well with a Telemedicine approach.

One of the main advantages of Telemedicine is the possibility for smaller Care Centres to learn from experts, which results in a reducing need for patient transportation. They will not have to be sent to Centres of Excellence (CoE) in cases where the analysis can be done via Telemedicine. Travelling costs are a major part of the health care system expenses in general. Less transportation is also an important aspect these days as it will help to reduce CO\textsuperscript{2} pollution in the environment. As long as patients are given the same high quality care as before everyone will benefit from this project.

So far, the gains of the HO project can be measured in human capital, time saved, patient’s access to CoE, and resources saved. On the issue of human capital, the project has successfully demonstrated that the education and further research of the involved parties has improved. While the opportunities for improved research for the doctors involved was not part of the project

\footnote{A ward is the physical place where a department has its organisation}
specification, it has shown to be a positive side-effect. The project has also shown positive results in spreading excellence from experts to general practitioners all over the county. We can further conclude that most of the staff involved with Telemedicine in their practice has been positive to the possibilities that the new technology brings.

Among negative effects it should be said that some technological devices will have to be installed at the wards and that this could be met with resistance by the staff, as proven by earlier attempts to change work structure and methodology. Therefore careful analysis of the future work situation created by the computer system should be done. Changes in work procedures are likely to happen when introducing new technology, and this needs to be carefully considered in advance. Technological devices are also usually expensive, which might prevent the wards from adapting to the project. To encourage the wards to do necessary and costly investments, a well worked out plan of introducing the project to the wards is required. This will help the wards to understand the long term benefits of using Telemedicine in their daily work. Furthermore, wards are today using different systems using different standards in order to perform similar tasks. This causes unnecessary problems and leads to ineffective work. It would be difficult for everyone to invest in and use the same system but discussions between developers could allow e.g. standardised file formats as a possibility, and should be something to strive for.

In some of the wards the extra work put in by the staff is sometimes incommensurable to the gain of Quality of Care. With this in mind we believe that as many wards as possible should at least evaluate the use of Telemedicine.
9 Acknowledgement

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# Glossary

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<td>CoE</td>
<td>Centre of Excellence</td>
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<tr>
<td>DICOM</td>
<td>Digital Imaging and Communications in Medicine</td>
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<td>EEG</td>
<td>Electroencephalography</td>
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<td>HCC</td>
<td>Heby Care Centre</td>
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<td>HL7</td>
<td>Health Level 7, a dataprotocol used in Radiology</td>
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<td>NEMA</td>
<td>National Electrical Manufacturers Association</td>
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<td>MHE</td>
<td>Mällarsjukhuset Hospital in Eskilstuna</td>
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<tr>
<td>PACS</td>
<td>Picture Archiving and Communication Systems</td>
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<td>RIS</td>
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<td>SPEX</td>
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<td>SSL</td>
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<td>VDC</td>
<td>Video Discharge Conference</td>
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<td>VPN</td>
<td>Virtual Private Network</td>
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Appendix A: The Cosmic System for Telemedicine

1 Background

Before computers were widely used in health care, all medical records were kept on paper making it a very time-consuming and costly task each time these had to be shared with another point of care. About one decade ago a system named Journal III was introduced for the Primary Care units in Uppsala County Council. The system made it possible to digitally save records instead of handling paper. It also allowed for day-to-day patient administration to be handled digitally, as for example patients' contact information. However, these records were still saved locally on each point of care and in order to send them to another point of care they had to be printed and either faxed or posted. Meanwhile, the hospitals still used papers for their records but had started to use a system named IMx for patient administration.

This was not an optimal solution and Uppsala County Council decided it would be best to use one common system in all parts of health care, ie. at hospitals as well as in Primary Care. The Journal III system that was already in use at the Primary Care units was considered for this purpose but it was decided that it could not fulfil the needs of the hospitals. Instead, a system called Cosmic\(^{53}\) was chosen in 2001 for its ability to suit all parts of the county’s health care. Cosmic uses a central database that stores all records and every point of care connects to it using a client. This enables easy sharing of information to all parties.

2 Education and Deployment

When Cosmic is introduced at a new point of care, all affected staff members are offered to attend a three day long course. During these three days they work with Cosmic and its different modules. They are given an opportunity to try out common tasks that they are likely to do often in the future, for example filling out a prescription, referring a patient to another point of care, reading and writing in a patient’s medical record, and receiving payment etc. The course is followed by two

weeks of on-site training where the users will have access to educators and support personnel if problems arise. The point of care usually reduces the number of patients they see during these weeks in order to have enough time to familiarise with the system and make sure that the integration is successful. These two weeks of on-site help was not offered in the beginning of Cosmic’s release in Uppsala County Council, but due to the many problems they encountered when implementing the system, the release was postponed and this extra time for education and training was introduced. After the first introductory weeks, the users are offered to attend seminars and meetings where they have an opportunity to meet support personnel, obtain further knowledge of the system, and discuss problems and possible solutions. However, these meetings and mini-courses are rarely attended by more than a few users and user groups. The user group that experience most problems with Cosmic are the doctors and they rarely attend\textsuperscript{54}.

3 The Medicine Module

3.1 Background

A recent study shows that every day of the year there are five people staying at Uppsala University Hospital due to conflicting drug prescriptions\textsuperscript{55}. The study also shows that this is because doctors can not easily find out what drugs their patients are presently taking, or have been prescribed previously by other doctors. They will often have to rely on the patient to inform them which unfortunately is not always a reliable method. In order to reduce the number of patients that are suffering because of this the Common Drug List was created. By using this list, doctors can see their patients’ prescription history and use that information to avoid drug-related conflicts. This list is the core of the medicine module and it also supports ordinations and electronic drug prescriptions.

\textsuperscript{54} Interview, support personnel at EPJ at UUH, Uppsala, Sweden, 2007-11-08

\textsuperscript{55} Stockholms läns landsting, \textit{Läkemedelsbiverkningar som orsak till inläggning på sjukhus}, 2005. The numbers have been modified to fit Uppsala University Hospital
3.2 Usability

The Common Drug List is a drug prescribing support tool for doctors. Its purpose is to reduce the number of drug-related incidents. It can warn doctors if the present prescription conflicts with a previously prescribed drug. In order for this to work the list has to be maintained and up-to-date. When writing a prescription or making an ordination (used when a patient is admitted to a hospital), the drug is automatically added to the Common Drug List. It is also removed automatically after the prescription time has expired. Sometimes drugs are supposed to be taken "as needed" and those will not have an expiration date and will therefore have to be manually removed from the list. Unfortunately, this is often forgotten and the list becomes incorrect. This is a severe risk to patient security.  

Writing and sending prescriptions electronically is convenient for patients since they do not need paper prescriptions. It also ensures higher security since the risk of misinterpreting a doctor’s handwriting is removed. For drugs that are commonly prescribed, templates can be used to speed up the process. However, templates can not be used for less common drugs and the doctor will have to write these prescriptions from scratch. Writing electronic prescriptions can take some time even when using a template and it can, in some cases, be faster to write them on paper. This is especially true for very common prescription that was previously pre-printed on paper and only needed the doctor’s signature. Some doctors are therefore not using the new system and they write prescriptions on paper instead. This causes problems with the drug list since the prescriptions are not added to the system correctly, and hence do not appear as prescribed drugs when looking at the drug list.

Ordinations, that are used when the patient is treated in the hospital, are viewable on an Ordination List. The list is supposed to make it easier to hand out drugs to patients. Adding an ordination also adds the drug to the Common Drug List. Unfortunately, there are several problems with the Ordination List which has a negative effect on the Common Drug List.  

56. 7.1.5 Medicine Module
57. Ibid
prescriptions and ordinations in Cosmic, some doctors and nurses have chosen not to use the system, or to use it as little as possible, and continue to use the old paper methods\(^{58}\).

### 3.3 Discussion

The Common Drug List has potential to improve quality of care. However, the list can at the moment not be used to its full extent due to its possible inaccuracy. It may contain old information about a prescription that should have been made inactive, and it may also lack information about prescriptions that were written on paper and not entered on the list. In order to address this problem everyone in health care need to take responsibility for keeping their patients' records up-to-date and those who still use paper instead of Cosmic need to be informed about the consequences of such an approach. Failure in making everyone use the system will most likely result in the list being less useful. However, even when everyone is using the systems as they should it is important to remember that it will never be possible to completely trust the list. As long as humans are involved in the process, errors can occur. The list should be seen as a complement, not as a substitute, to asking patients what drugs they are using. In some cases it is not possible to ask patients about their current drugs, for example in an Emergency Room, and therefore the list will still needs to be maintained.

### 4 Referrals

#### 4.1 Background

More than thirty thousand referrals are sent to Uppsala University Hospital each year\(^{59}\). Before the introduction of Cosmic, most points of care used paper referrals both for sending and responding to a received referral. This was a time-consuming task for the medical staff at both the receiving and sending end, as all incoming referrals had to be accepted and the sender had to be notified. In most cases a formal reply to the referral had to be sent back. Uppsala County Council decided that a digitisation of the referrals was needed to speed up handling and eliminate unnecessary work.

\(^{58}\) Problem Inventory, EPJ at Uppsala University Hospital, Uppsala, Sweden, 2007-11-08

\(^{59}\) Weiman, Erik, Yttrande EPJ-revisionen, Uppsala County Council, 2007
Cosmic can handle all types of referrals, both incoming and outgoing. Referrals are sent electronically and the sender will receive a confirmation when the referral has been accepted. There are several statuses that a referral can have, as for example booked, under considerations, and answered. These have been implemented to let the sender see if the referral has been dealt with yet, if it is undergoing investigation, etc. The goals of this complete digitisation of the referrals are to save time, which eventually boils down to money, and to ensure proper handling of referrals.

4.2 Usability

The process of receiving a referral at a hospital is similar for both electronic and paper referrals. The only difference is that all referrals on paper will have to be manually entered into Cosmic. This means extra work for users. However, receiving referrals is complicated. It is considered to be too many steps that need to be taken and this increases the risk of mistakes\(^\text{60}\). In order for the sender to see how far in the process the referral has come, the Cosmic system has implemented a way of showing this by using different statuses. A referral can have fourteen different statuses, not all of these have to be used however. A few problems have been reported to exist in the system that can lead to a referral getting an faulty status. Users have complained about having trouble keeping track of what is going on when handling a long term commitment of patients’ care\(^\text{61}\). They lack logic order, and a good overview of patients’ care from initial contact to the closing stages of treatment. A good overview is needed for other reasons as well. Some users have a problem to understand and trust the referral statuses. According to a nurse, one of the later updates to Cosmic has caused an increased amount of referrals being given the wrong status\(^\text{62}\). Users are likely to double-check a status due to this, which makes the process more time-consuming. These status difficulties are such a problem that one user have said that “I can not trust the things I see”\(^\text{63}\). Another user claimed that “it is a damn detective job” when it comes to finding referrals with the wrong status\(^\text{64}\). This has lead to the staff printing out paper copies to make sure that referrals are not lost. Referrals are sometimes

\(^{60}\) Interview, Sävja Care Centre, Sävja, 2007-11-07; Interview, Heby Care Centre, Heby, 2007-10-19; Interview, Enköping Hospital, Enköping, 2007-11-23

\(^{61}\) Interview, Enköping Hospital, Enköping, 2007-11-13

\(^{62}\) Ibid

\(^{63}\) Interview, Enköping Hospital, Enköping, 2007-11-13

\(^{64}\) Interview, Enköping Hospital, Enköping, 2007-11-13
sent to the wrong recipient. The list of recipients that the sender can choose from is problematic and contains units that are not supposed to receive any referrals. Trying to send an electronic referral to a place that can not receive them will result in a printout on paper instead.

4.3 Discussion

Electronic referrals have the potential to become an excellent tool. However, the usability problem that causes mistrust in the status of referrals has to be solved in order for electronic referral to reach its full potential. The link between Care Commitment\textsuperscript{65} and the referral system would not be a new idea. Paper referrals and care history have always been linked even before the introduction of Cosmic, usually by stapling the papers together. Implementation of this link should be possible since both systems are already a part of Cosmic.

When it comes to the list of recipients within Cosmic; the possibility of sending the referral to the wrong place should be removed. One solution to this usability problem would be to make all recipients that are incapable of receiving an electronic referral unselectable. This may not always be a good idea though, since humans feel stressed and agitated when computers do not perform seemingly easy tasks without explanation. This does not only create a bad work environment, but also potentially cause mistakes. A better solution could be to divide the recipient list into two separate lists; one containing referral recipients and the other showing a list of the units that particular recipient contains.

Moreover, one should consider the consequences the perceived lack of control of a referral status and its impact on the work environment of the users. Lack of control is one of the well known stress factors that one needs to avoid when implementing computer systems\textsuperscript{66}.

\textsuperscript{65} Fel! Hittar inte referenskälla. Fel! Hittar inte referenskälla.

\textsuperscript{66} Åborg, Carl, \textit{How does IT feel @ work? And how to make IT better. : Computer use, stress and health in office work}, Uppsala University, 2002, retrieved 03 December 2007, <http://urn.kb.se/resolve?urn=urn:nbn:se:uu:diva-2849>
5 Shared Medical Records

5.1 Background
Before the introduction of Cosmic all doctors would have to request patients' medical records from other points of care. The records were sent using the postal service or a fax machine, which required both manpower and time on both locations. This was a time consuming task, which could be solved using an electronic medical record database. This database should be easily accessible from any point of care without being too time consuming.

5.2 Usability
With the deployment of the electronic Medical Records Module in Cosmic came changes in work procedures for the medical staff. They no longer had to keep records on paper as everything was stored in a shared database where they could find all patients' medical records.

In order to have patients' old medical records available, without having to go and look them up in a file somewhere, a system called KoVis was introduced and made accessible through Cosmic. All old records, and any new records that are available only in paper form, are scanned and saved as image files and connected to patients' medical records for easy access. This has, however, not worked out very well. Image files are by nature non-searchable which means finding information in them can be difficult. This is not different from a document on paper. The most prominent problem is that they are sometimes mislabelled so that they are sorted into the wrong section of the medical record, making them very difficult to find. There are also reports of several duplicates cluttering the system. One user said that "we usually refer to [any KoVis activity] as ‘Go Fish!’" (referring to a card game where one has to find a certain card in a sea of cards).

The general opinion about the electronic medical records in Cosmic seems to be that it is working quite well. A few users expressed a concern that too much unnecessary information is shown when

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67 Interview, Enköping Hospital, Enköping, 2007-11-13
68 Ibid
opening a patent's medical record. There is a filter function that is meant to solve this problem, but it is not working well. See section 8.7.1.3

Another problem is the searching of a diagnosis code. Every time a diagnosis is entered into the medical records of a patient, a code has to be specified. Over 30,000 of these codes exist and many are very similar. The current search system has a few problems that severely limit its use. See section 8.7.1.2.

5.3 Discussion

The benefits of shared medical records lies not only in better quality of care when doctors acquire a better picture of patient medical history, but also in monetary savings resulting from less time spent maintaining old paper records (faxing and mailing the records when requested by another point of care, storage, etc.). However, there are several problems that prevent the system from reaching its full potential. Some problems like for example the filter function is not yet a problem since the system is young and most patients do not have enough information in their records to need filtering. But as the records grow larger, so will the need of a well designed filter. Other problems are more urgent, like the diagnose codes or KoVis, and needs to be addressed promptly.

6 Economy

A project as large as the Cosmic introduction will not be fulfilled if there is not a financial gain to be made as the goal of Cosmic is to save money and increase the quality of care. Before the project started in 2001 the County Council of Uppsala made a budget for the entire decade, trying to pinpoint where the project might break even. It was approximated to occur during 2008, with 2005 being the last in a number of non-profit years. Since 2001 there have been a few factors that notably changed these dates among which is the delay of the project introduction in the Primary Care. That delayed the introduction with a few years. However, it is well worth remembering that savings can not always be measured in money in a project of this magnitude. Increased quality of care is also an important aspect.
7 Problems and Solutions

Cosmic does what it is intended to do and works fairly well, in general, but there has been some problems. In this chapter some of the current problems are covered in more detail and most of them are given a possible solution. There are also estimations and calculations of what it would cost per year not to fix these problems.

The most noticeable symptom of the problems in Cosmic is that more time is spent working with the system, and thus less time with patients. Several users have expressed that they now can handle fewer patients per day than before the introduction. One user said that while she could handle six patients per hour before the introduction she can now only handle four, and that with a good measure of stress involved. One can argue that the user in question had only used the system for one month; however, users who have used the system for almost a year have similar problems. It is important to notice though that the system the comparison is made against, Journal III, had been in use for almost ten years.

7.1 Problem descriptions

7.1.1 Manual Update of Lists

One recurring feature in Cosmic is the many different lists. They can contain anything from a list of patients that are waiting to be seen, to a list of a particular patient’s drugs. These lists are easy to navigate and use, but most of them have one major drawback; they will not automatically refresh if the data they are displaying changes. This means that the user will have to manually update the lists to see if any changes have been made. This is something that will, without a doubt, eventually cause problems. Users do (and should) expect the system to automatically tell them if anything has changed. The requirement of a manual update is more noticeable in some areas than others. The list that is likely to be affected the most is the Visitations List. It is a list of all the patients that a doctor have been scheduled to meet. This list will indicate if the patient has arrived to the waiting area and is ready to be called in. Doctors therefore have to manually update this list in order to determine whether the patient has arrived or not.

69 Interview, Sävja Care Centre, Sävja, 2007-11-07 and Heby Care Centre 2007-11-30
The manual update is a likely source of frustration for users, and a stressful feature of the system. It is claimed to be performance issues that are the reason Cosmic does not have an automatic update function\(^70\). However, it is difficult to see why it would constitute a strain on performance considering the low number of simultaneous users on this system compared to many other database-based applications\(^71\). This indicates a more complex and severe problem with the Cosmic system and a solution is most likely not that easily implemented. At first glance this appeared to be a severe problem with the possibility of a huge time lose. However, users has expressed that updating lists quickly becomes a regular habit, as one user put it "it is so important the we keep reminding ourselves to update, by now it has become almost a reflex"\(^72\). Consequently, the need to update lists manually might be irritating for new users it does not seem to be of huge impact on the work of experienced users.

### 7.1.2 Diagnoses

When a diagnosis is to be set, the doctor needs to assign a diagnose code. Virtually every thinkable diagnosis has its own code and there are nearly 30,000 different codes\(^73\). In spite of this huge number of codes, the search system is not optimally designed for the kind of search that needs to be done to find the correct code fast. The best search utility here, at least from a user point of view, would be a dynamic search that filters out the result while typing. The one in place today is a standard, non-dynamic, search where the user has to click the search button manually whenever a search phrase has been entered. This inconvenient search function together with the large amount of diagnosis codes has resulted in some doctors simply not entering a diagnosis code\(^74\) as in this quotation: "I don't set a diagnosis code simply because it is too much of a hassle"\(^75\)

\(^70\) Course in Cosmic for Heby Care Centre, Instructors, Uppsala, 2007-10-09  
\(^71\) Interview, EPJ, Uppsala University Hospital, 2007-11-09  
\(^72\) Interviews, Heby Care Centre, Heby, 2007-11-30  
\(^73\) Course in Cosmic for Heby Care Centre, Instructors, Uppsala, 2007-10-09  
\(^74\) Interview, Doctor at undisclosed location  
\(^75\) Ibid
7.1.3 Medical Record

The Medical Record Module comes with a filter function that can be used to limit the amount of visible information. The entire medical record is divided into parts and only the first part is visible to users when it is first opened. To see the next part of the record as well, users will have to click on a button. This could mean a lot of button clicking if a patient has a long medical record. The filter function will allow users to remove those entries that are of no interest to them at the moment. This sounds good in theory, but turns out to be very weak and almost impossible to use in practise. If users set up a filter before they have the entire medical record in front of them, the filter will only work on entries that they can see. As a consequence users will be forced to click on the button until the entire medical record is visible before applying any filter. If users accidentally apply a filter before getting the entire record, the filter will disappear when the user clicks on the button to see the rest of the record, and it will have to be reapplied again when the entire record is visible. This illogical paging function together with the poor filter function is something that can be very time-consuming and it will take away much needed time with the patients. It may not be a problem today when most patients only have a handful of entries in their medical record, but it will likely become a problem within a couple of years.

When new information is entered into the medical record it has to be classified with a keyword. This is how the filter function knows what the entries are concerning and if they should be filtered out or not. If no keywords are given, the medical record will not be filterable and it will have to be read through completely even if it is only a specific entry that is sought. Some concerns have been raised that medical professionals are not using the medical record as intended and are therefore loosing many of the possible benefits of it\textsuperscript{76}. If this behaviour is due to problems in Cosmic, or if it is related to something else, will have to be investigated further.

Moreover, it appears today that not every point of care are using all the features of the medical record. As one doctor said: “we are not using the system to its full extent” and “we are writing

\textsuperscript{76} Interview, User at undisclosed location
paper records electronically”77 referring to the fact that they are not using the keywords at all, but are instead writing free text.

7.1.4 Dictates
Most doctors do not have time to put in basic information about a patient in Cosmic, instead they dictate all information and save it for a secretary to transcribe it later. Two major security issues have been discovered with this function. If a user opens up a dictate from another doctor that has not been typed in by a secretary yet, and accidentally saves the dictate, it will be taken over by the user and will no longer be viewable in Cosmic for the original doctor’s secretaries. This may not matter much if the user takes over a dictate from a doctor at the same workplace, but it could lead to a lot of problems if the doctor is working elsewhere and have other secretaries. The second security issue is far more severe as a user is able to bring up another doctor’s dictate and erase it completely by simply clicking on the Record button. This poses a severe security risk that should be addressed immediately. A few users asked for a confirmation dialogue or something similar that will make it clear to them that they are about to take over a dictate from another doctor78.

7.1.5 Medicine Module
The Medicine Module consist of several parts that are all related to medicine and in some way connected to each other. The two largest and most frequently used parts are the Common Drug List and the Ordinations List.

The Common Drug List is a good system, but it requires all branches of health care to use it. Otherwise its reliability decreases dramatically. Unfortunately, many doctors at UUH are very reluctant towards using it and that keeps the system from being a real success. The formal decision to use the system has been made, but apparently the doctors are not using it, which in turn means that it is mostly doctors in smaller points of care that will have to clean up and try to maintain the drug list. One doctor at UUH said that “of course it is possible to maintain a common drug list. It is

77 Interview, Doctor at undisclosed location
78 Interview, Heby Care Centre, Heby, 2007-10-09
only a matter of making a decision”79. This is most likely one of the largest problems today and it will need to be addressed as soon as possible. It is not really a problem related to Cosmic, but rather more of an organisational problem, which makes it even more difficult to solve. Even though a few doctors try to clean up their patient’s drug list as often as they can, it is not a reliable method. One doctor said that “it does not feel right to interfere in areas [of medicine] where I am not an expert”80. This points out an important aspect of the problem and it also indicates a possible risk to patient security. The only safe and effective solution is that doctors take responsibility for their own prescriptions to make sure that they are represented correctly in the patient’s drug list.

“It has happened that a patient has ended up in the Emergency Room because of mistreatment due to an incorrect drug list in Cosmic”81. This statement symbolises the importance of dealing with this problem at an early stage. One user felt that it required "an amazing number of clicks"82 to fill out a prescription. However, this user did not use templates, which would have made searching and dosage of drugs faster and required less clicks. The user said that she felt it was too complicated to learn how to use these templates. It is possible to prolong a prescription with only two clicks, however, none of the interviewed users seemed to be aware of this.

Naming inconsistencies exist throughout this module. It is confusing when buttons with names like ‘save’, ‘sign’, ‘send’, ‘print’, etc. means one thing in one dialogue box and something different in another. It is likely that most users will learn the difference between them eventually, but it will most likely slow down work and lead to unnecessary mistakes in the beginning.

A few standard dosage types are available for the user to choose from when creating a dosage in Cosmic. They speed up the process but can not always be modified in a way that the user might need. For example; if a user wants to prescribe one pill once a day to a patient, the final dosage text would look something like this: “1 pills once a day”. It is not possible to change these types of

79 Problem Inventory, EPJ at Uppsala University Hospital, Uppsala, Sweden, 2007-11-08
80 Ibid
81 Ibid
82 Interview, Sävja Care Centre, Sävja, 2007-11-07
grammatical errors and one doctor put said that “it makes me mad that I can not change the text in an easy way. Having these grammatical errors make the dosage instruction look very unserious”\textsuperscript{83}. Cosmic lack an automatic function to calculate the number of pills that need to be prescribed to the user based on the ordination. This feature has been asked for by many professionals but has not yet been implemented\textsuperscript{84}.

There is a list in Cosmic called the Ordination List where all ordinations, current and past, are viewable. This Ordination List is mainly used by hospitals when treating admitted patients and it consists of several categories, such as injection and infusion. It is possible to create default ordinations, templates, to make it easier for the doctors when they need to put a patient on a drug. A template that a doctor may want to create can look like: "Give two pills three times a day for the coming five days".

Unfortunately, Cosmic does not allow the creation of ordination templates that span more than one day. So the aforementioned template would not be created properly, or it will be created but will have its life span reduced to one day instead of the intended five. This constitutes a severe risk to patients’ health if doctors believe that the drug will be given to the patient for five days when it will in fact only be given for one day. According to a doctor “it’s just a matter of time before something really scary happens”\textsuperscript{85}. The obvious solution to this problem is to allow the creation of templates that span over more than one day.

Every ward at the hospital has their way of organising and planning the hours of the day. One specific ward may hand out drugs at specific times during the day. When a doctor writes an ordination, specific times will be entered instead of the number of times per day a drug should be given to the patient. This makes it easier to hand out the drugs, but it can complicate things if a patient has to be transferred to another ward that does not use those specific times. The receiving

\textsuperscript{83} Problem Inventory, EPJ at Uppsala University Hospital, Uppsala, Sweden, 2007-11-08
\textsuperscript{84} Interview, Sävja Care Centre, Sävja, 2007-11-07; Interview, Heby Care Centre, Heby, 2007-10-19; Interview, Enköping Hospital, Enköping, 2007-11-23; Interview, EPJ at Uppsala Hospital, Uppsala, 2007-11-09
\textsuperscript{85} Problem Inventory, EPJ at Uppsala University Hospital, Uppsala, Sweden, 2007-11-08
ward will have to re-write the ordination to make the handout times correct. “This means that we have to remove the ordination and add it back again [...]. It is like doing it all over again”\cite{86}. One possible solution to the problem is to allow any doctor to update the ordination based on the templates used at that specific ward. This is not a perfect solution and it will not work if the ward does not have a template for that particular drug. Perhaps this is more of an organisational problem than a Cosmic one, but it still needs to be resolved in order to avoid putting an unnecessary work load on the staff.

Another severe risk to patient health is the fact that any current ordination will not automatically be removed when a patient is discharged. Usually this is not a problem since the ordination will expire within a few days anyway and the patients will obviously not receive any medication since they are no longer admitted to the hospital. But there are times when patients come back a day or two after they have been discharged. If they are admitted again they will start receive drugs based on the old ordination if it has not yet expired. This is not always desirable and can severely jeopardise patients’ health. Whether this problem is of an organisational or Cosmic nature can always be debated. The doctor in charge of a patient’s discharge should make sure that any current ordinations are ended and that nothing is left active that should not be. On the other hand, it would be helpful if Cosmic displayed a warning that there are active ordinations and ask if those should be ended.

Making changes to an already existing ordination is time-consuming and somewhat difficult to do. Some parts of the ordination are not possible to change at all, like the type of the dosage, without removing the ordination and redoing it from the beginning. These problems put together make it difficult for the staff to trust the Ordination List fully. “The problem is that it can not be trusted”\cite{87}. One doctor expressed that she felt “forced to use the system in a pre-defined way”\cite{88}. She asked for more freedom when it came to the way she is meant to work with the system.

\begin{flushright}
\footnotesize
\end{flushright}

\begin{flushright}
\footnotesize
86 Problem Inventory, EPJ at Uppsala University Hospital, Uppsala, Sweden, 2007-11-08
87 Ibid
88 Problem Inventory, EPJ at Uppsala University Hospital, Uppsala, Sweden, 2007-11-08
\end{flushright}
7.1.6 Referrals

Referrals are usually split up into two parts. It can be either an incoming referral or an outgoing referral. A user at a hospital that recently started using Cosmic’s referral module said that “the introduction [of the Referral Module] went surprisingly well”\(^89\). When they were asked to describe all the different steps they take when they receive a referral, they said that they print out a copy of it on paper and use that to keep track of it when it goes through all the stages and to the different medical professionals. This could be an indication that something is missing in the system, or is not working as intended. They said that “the logic that ties everything together is missing”\(^90\). To ensure that no referrals are lost or misplaced in Cosmic they use the paper copy as a reminder. It should be noted that this is not the way all departments work at the hospital, and it may even be an uncommon way of working. But still, it is a problem that should be looked at as soon as possible, since this paper copy solution is time-consuming and usually means that any changes to a referral must first be made in Cosmic and then on paper\(^91\). When a referral is received by a point of care, it will go through a lot of stages and it will change status accordingly. There are several statuses that a referral can have\(^92\) and it allows the doctor that sent the referral to see where in the process it is currently. Due to the many stages and statuses the users have to deal with the referral in a pre-defined way. It has to go through the different stages in a given order to get the correct status and appear to the right people. Most users, who were interviewed, said that this module is problematic and too time-consuming.

7.1.7 Other Problems

Users have expressed that many tasks requires far more mouse clicks that previous systems and some are complaining of pain in their shoulder and neck region as a result of this. At one Care Centre they are bringing in an ergonomist to see if there is anything in the working environment that can be done to relieve tension created by excessive clicking.

\(^{89}\) Interview, Enköping Hospital, Enköping, 2007-11-23

\(^{90}\) Ibid

\(^{91}\) Ibid

\(^{92}\) 8.4 Referrals
The system is generating more paper printouts than is necessary, at times something will be printed and then directly thrown in the dumpster since it was not wanted but came as a by product. This happens for example when expediting a test.

### 7.2 Cost Estimates

Whether or not to fix a problem in a software system is often an economical question. It is not easy to motivate a fix to a problem if the gain is small or non-existing. The cost of correcting larger problems is usually higher, but the gain of correcting them is usually higher as well. It is not easy to come up with an exact formula where it is clearly visible which problems that are worth fixing, especially since some problems are difficult to categorise properly. Still, the cost of not fixing the problems have been estimated and entered into the table in section 9.7.3. It should be noted that these numbers will be mere approximations, but will still give a fairly good indication of how big the problems are and costs of not fixing them. Our estimates are based on the assumption that the extra time spent in Cosmic due to the problem could be spent on work tasks and care of patients instead if the problem was fixed. Not every calculation will be gone through in detail here, but we will give an example of how we have been thinking when doing them\(^3\).

Doctors have reported that it is very time-consuming to find the correct diagnosis code when putting information into a patient’s medical record. This is, to a large extent, due to the poor search functionality in Cosmic. It is our belief that the doctors in average could save about five seconds per doctors’ appointment if a dynamic search function was added. Not all appointments require these diagnosis codes to be set and the estimation is that roughly half of them does. These five seconds add up to about a half a year in total. In money, this would be translated to 400,000 SEK per year.

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\(^3\) Appendix C: Cost Estimates.
7.3 Table of Problems

We have graded the problems on a scale from Low to Severe based on our experience in Computer Science, Graphical Design, and Programming. Problems that could potentially constitute a risk to patient safety, or have a major impact on the usability of the system, have been graded Severe. Problems that do not fall under the above category have been graded with either Medium or Low depending on how much trouble we believe it will cause for the users.

All estimates in the tables of this section are given in Swedish currency (SEK). See Appendix: Cost Estimates for more information about the cost estimates.

<table>
<thead>
<tr>
<th>Problem</th>
<th>Area</th>
<th>Description</th>
<th>Severity</th>
<th>Est. cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>General</td>
<td>The program runs out of memory after a long up-time.</td>
<td>Severe</td>
<td>6,200,000</td>
</tr>
<tr>
<td>2</td>
<td>General</td>
<td>Performance issues are limiting usability</td>
<td>Severe</td>
<td>n/a</td>
</tr>
<tr>
<td>3</td>
<td>General</td>
<td>Lists are not updated automatically</td>
<td>Medium</td>
<td>220,000</td>
</tr>
<tr>
<td>4</td>
<td>Medical Record</td>
<td>The filter function is poorly designed and its behaviour is unexpected.</td>
<td>Severe</td>
<td>170,000</td>
</tr>
<tr>
<td>5</td>
<td>Medical Record</td>
<td>“Now showing 39 of 39 notes” even though a filter is applied that limits the visible entries to, for example, 5.</td>
<td>Severe</td>
<td>See 4.</td>
</tr>
<tr>
<td>6</td>
<td>Medical</td>
<td>If you change to another category on the left side of the window, your active</td>
<td>Severe</td>
<td>See 4.</td>
</tr>
<tr>
<td></td>
<td>Record</td>
<td>Description</td>
<td>Severity</td>
<td>Pages</td>
</tr>
<tr>
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<td>-------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>----------</td>
<td>-------</td>
</tr>
<tr>
<td>7</td>
<td>Medical Record</td>
<td>If you apply a filter and then click the button “Get next…” your filter disappears and you have to reapply it.</td>
<td>Severe</td>
<td>See 4.</td>
</tr>
<tr>
<td>8</td>
<td>Medical Record</td>
<td>Diagnostic codes are very difficult to search for.</td>
<td>Severe</td>
<td>600,000</td>
</tr>
<tr>
<td>9</td>
<td>Medical Record</td>
<td>If you select the last row in a record and push the “get next..” button, your selected row becomes deselected and you end up at the first row which means you have to manually scroll down to find the row you had selected.</td>
<td>Medium</td>
<td>See 4.</td>
</tr>
<tr>
<td>10</td>
<td>Medical Record</td>
<td>If you change category on the left all the downloaded data will be thrown away, meaning it will have to be downloaded again if you visit the same category later.</td>
<td>Medium</td>
<td>See 4.</td>
</tr>
<tr>
<td>11</td>
<td>Medical Record</td>
<td>Expanding a dynamic folder in write mode is very tricky and requires weird key presses like ARROW, ARROW, TAB, TAB.</td>
<td>Medium</td>
<td>n/a</td>
</tr>
<tr>
<td>12</td>
<td>Scheduling</td>
<td>Too many bookings in a small period of time will render the schedule cluttered and difficult to read.</td>
<td>Medium</td>
<td>1,280,000</td>
</tr>
<tr>
<td></td>
<td></td>
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<td>---</td>
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<td>---</td>
<td>---</td>
</tr>
<tr>
<td>13</td>
<td>General</td>
<td>Naming inconsistencies appear throughout the program. ‘Save’ at one place means save, while it means save and close in another dialogue.</td>
<td>Medium</td>
<td>275,000</td>
</tr>
<tr>
<td>14</td>
<td>Aids</td>
<td>It’s not possible to sort the list of aids in chronological order. It’s sorted per doctor.</td>
<td>Low</td>
<td>600,000</td>
</tr>
<tr>
<td>15</td>
<td>Common Drug List</td>
<td>It’s possible to type in dosage texts that are longer than Apoteket can print.</td>
<td>Low</td>
<td>n/a</td>
</tr>
<tr>
<td>16</td>
<td>Warnings/Observandum</td>
<td>There is a - sign next to a folder indicating that is possible to collapse it, but it’s not working.</td>
<td>Low</td>
<td>n/a</td>
</tr>
<tr>
<td>17</td>
<td>Schedule</td>
<td>Strange choice of colours in the search result list. Difficult to read.</td>
<td>Low</td>
<td>216,000</td>
</tr>
<tr>
<td>18</td>
<td>Ordering Tests</td>
<td>When you switch the category, the text remains in the search field. It would be better if it was cleared automatically.</td>
<td>Low</td>
<td>500,000</td>
</tr>
<tr>
<td>19</td>
<td>Medical Record</td>
<td>Inconsistency when it comes to sorting by clicking on the headlines. Sometimes it works, sometimes it does not.</td>
<td>Low</td>
<td>n/a</td>
</tr>
<tr>
<td>20</td>
<td>General</td>
<td>Weird key combinations throughout the program. Like CTRL-V for an action</td>
<td>Low</td>
<td>See 11.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
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<tr>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>General</td>
<td>Fields that users shouldn’t change should be grey</td>
<td>Low</td>
<td>n/a</td>
</tr>
<tr>
<td>22</td>
<td>Medical Record</td>
<td>Not all doctors are tagging the text they put in a medical record correctly and the system will not work optimally due to this.</td>
<td>Medium</td>
<td>990,000</td>
</tr>
<tr>
<td>23</td>
<td>Medicine Module</td>
<td>Not all doctors are using the common drug list and this constitutes a risk to patient security.</td>
<td>Severe</td>
<td>8,000,000</td>
</tr>
<tr>
<td>24</td>
<td>Medicine Module</td>
<td>There exists no function for automatically calculating the number of pills that a doctor needs to prescribe in order to cover the entire ordination time.</td>
<td>Low</td>
<td>500,000</td>
</tr>
<tr>
<td>25</td>
<td>Medicine Module</td>
<td>Ordination templates can not be created if the ordination spans over more than one day. This can lead to severe health issues if a doctor thinks that a patient has been put on a drug for several days when it will in fact only be for one day.</td>
<td>Severe</td>
<td>n/a</td>
</tr>
<tr>
<td>26</td>
<td>Medicine Module</td>
<td>When a patient is transferred to another ward, the ordination will have to be deleted and put back in again if the two wards are not using the exact same</td>
<td>Medium</td>
<td>n/a</td>
</tr>
</tbody>
</table>
times during the day to hand out medicine.

| 27 | Medicine Module | An ordination will not automatically be ended when a patient is discharged. This can cause severe health issues if a patient is admitted again and automatically put on the same drugs as before. | Severe | See 25. |
| 28 | Medicine Module | Making changes to an already existing ordination is difficult and time-consuming | Medium | n/a |
| 29 | Referrals | It is difficult to keep track of a referral and a lot of unnecessary work are therefore carried out | Medium | 1,000,000 |
| 30 | General | The user is sometimes logged out of Cosmic without seeming cause. | Severe | 900,000 |
| 31 | General | Cosmic requires more clicks to perform the same tasks than older systems. Some users have complained of pain in their shoulder and neck regions due to this. | Severe | n/a |
| - | - | Approximated sum of all problems | - | 21,500,000 |
7.4 Table of Solutions

The table below indicates possible solutions to the problems mentioned earlier. These are solutions that we have found reasonable based on our experience in this field. There is always more than one solution to a problem and the solutions we give here should be treated as suggestions rather than absolute truths. We have tried to categorise the difficulty of implementing the solutions based on our limited knowledge on how the system is built. We have used a scale from Easy to Difficult. How these different grades translates into implementation time is difficult to estimate, but we feel that a solution graded as Easy should not require too much planning or manpower to implement, while a solution graded as Difficult may very well require a lot of time and resources to be implemented efficiently.

Table 2: Solutions of Problems in Cosmic

<table>
<thead>
<tr>
<th>Problem</th>
<th>Solution</th>
<th>Implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Some users have had problems with Cosmic indicating that it is running out of memory when it has been running for a long time. This is most likely due to a memory leakage and the only solution to the problem is to find the leakage and fix it.</td>
<td>Difficult</td>
</tr>
<tr>
<td>2</td>
<td>A lot of reduction is usability (no automatic updates of lists, having to retrieve parts of a medical record by push of a button etc) has been said to be because of performance issues. It’s impossible for us to deliver any solution to the problem since it can reside in a number of places, but something is apparently not right and it must be looked into.</td>
<td>Difficult</td>
</tr>
</tbody>
</table>
3. Make the lists update automatically wherever possible. See section 5.2 for more information.

4. See the section about the Medical Records.

5. Not telling the user that a filter is active can make the user believe that he is looking at all the information there is when there is in fact more, but it is not being shown because of a filter. This is very severe and can potentially lead to misdiagnosis or wrong treatment.

   A solution is to update the text that tells the user how many entries he or she is looking at. Or add a warning message that tells the user that a filter is in use.

6. This is severe in the sense that it may force the user to reapply a filter time after time and thereby wasting time.

7. See the suggested solution to problem 2.

   Some kind of warning should be added to let the user know that the filter is not applied to all entries in the record

8. Our suggested solution is a dynamic search functionality that automatically filters the search results while typing.

9. This can be solved by having the program not deselecting the selected row when you click on a button

10. This extra download of data is not severe from a user’s point of view, but it puts extra pressure on the system and it
<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>should be possible to cache at least some of the data.</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>The weird key presses needed to access some parts of the medical record elements can be solved by adding buttons or other ways of navigating.</td>
<td>Easy</td>
</tr>
<tr>
<td>12</td>
<td>See section 5.2 about the Schedule.</td>
<td>Easy</td>
</tr>
<tr>
<td>13</td>
<td>The naming inconsistency is confusing for the user and it’s easily fixed by going over all of the modules and changing names where necessary.</td>
<td>Easy</td>
</tr>
<tr>
<td>14</td>
<td>See section 5.7 about the Aids.</td>
<td>Easy</td>
</tr>
<tr>
<td>15</td>
<td>One solution is to cap the length of the text that a user can enter in the text field. Another is to warn the user if he or she tries to send text that is too long</td>
<td>Easy</td>
</tr>
<tr>
<td>16</td>
<td>Our suggestion is to either remove the minus sign or make it behave like it is expected by most users</td>
<td>Easy</td>
</tr>
<tr>
<td>17</td>
<td>A more user friendly choice of colour combinations would make it easier for the user to locate relevant data</td>
<td>Easy</td>
</tr>
<tr>
<td>18</td>
<td>A simple clear of the text field whenever a new category is chosen would solve the problem.</td>
<td>Easy</td>
</tr>
<tr>
<td>19</td>
<td>The obvious solution is to go over the program and implement sorting on all tables</td>
<td>Easy</td>
</tr>
<tr>
<td></td>
<td>Description</td>
<td>Difficulty</td>
</tr>
<tr>
<td>---</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>------------</td>
</tr>
<tr>
<td>20</td>
<td>Some key combinations should be changed. A lot of the users are familiar with the CTRL-V shortcut and they expect it to be related to pasting, which is not the case here. This can cause unnecessary confusion.</td>
<td>Easy</td>
</tr>
<tr>
<td>21</td>
<td>By making all fields grey that a user shouldn’t change, you make the user feel more secure.</td>
<td>Easy</td>
</tr>
<tr>
<td>22</td>
<td>The first thing that has to be determined is if this problem is related to Cosmic, or if it is an organizational issue. One solution, although it is not efficient, is to force the user to tag the text. This will greatly impact the user’s work speed, but it will ensure that the system is used as it is intended.</td>
<td>Medium</td>
</tr>
<tr>
<td>23</td>
<td>This problem is most likely an organizational issue and getting everyone to use the common drug list is very important to ensure that patient security is upheld</td>
<td>Difficult</td>
</tr>
<tr>
<td>24</td>
<td>Cosmic forces the doctors to manually calculate the number of pills that needs to be prescribed. This is not a good solution and an automatic function should be added as soon as possible to increase the doctors’ work speed.</td>
<td>Medium</td>
</tr>
<tr>
<td>25</td>
<td>The most obvious solution to this problem is to allow the doctors to create ordination templates that spans over more than one day. This should not be very difficult to implement.</td>
<td>Easy</td>
</tr>
<tr>
<td>26</td>
<td>By having the number of times per day a drug should be given to the patient in the ordination instead of the specific times would solve this problem, but may make the</td>
<td>Medium</td>
</tr>
</tbody>
</table>
ordination more difficult to interpret. Another solution could be to create some kind of a translator that translates the specific times between wards when a patient is moved.

| 27 | One solution to this problem is to implement a stop function in Cosmic that automatically ends all ordinations when a patient is discharged, or at least asks the doctor which ordinations that should remain active. | Medium |

| 28 | Re-designing the way ordinations are saved and presented to the user could solve this problem. A more easily implemented solution can be to update the current “change” functions and make them work on more attributes of an ordination. | Medium |

| 29 | A few users have expressed concerns that it is too easy to misplace or loose a referral when it is travelling between the different places in the system. A better theme to bind the parts of the process together would help the users a lot. It may require a major redesign of the entire referral management system | Difficult |

| 30 | Some users are logged out of Cosmic while working. Cause if unknown, perhaps network problems. Needs investigation to find cause. | Difficult |

| 31 | Changes in the working environment of the users can help relieve tension that causes pain. However this is only part of the solution, the number of clicks needed to perform | Difficult |
different tasks needs to be streamlined.

8 Discussion and Conclusion

Several of the problems described in the above section could be solved with better education. For example, adjusting dosage type is something that several doctors have struggled with\textsuperscript{94}. The solution is rather simple but not logical. If they had received a more thorough education this would never have been a problem. However, should education be the answer to an illogical system? Is it not better to design the system so that it is possible to discover the correct way on your own? The answer is that you have to find some kind of middle ground; no system of this magnitude can be so self-explanatory that you can learn everything there is to know about it simply by using it. Hence, education and practise is always needed when introducing new computer systems, however, an education can not cover everything. All features of the system should strive to be logical for its users, enabling the users to discover these by themselves, provided that they have been given a basic education. For Cosmic this means that some features should be redesigned, and that basic education should probably be made mandatory.

Some of the technical solutions are, from a usability standpoint, not well implemented. Many of these solutions are said to be chosen because of performance issues. This is probably true, however, from a technical standpoint this should not be the case. The filtering function in the Medical Records is a good example of this. See 8.7.1.3 Medical Module for more information. While the current implementation was most likely chosen in order to improve performance it should never have been an issue to being with. Larger systems can handle far more information without any performance issues.

The general opinion of Cosmic seems to be that while it currently takes a lot of work, this will eventually pay off. One thing that presently is working very well is the support organisation.

\textsuperscript{94} Problem Inventory, EPJ at Uppsala University Hospital, Uppsala, Sweden, 2007-11-08
Responses to queries are made quickly and efficiently and the users have indicated that they are very happy with it.\textsuperscript{95}

It has to be said that for a system this size, Cosmic is working surprisingly well considering its complexity and many modules. While it has many problems and design flaws there are very few critical errors and it is overall doing what it is intended to do.

Cosmic was introduced in order to improve quality of care and to save money. In the initial budget made in 2001 the break-even was approximated to occur in 2008, but is now believed to be a few year behind schedule. A lot of problems currently exist in Cosmic and they need to be resolved in order for it to achieve its goals.

When Cosmic is introduced in a new care unit, the personnel is offered to attend a course for three days. As the deployment progressed they added a 2 week long on-site support program due to earlier introduction problems. New Cosmic users that are not present during the introduction are offered only the three day course in Cosmic and scattered follow-ups throughout the year.

Cosmic is a module-based system, the cornerstones of which consist of the Medicine Module, the Referral System and the Shared Medical Records. It is fully operational and is in fact already in use at most locations within Uppsala University Hospital being the only exception. As a contrast to this the Common Drug List, which is a part of the Medicine Module, is fully deployed, but at some locations not in use. Because the different systems are not used by everyone, the effectiveness is reduced. Cost estimates have been made to show an approximate cost of not correcting the problems currently residing within Cosmic.

\textsuperscript{95} Interview, Sävja Care Centre, Sävja, 2007-11-07; Interview, EPJ at Uppsala Hospital, Uppsala, 2007-11-09
Appendix B: Dermatology

1 Background

The work of the Department of Dermatology is very well suited for Telemedicine. The patient’s condition is rarely acute and the skin diseases make dermatology very suitable for taking photographs for diagnose. With a photograph as the only material an experienced specialist can not only diagnose but also determine if the photograph is of adequate quality for this purpose. This requires a certain quality of the photographs and possibly education or experience from the photographer. At present, when a doctor at the Care Centre has a dermatology case and is uncertain of a diagnosis, the patient is referred to UUH. The time-span between the referral and the scheduled meeting at the Department of Dermatology is usually about one to three months. The idea of this project is that a Care Centre, in this case Heby Care Centre (HCC), will use a digital camera to photograph patients. These photographs will be discussed once a week, during a video conference, with the specialist at the Department of Dermatology at UUH.

In the end of 1998 a similar project was carried out, though at that time an asynchronous consultation method was used. The consultations were performed by taking photographs of patients and e-mailing the them to a specialist at UUH for consultation. The project was rather successful and lasted until 2000/2001.

The commencement of the HO project in dermatology has been postponed during the autumn, as a person willing to take responsibility was not found at the Department of Dermatology at UUH. This was due to the doctors work load. However, after a couple of months a person responsible for the implementation of telemedicine at the dermatology department was appointed.

96 Interview, specialist at the Department of Dermatology at UUH, 2007-11-12 16/11, Uppsala, Sweden; Interview, family doctor, 2007-11-21, Uppsala, Sweden
97 Eriksson, Leif, Telemedicin HL-Hud, Uppsala County Council
1.1 Technology
Since the Department of Dermatology has not commenced with the HO project, technological
details are still in the process of being decided. A digital camera with a lens system capable of
taking macro shots will be used. At the PoC a video conference equipment consisting of a large flat
screen TV, a hardware decoder, and a camera will be used. The PoC will use the same equipment
they use for video Discharge Conferences. For more information regarding the video conference
technology used at Heby98. At the CoE it is speculated that the specialist doctor will use a standard
PC solution at his office with software like vPoint and Bridgit.99

2 Usability

2.1 New Way of Working
Telemedicine will be used between two doctors; one specialist at the Department of Dermatology at
UUH and a doctor at a Care Centre. The doctors at the point of care will, more or less, continue to
work as before. The difference is that if a patient has skin alterations of unknown type the doctor
has the alternative to take a photo of it and consult with a specialist, instead of referring the patient
to the Department of Dermatology at UUH. This results in some new procedures. The doctors have
to manage a camera and transfer the images to a computer. The difficulty is not to manage the
technology itself, but rather to take good photos. The video conference itself puts higher demands
on the doctors' computer experience, e.g. they need to share the photos with the specialist. During
these video conferences the doctors also have the opportunity to ask for a second opinion in cases of
uncertainty. The specialist will, due to the collaboration, have to spend more time with the
computer.

2.2 User Opinions
At present, the collaboration have not commenced and there are no opinions about the actual
collaboration yet. However, there are opinions about the concept itself. One specialist at UUH does

98 1.1Technology
99 Appendix G: Technical Annex
not agree with the benefits of using video conference compared to using e-mail as he has experience from a previous project. The specialist feels that e-mail has the benefit of being asynchronous; he can send a reply when he is available. However, according to a general practitioner at Arsta Care Centre who has been involved in the previous collaboration with the Department of Dermatology, it can be valuable to have an interactive communication between the doctors. The video conference makes it possible to ask follow-up questions leading to education. He also pointed to the importance of usable technology to have a successful collaboration. Moreover, he believes that there are more applications and points of care that would benefit from such collaboration.

2.3 Benefits and Side Effects

The Department of Dermatology will, because of the collaboration, receive less referrals. The specialist at the department gave a rough estimate that ten per cent of the referrals could be avoided. Whether this results in time saving is hard to tell; the specialist still have to look at the images and participate in the video conferences. One benefit is that the doctors at the Care Centre will learn from the specialist in the cases they discuss. This will probably lead to a decreasing need for video conferences in the future and eventually a smaller workload for the specialists.

The use of an asynchronous consultation method has the benefit of having specialists look at cases whenever they have time. When using a synchronous method the doctor at the PoC has the ability to ask related questions and obtain a deeper understanding of how to treat or determine a particular condition. When using e-mail for consultations the doctor at the PoC can not be sure of when the doctor at the CoE will respond, unless they have a specific time slot for this purpose.

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100 Eriksson, Leif, *Telemedicin HL-Hud*, Uppsala County Council
101 Interview, specialist at the Department of Dermatology at UUH, 2007-11-12 16/11, Uppsala, Sweden
102 Interview, General practitioner at Arsta Care Centre, 2007-11-21, Uppsala, Sweden
103 Interview, Specialist at the Department of Dermatology at UUH, 2007-11-12 16/11, Uppsala, Sweden
3 Quality of Care

3.1 Patient Satisfaction

No patient opinions have been gathered at present since the project has not commenced. One can still draw some conclusions from previous experiences from similar projects. At the Department of Plastic Surgery at UUH a consultation project has been conducted together with Eskilstuna Hospital. Similar to what is planned to be launched in the field of dermatology, the Department of Plastic Surgery has acted as a CoE to Eskilstuna\textsuperscript{104}. In the Plastic Surgery project the patients have not felt that the quality of care has been suffering when a Tele-consultation has been made. The patient does not have to travel a long distance to be diagnosed or have a procedure unless it is necessary for the quality of care. If the specialist at the CoE can, with the help of photographs, diagnose or decide of a line of action the expertise from the hospital is still used. The patient that comes in to the Care Centres has often had the condition for a long time and desires a fast diagnose. If the time before patients can be diagnosed is shortened from one to three months down to one week, it would be an obvious gain for the patients.

3.2 Benefits and Side Effects

One side effect of these kinds of consultations is that excellence and competence is spread from the CoE to the PoC. If the consultations have some element of interactivity, e.g. a video conference, the doctor at the PoC can ask questions giving a better understanding of the procedure and therefore learn faster.

A benefit is that the general practitioner or district nurse, at the PoC, can receive a second opinion from the CoE when they have an possible diagnosis. Diagnosing using images might increase the risk of malpractice. But previous projects\textsuperscript{105} have shown that the specialist immediately can see if it is possible to diagnose using the photograph and in most cases it is. If it is not possible it could either be because the photograph is unclear or the specialist at the CoE has to look at and touch the skin alteration.

\textsuperscript{104} Appendix C: Plastic Surgery
\textsuperscript{105} Background
4 Economy

The collaboration is kept inside the County of Uppsala and there will therefore be no explicit money transfers. Both the Care Centres and the hospitals have the county as their financier and the economical aspects are taken care of in their different budgets. At present, the number of documented treated patients is considered in the process of deciding how much funding each department should receive from their division.

How should the Department of Dermatology at UUH count consultations? It is still the Care Centre that is reported as having treated the patient even if they consulted the specialist at UUH. So if the UUH do not count them at all they will do more work without getting paid for it, and most likely receive less funding because they have a smaller amount of patients to the hospital. If the Department of Dermatology instead counts the consultation as a treated patient each patient will be counted twice. Some new kind of documentation must be implemented. The problem is how much a consultation should weigh compared to a treated patient. This is not easily determined; it depends on how much time each consultation takes.

New technology has to be bought when starting the collaboration. Even if the investment cost are not small for the economically strained health care, it should not large enough to be an obstacle for the collaboration.

5 Discussion and Conclusion

There are no medical or technical reasons why the collaboration between the Care Centre in Heby and the Department of Dermatology should not be a success. The dermatology area is well suited for diagnosis from photographs and previous projects have shown that the risk for a incorrect diagnosis on account of the technology is very small106. Instead the threat to the collaboration is of human character; willingness to share knowledge resources and admitting to be in the need of such resources. However, there is no reason to assume that there will be a problem in this collaboration.

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106 Interview, specialist at the Department of Dermatology at UUH, 2007-11-12 16/11, Uppsala, Sweden; Interview, general practitioner Ärsta Care Centre, 2007-11-21, Uppsala, Sweden; Eriksson, Leif, Telemedicin HL-Hud, Uppsala County Council
This mainly because there is no competition between the two different professions, general physician and dermatology specialist.

In the previous projects, the collaboration was conducted through e-mail\textsuperscript{107}. This solution has some benefits compared to the video conference that will be used in this project. If the video conferences should be held once a week, the e-mail solution would generally give a faster response. The specialist does not need to have a scheduled time to answer the e-mails and instead small free time slots can be used. Also, the time spent on each case will be shorter compared to video conferences. However, e-mail is not as efficient as video conferencing when it comes to spreading excellence and competence. Since both ways of collaborating have different positive effects, a combination off the two may utilise all benefits. One scenario could be that only the video conference is used initially. Later on, when the doctors at the PoC start diagnosing, using their new found knowledge, they can use e-mail to confirm their diagnosis and receive a second opinion.

A rough estimation of a ten per cent cut of the referrals to the Department of Dermatology can impact on how the doctor spends his time in the hospital. There is a problem estimating how much time that will be saved, if any. One scenario is that the longer the project continues, and the more the doctors learn, fewer cases will be sent to the specialist. Another scenario is that the amount of time for the consultations stays on a constant level. As the doctors learn to diagnose the easier cases themselves they can gradually move on with more difficult cases in the video conferences, instead of referring them to UUH. Either way the needed time is not expected to increase along the project. If the specialists' workload do not increase (more than initially) benefits for health care heavily outweighs the trouble of introducing the technology and collaboration. Another consideration before fully incorporating the project is the legal issue of which party to hold responsible for a faulty diagnosis.

\textsuperscript{107} 1 Background
Appendix C: Plastic Surgery

1 Background

The Department of Plastic Surgery at UUH has two main tasks; plastic surgery and burn treatments. Within the field of activities of plastic surgery, the department serves as a specialised unit towards the region of Middle Sweden. It also serves the whole of northern Sweden with burn treatment services. Between 2005 and early 2007, the department participated in an EU project called SPEX (Spreading Excellence). This project aimed towards spreading excellence with the aid of Telemedicine. This was achieved with the use of video conferences, shared desktops and mobile phones that were able to send and receive photos. In this project the department acted as Centre of Excellence (CoE) and collaborated with Mälarsjukhuset Hospital in Eskilstuna (MHE) who acted as a Point of Care (PoC). This gave the single plastic surgery specialist at MHE consulting opportunities to discuss and gain experience from. The collaboration between UUH and MHE was a successful project and it is still active as of 2007. With SPEX, an agreement was made concerning economical reimbursements and to secure economical benefits for both parties. For more information about SPEX see STEVE (2006)\(^\text{108}\).

Prior to the SPEX project, MHE referred plastic surgery patients to UUH when they were unsure how to diagnose or treat them. The result of this was that UUH received referrals from MHE, even though some of the referred patients could be treated locally in Eskilstuna. This led to unnecessary transportation's and an unnecessary workload at the Department of Plastic Surgery at UUH. These referrals to Uppsala have been minimised thanks to SPEX. Because of the success of the SPEX project the Plastic surgery’s part in Health Optimum will be a continuation and expansion of SPEX. The collaboration with MHE will continue to work as before, although one more doctor will be involved at both the PoC and the CoE. In addition, the hospitals in Gävle and Falun will collaborate in a similar fashion. In the collaboration with these two new sites persons responsible for the collaboration has been identified, but the consultations has not been initiated yet. As of now the Department of Plastic Surgery at UUH is preparing a sales pitch package including technological

\(^{108}\) STEVE Student Evaluation of Telemedicine, Uppsala University, 2006
solutions to hand out to the PoC. They are also searching for doctors and other hospital staff to collaborate with.

1.1 Technology

Depending on the type of consultation, different technological collaboration tools are used. The tools, at the plastic surgery clinic at UUH, are shared desktop software, video conference software, high quality streaming, and mobile phones that are able to send and receive photos. Shared desktops are used from the doctor’s office on a standard PC.

The shared desktop software is mainly used for image consulting. Users can share and draw in an image to explain different procedures, illustrate to the other party their train of thought, etc. The software used for this application is called Bridgit\textsuperscript{109}. The video conference technology is used for consultations both when the patient is present and when it is only the doctors that are discussing. Depending on the situation, different solutions are used.

When the patient is present, together with the doctor at the PoC, a high quality streaming video camera is used at the PoC. The high quality streaming at the PoC is used to look at a patient’s wounds in real time. Instead of a simple web camera, a DV-camera is used\textsuperscript{110}. This is mounted on a movable table together with a computer. The doctor at the CoE then uses a video conference software, VCON vPoint HD\textsuperscript{111}, together with a simple web camera, locally at the doctor’s computer. vPoint is compatible with the other video conference technologies used at UUH which means that one of them could use a dedicated video conference room if they felt a need for it\textsuperscript{112}. When patients are not present the PoC also uses the vPoint software.

\textsuperscript{109} Interview, Fallgren, Anders and Nylund, Ulf at MIT department at UUH, 2007-11-12, Uppsala, Sweden; Interview, specialist at the Departments of Plastic Surgery at UUH, 2007-10-22, Uppsala, Sweden

\textsuperscript{110} Fallgren, Anders, Nylund, Ulf, and specialist Loc. Cit.

\textsuperscript{111} Ibid.

\textsuperscript{112} VCON vPointHD, retrieved 28 November 2007, 
When the doctor at the CoE at UUH want to illustrate or explain a condition of a patient located at the CoE the doctor uses a mobile video conference solution built into a briefcase similar to the one used in the Discharge Conference project\textsuperscript{113}.

The last piece of technology that is used in the collaboration is mobile phones that are able to send and receive photos. The most usual scenario, when this technology is utilised, is when doing consultations on a patient located at the aftercare-ward after having a surgery. Then the doctor at MHE takes a photo of a wound or condition and sends it to a specialist in Uppsala. The specialist can look at the image and make an assessment of what they should do. Here, a mobile video conference solution could come to use\textsuperscript{114}. So far, the video functionality of the mobile phones is not used.

2 Usability

2.1 New Way of Working

The main users of the technology are the plastic surgery specialists at the PoC and the CoE. So far, only MHE has participated as PoC and UUH as CoE. Sometimes, the patients are also users when they are participating in the video conferences; not by controlling the system but by changing the preferences for how the system is used.

These collaborations affect how the doctors at both sides work. One of the changes is that the doctors will spend more time in front of computers and other technological tools than before. The physical work environment will also have minor changes, for example a web camera in their office (depending on what techniques they are using in their collaboration). More work in front of the computer and new pieces of software and hardware will demand more of the doctor’s computer- and technical experience.

\textsuperscript{113}0 Appendix D: Discharge Conference; Interview, specialist at the Departments of Plastic Surgery at UUH, 2007-10-22, Uppsala, Sweden

\textsuperscript{114}Interview, specialist at the Departments of Plastic Surgery at UUH, 2007-10-22, Uppsala, Sweden
At the PoC the doctor will have an alternative to referring all difficult cases to UUH. If the doctor can not diagnose, or does not know what to do, the doctor can ask the CoE for consultation. In case of uncertainty the doctor can ask the CoE for a second opinion. This puts less pressure on the specialist at the PoC in cases of uncertainty.

For the CoE, the use of mobile phones will make the doctors a lot more available for the doctors at the PoC. The PoC might need a quick consultation in a case and for this the mobile phone solution works well. This also makes the doctor at the CoE available outside of work hours. For the PoC this is a positive thing but not necessarily for the CoE. Another problem is how to count this kind of short work moments.

2.2 User Opinions

Both the PoC and the CoE are satisfied with the technology even though they point out that some things are not perfect\textsuperscript{115}. For instance, one of the participants said that he wants a better web camera so that they can replace the streaming camera with a video conference\textsuperscript{116}. Another thing that was brought up was that it would be easier with one application instead of several different: “What you want is to have everything gathered in one place.”\textsuperscript{117}

The doctors involved at the PoC and the CoE agree that it is very important that the solutions are easy to manage and they also think that even if the technologies used are quite easy to manage they could be better in some areas. A doctor at the department of Plastic Surgery at UUH described the situation this way: “The idea is that using the technology should be so simple that everyone could use it.”\textsuperscript{118}

\textsuperscript{115} Interview, specialist at the Departments of Plastic Surgery at UUH, 2007-10-22, Uppsala, Sweden; Interview, specialist at the Departments of Plastic Surgery at UUH, 2007-11-16, Uppsala, Sweden; Interview by phone, specialist at Department of Plastic Surgery, Eskilstuna Hospital, 2007-11-13

\textsuperscript{116} Specialist 2007-10-22 Loc. Cit.

\textsuperscript{117} Ibid.

\textsuperscript{118} Specialist 2007-11-13 Loc. Cit.
One of the doctors from the PoC does not believe that technology itself is an obstacle for good collaboration; instead it can sometimes be doctors’ unwillingness to show that they lack knowledge in a certain field. However, this has not been a problem, so far in the project. And even though the PoC does not need as many consultations as before the doctor still thinks it is very valuable to have this kind of collaboration.119

A request for mobile solutions which you could take home with you when you are on call was also made.120 The mobile solution could consist of a portable computer with a built-in camera: “It would be a ideal solution to have a compact integrated mobile computer system [...] With this you could solve simple cases without having to go to the hospital.”.

2.3 Benefits and Side Effects

For the doctors at the PoC the most obvious benefit with this collaboration is to the possibility to discuss more difficult cases with an expert. With these consultations the doctor at the PoC can be helped with diagnosis, assessments on how to treat a patient, or receive second opinion. During these consultations, the doctor at the PoC will learn from the discussed cases and this could lead to the doctor being able to diagnose more independently. The consultations does not only benefit the PoC, the CoE will at the same time have a change to sift away simpler cases that can be treated at the PoC. Since the Department of Plastic Surgery at UUH is a regional specialised unit they are supposed to handle the harder and specialised cases. The department also has quite a high workload today, which could be lowered with the help of this project.

3 Quality of Care

3.1 Patient Satisfaction

No opinions have been given by the patients. Therefore, no true view of the patients’ satisfaction can be discussed. However, one can look at what the patient satisfaction is according to the doctors

119 Interview by phone, specialist at Department of Plastic Surgery, Eskilstuna Hospital, 2007-11-13.
120 Interview, specialist at the Departments of Plastic Surgery at UUH, 2007-10-22, Uppsala, Sweden
121 Interview, specialist at the Departments of Plastic Surgery at UUH, 2007-10-22, Uppsala, Sweden
and also draw conclusions from the SPEX project. According to the doctors involved, the patients are satisfied\textsuperscript{122}. When the doctor at the PoC ask the patients how they thought their consultation was, if they felt any discomfort or if it felt awkward talking to another doctor, the answers were that they are comfortable and satisfied with the technology and the consultations\textsuperscript{123}. One reason for this could be that they feel safe because they have the support of their own doctor who sits next to them. When the doctor at the PoC asked one patient how it felt to talk to another doctor and participate in a consultation session the patient responded\textsuperscript{124}: “I was with you, wasn’t I?”

The patients generally also believe that it is a good thing that the doctor had consultations with a specialised doctor and did not see it as a lack of competence in their own doctor\textsuperscript{125}. In addition, they welcomed that they did not have to travel to Uppsala to be treated.

3.2 Benefits and Side Effects

Care will change both in aspect to the actual treatment and to the administrative and logistic parts of health care when implementing Teleconsultations. In the treatment aspect the doctor in the PoC will be able to be more secure in the diagnosis since they can get a second opinion and have new knowledge acquired from the previous consultations. There are also benefits in the administration and logistic fields of health care. In cases where a consultation is enough, the patient to diagnose and/or treat, does not have to be transferred to UUH. This saves both time for the patient and money for the PoC. For the CoE the benefit is in less work load which, for example, could lead to shorter patient queues and more time to focus on certain cases. In cases where the consultations are successful, the patient most often will be treated sooner than would have been the case if teleconsultations had not been used.

\textsuperscript{122} Interview, specialist at the Departments of Plastic Surgery at UUH, 2007-10-22, Uppsala, Sweden

\textsuperscript{123} Interview by phone, specialist at Department of Plastic Surgery, Eskilstuna Hospital, 2007-11-13

\textsuperscript{124} Ibid.

\textsuperscript{125} Interview by phone, specialist at Department of Plastic Surgery, Eskilstuna Hospital, 2007-11-13
4 Economy

When UUH and MHE made their agreement in 2006 the goal was to create an agreement that all parties could benefit from. The idea was that the it should be a win-win-situation for all three participants; UUH, MHE, and the patients.

The gain for MHE, with this kind of collaboration, is that they will reduce costs for sending patients to hospitals outside of the county’s borders. For UUH, the gain is that their excellence is used more optimally. If a case, where specialist care is not needed, is taken care of by MHE the clinic at UUH can concentrate on the more difficult cases. The surgical clinic at MHE compensates the plastic surgeon at UUH in two ways for the consultations; one annual payment of 200,000 SEK per year, and also a payment of 4,000 SEK per consultation. For the patients who are treated at MHE with help of this collaboration the transports and waiting periods are reduced. The transportations from Eskilstuna to Uppsala are, since the care is outside of the borders of the patient’s home county, the County Council of Sörmland’s responsibility. This means that the transportation cost, from MHE to UUH, is also reduced for the County Council of Sörmland with this collaboration.

The agreement lasts for two years and expires February the first of 2008. All parties involved are happy with how the agreement has been written and they think that it has worked well. The amount of patients at UUH from MHE have been reduced since the doctors at MHE now have learned how to handle many of the cases and only refer the highly specialised ones. Therefore, when the agreement is to be revised one effect that should be taken into consideration is that since MHEs competence increases with this kind of collaboration, UUH will not be consulted as much as before. Since the County Council of Sörmland and County Council of Uppsala have a general agreement concerning health care this project agreement could also be included as a part of the whole agreement between the two hospitals.

126 Interview, specialist at the Departments of Plastic Surgery at UUH, 2007-10-22, Uppsala, Sweden; Interview, Eklund, Benny, Project Manager Health Optimum, 2007-10-12, Uppsala, Sweden;
127 Ibid.
128 Interview, specialist at the Departments of Plastic Surgery at UUH, 2007-10-22, Uppsala, Sweden; Interview by phone, specialist at Department of Plastic Surgery, Eskilstuna Hospital, 2007-11-13
5 Discussion and Conclusion

The Department of Plastic Surgery already has come far with using Telemedicine, this mainly thanks to the previous EU project called SPEX. The Department of Plastic Surgery at UUH is looking for ways to spread the use of these kinds of collaborations further. Partly by starting collaborations with more hospitals outside of the county’s borders, but also inside of the hospital and with the county’s Care Centres. When doing so it is important that the technological solutions used are marketed and packaged in a comprehensive way to attract key personnel and facilitate commencing with the collaborations.

The following implementations of telemedicine is examples of situations where an implementation would be beneficial. One implementation, also mentioned by the Department of Plastic Surgery, is using this technology with the emergency ward at UUH\(^{129}\). When a patient with a difficult and advanced condition arrives, a consultation from a specialised plastic surgeon can sometimes be needed. For example, if a patient with severe burn wounds comes to the emergency ward and the staff needs an expert opinion on treatment of the patient, an on-call technology could be used to help a patient get adequate health care faster. There are advantages with these kinds of emergency consultations both in crucial cases, where the plastic surgeon can give instructions on treatment or preparations until the doctor arrives, and in cases that are not acute. In non-acute cases the personnel of the emergency ward may be unsure of the treatment or how severe the condition is and the plastic surgeon can diagnose or make an assessment. Early consultations can be crucial in severe cases. Another benefit is time saved for the doctor when a visit to the emergency ward is not necessary.

When the plastic surgeon is on-call at home, a dedicated on-call laptop can be used. When the doctor is at the, hospital existing video conferencing equipment or an on-call computer could be used. A laptop could also be used for video conferencing consultations when the plastic surgeon doctors are on standby duty at home. A similar implementation, that personnel at the plastic surgeon at UUH are evaluating, is to use these kinds of consultations when a specialist doctor is doing the rounds at more than one ward. The Department of Plastic Surgery also has an open mind towards

\(^{129}\) Interview, specialist at the Departments of Plastic Surgery at UUH, 2007-10-22, Uppsala, Sweden
implementing the collaboration technology in other areas, such as an operation theatre to be able to make fast consultations during operations.

Doctors at the Department of Plastic Surgery at UUH has expressed that parts of the software used on PCs is sufficient, but not optimal for the department’s needs. Also, a more homogenous solution is desired but at the moment not possible due to many circumstances. For one, the developers are not the same. And more importantly, the different systems do not solve the same kind of problems. To specially construct software that would fulfil all demands would be very expensive and only solve minor inconveniences like opening several different programs. There are no large benefits that would counter weight the costs of creating a uniform solution.

The Department of Plastic Surgery at UUH have moved forward fast and is eager and open-minded to try and find new application for Telemedicine but the MIT department at UUH have not been able to keep up. The MIT department has a lot to do and have not had the time to answer to the Department of Plastic Surgerys requests. The risk is that if the waiting is too long the entusiasm at the Department of Plastic Surgery might wither and the development of the project suffer. Furthermore, in some cases there is a resistance from the MIT department against PC-solutions because of bad experience with lack of reliability of such solutions.

The current collaboration is working well and the expansion to new sites is on its way, even if the start was slow. The collaboration with Gävle and Falun will initiate in the beginning of 2008. The technology used in the collaboration has been sufficient, but the development of new tools that fits the collaboration better have lagged behind. MIT department at UUH have not had the time to fulfill the Department of Plastic Surgerys wishes. As shown from SPEX the collaboration has many benefits and works economically. The next step is to adapt the technology better and expand the collaboration to see how it works on a larger scale.
Appendix D: Discharge Conference

1 Background

When patients', that needs further care, have been treated at the Uppsala University Hospital (UUH) they are to be transferred to their home municipality. If the discharged patient currently have, or in the future will have, home-help service, a Discharge Conference will take place. This is to ensure that the patient will obtain the correct care in their home municipality. When the doctor considers the patient to be fully treated, the home municipality and the corresponding Care Centre in the home municipality is contacted.

Regulations state that when UUH have informed the home municipality, the municipality have five weekdays to transfer the patient to the municipality care. After these five days the they will be charged 2,000 SEK\textsuperscript{130} per day that the patient is still in the care of UUH.

When a Discharge Conference is scheduled, the responsible nurse at UUH informs the aid worker, district nurse, and aid official from the municipality. Sometimes a physical therapist and/or an occupational therapist also participate. The conference is attended by the patient and next of kin. For each conference the staff from the home municipality travels to the UUH. To reduce this unnecessary travelling, Teleconference is being evaluated. At the beginning of this project only a few of the departments in UUH has participated with the municipalities Heby, Östervåla, and Tierp.

Heby Care Centre (HCC) that will be the focus of this section, has previous Telemedicine experience when it comes to Discharge Conference. When Heby municipality belonged to the county of Västerås they had video Discharge Conferences with Västerås hospital. When Heby, at the turn of the year 2006/2007 changed county, the Care Centre expressed a wish to also have Teleconferences with UUH\textsuperscript{131}. Hence, Video Discharge Conferences, now referred to as VDC, has been used three times during the spring of 2007 between Heby Care Centre and UUH Emergency and

\textsuperscript{130} Interview Lyttkens, Leif, Chief Medical Officer, 2007-10-16, Uppsala, Sweden

\textsuperscript{131} Interview, District nurse and technician at Heby Care Centre, 2007-10-19, Heby, Sweden
Rehab. In November 2007 they have had two VDCs. The Orthopaedic Department had approximately 6 conferences.

1.1 Technology

The video conference tools used to communicate between UUH and HCC are using Sjunet for its communication infrastructure through IP networking. As for audio and video, they use video conference hardware transcoders that are compatible with a standard which several different manufacturers support. The UUH has two different kinds of systems, a studio and a mobile solution developed by the MIT department. HCC has a single stationary solution.

Uppsala University Hospital Tele-technology

A Studio, located in the Orthopaedist Department building is, among other things, comprised of:

- Two 32” monitors of cathode array technology.
- A video camera with zooming and turn and tilt rotating possibilities, controlled by control remote and viewer control, made by Tandberg.
- Encoder/Decoder Hardware with remote control by Tandberg.
- A high quality pointed table microphone.

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132 Interview, Health care planner at UUH, 2007-11-06
133 E-mail conversation, Health care planner at UUH, 2007-11-26
• Speakers.
• Document camera.

A Mobile solution comprised of:

• A Camera with zooming and x-axis rotating possibilities, controlled by remote control.
• Hardware encoder/decoded with remote control by V-con, model h600.
• A 15” TFT monitor.
• A microphone located on top of the camera.
• Laptop PC speakers.
• Briefcase.

The mobile solution is not located at the point of care, but at the MIT department at UUH. When
the shared studio at the UUH is occupied, or when the relocation of a patient is inappropriate, a
technician brings the briefcase to the patient's ward. This has proven to become a temporary solution.
The briefcase is mobile, however, it is so heavy its placed on a trolley for transportation, this makes it
only a temporary solution. Therefore, plans have been made so the hardware will be fastened on a
trolley in the future. This also gives options to upgrade to a larger TFT screen.

**Heby Care Centre Tele-Technology Solution**

![Heby solution](image)

**Figure 3: Heby solution**

Heby's solution is stationary and temporarily placed in an examination room. The room is, among
other things, comprised of:

• A wall mounted 32” flat screen TV.
• Hardware encoder/decoder by Sony.
• Video camera.
A microphone, attached to the camera.

All of the video conference hardware is normally operating at 768 KB/s on Sjunet, but with the reserved option to work with ISDN connections. The system uses an IP address or a short-number service, giving telephone-like calling numbers to facilitate "calling" with the provided remote control\textsuperscript{134}.

2 Usability

2.1 New Way of Working

In a Discharge Conference a lot of different people are involved. Those who have to participate at the conference are the patient, the nurse in responsible for the patient at UUH, an aid worker, and the district nurse from the patient's home municipality. In addition to these there is also, most of the times, one or several relatives of the patient's present at the patient's side. So far, the health care planner from UUH also has been present at the UUH side mostly for administrative purposes. The health care planner may not be needed in the future depending on how certain issues will be handled. These issues will be discussed below. There has also been a technician involved to set up the technology and start up the conference.

When replacing the old way of having the Discharge Conferences with a video conference the Care Centre in Heby estimates that their district nurses will save three to four hours each conference session compared to travelling to Uppsala\textsuperscript{135}. Both the district nurse and the aid worker saves time. At UUH, the way of working changes in other ways. Depending on who is participating in the meeting either the health care planner or the nurse responsible for the patient have to participate in the entire meeting to manage the technology and keep the patient company (if there are no relatives present). This will take a lot of time from the nurse who could previously leave the meeting after the representatives from HCC had been briefed. This briefing takes about fifteen minutes which

\textsuperscript{134} Interview, Fallgren, Anders and Nylund, Ulf at MIT department at UUH, 2007-11-12, Uppsala, Sweden

\textsuperscript{135} Interview, District nurse at Heby Care Centre, 2007-10-19, Heby, Sweden
means that, since a Discharge Conference can take up to an hour, the nurse may have to stay up to 45 minutes extra when a video conference is held\textsuperscript{136}.

Another change, that will affect UUH the most, is when new meetings are scheduled. If the video conference studio is not used, the technician must be available to bring the briefcase. This might only be in the beginning and hopefully later on, each ward or department will have their own video conference system. At HCC, the janitor is responsible for the technology and he is the one that tests and prepares the technology before every meeting. If the number of video Discharge Conferences increases a lot, the workload on the janitor will also increase.

\subsection*{2.2 User Opinions}

The users at Heby Care Centre are mostly very satisfied with the use of video conferences. Regarding the technology the main opinion is that it is easy and simple to use. However, they also believe that some things, mainly regarding how the technology is used, can be improved. For example, one thing that was pointed out was that during a video conference with UUH, the UUH side zoomed in on each person who talked. This was sometimes unnecessary and a disturbance. The staff at HCC feels that if a constant zoom where used, where everyone was more or less visible, they could see who was talking anyway. One member of the staff at HCC also believed that the actual meetings sometimes were more effective when using the video conference because there is less unnecessary talk\textsuperscript{137}.

The staff at UUH agrees with HCC and understands why they want to have video conferences instead of real life conversations. Contrary to HCC, the staff at UUH believes that it is important that they zoom in on the person talking\textsuperscript{138}. It might feel more important to the personnel at UUH that the zoom is extensively used because they have a smaller screen (if they are using the briefcase) than HCC and the faces are not as visible. It may also be that since they feel that it is

\begin{flushright}
\textsuperscript{136} Interview, Health care planner at UUH, 2007-11-06
\textsuperscript{137} Interview, District nurse and technician at Heby Care Centre, 2007-10-19, Heby, Sweden; Observations, Video conference between UUH and Heby Care Centre 2007-11-13, Heby and Uppsala, Sweden
\textsuperscript{138} Observations, Video conference between UUH and Heby Care Centre 2007-11-13, Heby and Uppsala, Sweden
\end{flushright}
important for the patient and relatives to see who they are talking to, that it would be important the other way around as well. The impression is also that someone has told them that it is very important to zoom.

The question whether they prefer the briefcase or the dedicated room was easily answered. If they have to transport the patient a long way they much rather use the briefcase. For example the emergency and rehabilitation ward rather use the briefcase because they are located in another building than the dedicated room. For the opposite reason the Orthopaedist uses the dedicated room because it is in the same building and all they have to do is take the elevator some floors down.

2.3 Benefits & Side Effects

The major benefit, and the main reason why to use video Discharge Conferences, is the large time-saving for the municipality and Care Centres. As one of the nurses pointed out it might be that not only the travel time is saved, but also if the meetings are more effective, time from the actual meetings are saved. Another side-effect is that nurses in UUH might waste valuable time during conferences because of the time to set up the technology and when they keep patients company during the rest of the conference. This could be solved with a person responsible for conferences, who does not have to be medically educated and who sets up the video stream and keeps the patient company during the rest of the conference. If it is a fact that the meeting becomes more effective this time loss might not be as much as first expected.

The meeting should also be easier to schedule, since it is easier for all involved to find an open one hour slot instead of an open three hour slot. The new way of communicating has some effects on how the involved persons interact with each other. Since the small talk and social interaction is minimised the "water cooler effect" is lost. The staff at UUH will have some more things to think about, and to do (at least initially), and the result of this could be more stress.

139 Interview, Health care planner at UUH, 2007-11-06
140 Interview, District nurse and technician at Heby Care Centre, 2007-10-19, Heby, Sweden
Considering the generally high age of the patients, the technology used at some sites (e.g. the video conference briefcase) should be revised. When using the video conference briefcase, some of the elderly have problems to see the other party because of the limited screen size\textsuperscript{141}. This is quite crucial because if the patient can not properly see the person talking, the communication will become less intuitive and harder for the patient to accept. The dedicated video conference room is not without problems either. In the dedicated video conference room the atmosphere is very formal and strict which can make the patient and next of kin unfamiliar to video conference, tense, and uncomfortable.

3 Quality of Care

3.1 Patient Satisfaction

Due to the low amount of patients involved in the Discharge Conferences the following information is extracted from interviews with the involved medical staff and from participatory observations during video conferences. How do the patients react when you replace a local conversation with a long distance conversation over the Internet? None of the patients so far have had any specific objections towards participating in the video conferences. Instead the patient often seem to be a bit impressed and curious of use of technology\textsuperscript{142}. We have to keep in mind that this is when there is another person together with the patient during the conference. If the patient would be left alone the impressions of the video conferences might change because the patient feels more vulnerable. In some of the observed cases the next of kin have seemed displeased with the whole situation. This could probably be improved with better information to the ones participating in it.

3.2 Benefits and Side Effects

One of the requirements for this project to be successful is that the quality of hospital care is not affected in a negative way. So far, during the initial Discharge Conferences, nothing implies that

\textsuperscript{141} Interview, Health care planner at UUH, 2007-11-06.

\textsuperscript{142} Interview, District nurse and technician at Heby Care Centre, 2007-10-19, Heby, Sweden; Interview, Health care planner at UUH, 2007-11-06
this requirement has been broken. On the other hand, video conferences do not have any clear benefits to the quality of care either.

A possible benefit would be that, because of time-savings at the patient's home municipality, the conferences should be able to be scheduled sooner, because it is easier to find a one hour slot than a three hour slot, the patient could therefore be transferred faster to the municipality care. This could in the long run make patient queues shorter because the wards/departments are able to increase the flow of patients. At the same time, the opposite might happen in the beginning since a technician also has to be able to attend to the meeting. Because of the large time-savings in the patient's home municipality, the district nurses will also be able to treat more patients. A consequence of this is that the patients in Heby will be treated sooner.

One side effect is that if technology itself is malfunctioning the quality of the meeting will be worse. Things might not be decided because difficulties in the communication. The same thing might happen if the patients or next of kin feel very uncomfortable. They may keep silent about things they feel may not be that necessary because it feels bothersome to say it over the video. The problem is that things the next of kin believes is not important may be important for medical staff.

4 Economy

The main beneficiaries of this part of the HO project are the municipalities and Care Centres that are located a bit further away from Uppsala. These are the ones that saves most time, and therefore more money, with the new way to collaborate. Not only will the district nurses be more effective but also because they can treat more patients the Care Centre will acquire more funding. But there is also a downside for the Care Centres with this type of Discharge Conference; in today's system this video Discharge Conference is not registered as a patient session and the Primary Care does not receive any funds for it[143]. Depending on the future implementation of the conference, UUH will develop additional costs. If they need to have a person to keep the patient company during the video conference it will cost in man hours.

[143] E-mail conversation, Lindberg, Charlotta, Project Assistant Health Optimum, 2007-11-12
Even though, most of the benefits are at the Care Centres and in the municipality, UUH can also save some money due to the VDCs. If the patient is able to be transferred to the municipality care faster, the hospital and the society will save money because a bed at the hospital is far more expensive than a bed in the municipality care. But even though this is a saving for the society in a larger perspective the municipality loses money. Because the municipality have five free days before they need to pay for the patient at UUH it will only be a cost to take over the patient earlier.

To support the introduction of Video Discharge Conferences, two kinds of new reimbursements might be necessary. First, UUH needs to have an economical incitement to have the video Discharge Conferences, or improved quality of care. Today the impression is that UUH only wants to do it because they feel obligated when they know how much time the municipality and Primary Care will save. This could be helped if UUH got a small economical compensation for the more work in connection to this video Discharge Conferences. Second, reimbursement does not affect the video Discharge Conference but the whole hospital care. The municipality needs some motivation to take care of patients as soon as possible. This could be done with a small bonus if they can take over the patient before the 5 days have expired.

The cost of the actual technology is not a large obstacle for the introduction of this in additional departments/wards. The technology can be used in other contexts and the purchase of the technology is a one-time cost.

5 Discussion and Conclusion

All of the problems mentioned in this discussion are problems that eventually will be solved with experience. These are problems that are not specific to this situation or the people using it. The problems encountered naturally arise when new technology is introduced. Our suggestions are merely shortcuts to minimise the time to needed acquire this experience. The following proposals derive from observations of VDCs and interviews with key personnel.

The technology infrastructure and hardware is well-founded and needs only minor peripheral adjustments, e.g. a larger screen for mobile equipment at UUH and a better microphone at Heby health Care Centre. These issues are easily solved and greatly beneficial to solve. These technology
issues are well known by the MIT personnel and will be dealt with\textsuperscript{144}. However, the main problems are related to human computer interaction, i.e. how the staff relates to the technology. The personnel have only had a few video Discharge Conferences and therefore it is natural to have an un-transparent relation to the technology. To achieve transparency you need time and experience. To speed up the process, routines for how a VDC should be performed, are needed. These routines would aid health care staff to use the technology as a natural part of a VDC. This will most likely be a great tool for future collaborations at the early stage of deployment for the staff. When collaborating on a larger scale, experience can be spread using these routines. This experience could help staff so they do not have to invent the wheel for each new deployment of the technology. Unified technical and social manuals would also be of great benefit to the patient and next of kin.

There should also be information channels for patients and next of kin to prepare them for a Discharge Conference. After observations of the VDCs, indications were seen that the next of kin and patient participating in VDC felt discomfort at these conferences. Especially the studio solution can be a discomfort factor since the next of kin and patient enters unprepared into an unknown, unnatural, and highly technical environment. The mobile solution can be more adequate in a psychological aspect relative to the patient, since you bring an unknown object to an environment you are already acclimatized to. The discomfort could be avoided, or reduced, with information and established routines modelled to benefit the next of kin and patient before a planned VDC. To prepare the patient and next of kin they should be informed of how and where the conference will take place. This could consist of a pamphlet to inform the involved individuals of the studio with pictures and simple explanations of the technology to reduce discomfort of the unknown. Routines and technical manuals should be made for the staff to achieve technology transparency sooner and ensure better experience for the patient. An evaluation of the these aspects is needed in order to create the needed routines.

When the nurse at UUH has informed all parties of the patient's condition the nurse can leave the conference. Previous to VDC, this was not a problem since members of both UUH and Heby health Care Centre where physically present at the same place. With VDC, if the nurse leaves, the patient

\textsuperscript{144} Interview, Fallgren, Anders and Nylund, Ulf at MIT department at UUH, 2007-11-12, Uppsala, Sweden
and next of kin would be left alone for the remainder of the conference leading to a feeling of abandonment. Also, technical complications could arise in the conference. This can be solved by assigning one of the personnel at UUH to sit in on the meeting. As of now the health care planer does this task. One could choose to keep having this assigned to the health care planner, however, this solution can be unwise since these members of the staff generally are very busy. In the future, if collaborations are spread to include additional wards at UUH and additional Care Centres, the issue needs to be addressed. One solution could be to have one person at the division responsible for all these conferences who attends these conferences and makes sure that they are performed well and correctly.

Using video Discharge Conferences has an undisputed gain for the Care Centres, and the further away from UUH they are located, the greater the benefits are when unnecessary travelling is reduced to a minimum. As of now the gain for UUH is unclear. One can argue that time saved at the Care Centres can result in faster discharged patients at the UUH.

The implementation used by the UUH and HCC are well-founded and generally a very good solution to the issues that arise with travelling. Since this project is in an early stage, the staff is naturally lacking experience, but experience and solutions to small peripheral technology issues can probably be hastened with the aid of tools such as technical manuals and routines. Regardless, there are things that could be improved. For example, the problem with leaving a patient in a VDC alone on UUH needs to be considered.
Appendix E: Neurophysiology

1 Background

Neurophysiologic examinations aim at mapping functions in the central and peripheral nervous system. They are designed individually depending on symptoms and modified depending on the acquired results. The diagnosis aims at being a description and an interpretation of the acquired results. It also contains a summary which should act as guidance to the referring doctor\(^\text{145}\).

One examination method used at the Department of Neurophysiology at UUH is electroencephalography (EEG). The examination is performed by attaching a number of silver electrodes to the patient’s head. Brain activity is then registered at rest and during provocations, such as hyperventilation for a period of three minutes, and flashing light for a period of five minutes. Total registration time is usually about 40 minutes. If there is a suspicion of epilepsy, sleep is also used as a provocation, which prolongs the examination time\(^\text{146}\).

The Department of Neurophysiology at UUH currently consists of ten doctors, ten biomedical analyzers, four secretaries, one assistant, two engineers, and one attendant. University employees, such as scientists, secretaries, and engineers, are also a part of the ward. Patients are referred to the ward from both the hospital’s other wards and non-institutional care sites, called satellite labs. When a patient at a satellite lab is referred to the Department of Neurophysiology a biomedical analyzer at the satellite lab performs the EEG registration, which is then accessible to the Department of Neurophysiology via Sjunet\(^\text{147}\). Patients are only referred to the Department of Neurophysiology at UUH when they can not be diagnosed at the satellite lab\(^\text{148}\).

\(^{145}\) Brochure “Metoder och Indikationer” - Department of Neurophysiology at UUH

\(^{146}\) Ibid

\(^{147}\) Carelink, Sjunet - Kommunikationsnätet för vård och omsorg, retrieved 26 November 2007 <http://www.carelink.se/tjanster/sjunet>

\(^{148}\) Brochure “Metoder och Indikationer” – Department of Neurophysiology at UUH
Current satellite laboratories:

- Gävle (Hudiksvall)
- Falun (Säter, Mora)
- Karlstad
- Örebro
- Västerås
- Eskilstuna
- Stockholm
- Mariehamn

When performing an examination where there is a suspicion of epilepsy it is sometimes difficult to separate artefacts, such as the patient moving, from real epileptic activity. The new project will evaluate the use of embedding video with the EEG in order to address this issue. All EEG registrations with embedded video are analysed at the Department of Neurophysiology at UUH\textsuperscript{149}.

An EEG registration requires about ten megabyte and a video recording about ten megabyte per minute. Video is recorded with a standard MPEG-4 codec which makes it easy to play in other applications at other locations relating to educational purposes. It can also be edited allowing only video containing interesting information to be kept. This allows for faster analysis if the registration has to be reviewed\textsuperscript{150}.

The project is, as of 8th of November 2007, active as a pilot project between the satellite lab in Hudiksvall and the Department of Neurophysiology at UUH. This pilot project will hopefully be accomplished before 1st of January 2008 and consist of about fifty EEG diagnoses. Negotiations are currently also in progress to include the satellite lab in Örebro. The pilot projects will then be evaluated and one will decide whether to incorporate satellite labs in the rest of the country. If incorporated, the satellite labs need to be convinced that this solution is worth the investment\textsuperscript{151}.

\textsuperscript{149} Interview, Flink, Roland, Uppsala, Sweden, 2007-10-16
\textsuperscript{150} Interview, Flink, Roland, Uppsala, Sweden, 2007-11-16
\textsuperscript{151} Ibid
Expectations are that the project will result in better diagnostics and fewer patients brought back for the complementary registrations needed to distinguish artefacts from real epileptic activity. It is also expected that it will be possible to use a smaller amount of registrations to diagnose the patient’s condition\textsuperscript{152}.

\section{Evaluation of EEG Recordings with Embedded Video}

\subsection{Background}

As stated in the previous section, in order to improve the diagnosis for possible epileptic patients an evaluation of using electronic EEG recordings combined with video has started. During normal activity, the EEG recording consists mostly of regular shapes. When there is an epileptic activity the chart fills up with spikes. It is these spikes the doctor looks for when examining an EEG chart. A lot of times it is hard to know whether a spike in the EEG recording is epileptic activity or not. For example, merely touching one of the electrodes can give multiple huge spikes in the EEG recording and thus look like an epileptic activity. Normal movements will also cause registrations in the chart, which makes diagnosing harder. However, if a video of the patient is provided along with the chart, the analysing doctor can more easily see whether the spikes in the chart are due to some external factors or if it is caused by an epileptic seizure. This is time saving for both the doctor and the patient. It is not time saving in the sense that an analysis will take shorter time (to do a diagnosis should take between ten to fifteen minutes), in fact an analysis including video will take a few minutes longer, but saves time by enabling the doctor to do a more exact diagnosis. For example, if the doctor analyses an EEG recording that contains some suspicious activity she might not be completely convinced that the patient actually has epilepsy and wants to do another test. If the doctor had been able to watch a video of the patient during this suspicious activity, the doctor could have been able to either rule out or diagnose epilepsy after merely one analysis. There is no real difference in how the doctor works when analysing with video. The doctor analyses the electronic EEG recording and only uses the video as a complement\textsuperscript{153}.

\footnotesize
\begin{itemize}
  \item \textsuperscript{152} Interview, Flink, Roland, Uppsala, Sweden, 2007-11-16
  \item \textsuperscript{153} Ibid
\end{itemize}

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There is an agreement between the Department of Neurophysiology at the UUH and the hospital in Hudiksvall that all the electronic EEG recordings, with video from Hudiksvall, will be diagnosed in Uppsala. The charts and the video are stored locally and can be accessed and analysed in Uppsala using a computer program called “Nervus Study Room”. An EEG registration session normally takes about 40 minutes. It is important that the doctor can see the whole body in the video because epileptic seizures can induce movements in the limbs. The lighting should be sufficient enough to distinguish even small eye movements. The ideal situation would be to have two cameras; one showing the whole body and another showing the face\textsuperscript{154}.

2.2 Method

The Department of Neurophysiology at UUH has set up a procedure to evaluate this new way of working. For every patient diagnosed using the new system the analyzing doctor evaluates whether the video was a helpful complement or not. The procedure used to evaluate the new system is shown in the table below:

<table>
<thead>
<tr>
<th>Point</th>
<th>Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0+</td>
<td>Not helpful at all, the diagnose could be done without video</td>
</tr>
<tr>
<td>1+</td>
<td>A technical artefact in the chart can be discovered using video, the patient does not need to do another EEG</td>
</tr>
<tr>
<td>2+</td>
<td>A diagnosis of epilepsy can be made using the video</td>
</tr>
</tbody>
</table>

\textsuperscript{154} Interview, Flink, Roland, Uppsala, Sweden, 2007-11-16
It is estimated that at least 50 evaluations is needed to do a fair judgment of EEG recordings with video\textsuperscript{155}.

3 Usability

The staff involved with the procedure of EEG recordings at the point of care is the committing doctor, a biomedical analyst (BMA), who connects all the necessary technology, and a nurse that also observes the patient during the procedure. At UUH there is, besides the responsible neurophysiologist, a secretary that prints what the doctor dictates after having reviewed the patient’s case. The neurophysiologist reviews the referral and signs it digitally. The referral is then sent automatically back to the committing doctor. The extra work for the neurophysiologist includes a click on the screen when he needs it since the video feed is included with the EEG recording. To see hold of the video and the chart the neurophysiologist at UUH logs on to the actual satellite lab server and streams the chart, and if it is necessary the video, through Sjunet.\textsuperscript{156}

The initial feedback from the satellite lab in Hudiksvall was positive. This, since it is very little extra effort is needed by the medical staff to implement the video stream in their examination. The staff that is doing the examination in Hudiksvall says that it is less stressful with the video stream, since they will not miss anything of importance, for instance if the patient moves. It is also easier than they expected to operate the camera. With time they think they will be able to handle the camera more proficiently and thus acquire better video recordings.\textsuperscript{157}

From the patient’s perspective, as long as there is a chance of a better diagnosis using video, it is worth an evaluation. The only thing different in the examination procedure for the patient, is being informed that there will be a video camera filming the procedure and what the benefits to expect from this. There is no extra concern for the patient.

\textsuperscript{155} Interview, Flink, Roland, Uppsala, Sweden, 2007-11-16
\textsuperscript{156} Interview, Flink, Roland, Uppsala, Sweden, 2007-10-16
\textsuperscript{157} Interview via e-mail, biomedical analyst, Hudiksvall, Sweden, 2007-11-28
One of the few problems is that all of the satellite labs have to be equipped with the new Telemedicine equipment, which is a costly investment, and be informed on how to set the lighting in a correct way. Bad lighting is a problem that can cause the video stream to be less useful. It was common in the beginning of the deployment of the system.

4 Quality of Care
A normal EEG-recording takes about 40 minutes when patients is treated by a neurophysiologist. If this exam is done in one of the satellite laboratories and the evaluation is done in UUH, the evaluator needs more information due to some suspect signals in the EEG-graphs. The patient must then make another journey to the satellite laboratory to for an additional exam do determine whether or not the signal was an artefact. If the satellite laboratory uses video recording during the exam the examiner at UUH has a helpful asset to exclude artefacts as possible brain activity that may lead to an epileptic seizure. This leads to faster results from the examiner and less travelling for the patients, making them more satisfied. It also helps the specialist to diagnose the patients more rapidly, enabling for faster treatment\textsuperscript{158}.

In the future, hopefully several satellite laboratories will be connected to UUH. The benefit from using Telemedicine and video in EEG-recordings is that, because of the increased centralized diagnoses, the specialist doctors at UUH will increase their expertise. By studying the EEG-recordings and read the diagnosis from UUH the personnel at the satellite laboratories could also develop a greater skill at what they do\textsuperscript{159}.

5 Economy
In the Department of Neurophysiology each session of recorded EEG with video must take no more than fifteen minutes to examine and diagnose. The satellite labs and corresponding county sends a request for UUH to examine all newly recorded EEGs. For each of these examinations the county charges 400 SEK. As there is a steady flow of three to five requests for EEG recording

\textsuperscript{158} Interview, Flink, Roland, Uppsala, Sweden, 2007-11-16
\textsuperscript{159} Ibid
examinations per day, the county receives somewhere between 1200-2000 SEK a day for a relatively short amount of man hours\(^{160}\).

## 6 Discussion and Conclusion

Neurophysiology is well suited for combining with Information Technology, since in order to do a diagnosis for epilepsy the doctor is mostly interested in the EEG recording. These recordings can very well be transferred electronically from the PoC to another location for analysis.

By including video with the recording it is possible to reduce the number of registrations needed, since a completely healthy person might need to do another registration because of artefacts making the doctor uncertain. If the doctor had the possibility to watch a video of the patient during the activity he could exclude the diagnose epilepsy. Furthermore, EEG recordings with video increase the chance of a faster diagnosis because the doctor can confirm an epileptic movement. A more exact diagnosis done early can possibly shorten the inconvenience for the patients, since it allows control of the disease at an earlier stage through ordination of the right medication.

The use of EEG recordings with video looks promising and has the potential to be really useful and help doctors make an exact diagnosis early, without being at the PoC. The evaluation being done at the Department of Neurophysiology at UUH will show if this is something to continue to use in the future.

\(^{160}\) Interview, Flink, Roland, Uppsala, Sweden, 2007-11-16
Appendix F: Radiology

1 Background

The radiology department at UAS has been using a digital system, called RIS/PACS\textsuperscript{161}, since 2001. Before this, the x-rays and other picture materials were handled in paper form and stored in large underground archives. The digitalization meant storing x-ray data in digital form on disk, and implementation of both fast short-term storage and slower long-term storage. The short-term storage was designed to give quick access to recent examinations from the last six months. The capacity of the short-term storage was matched to the number of expected examinations at the time, while the long-term storage was supposed to act like an archive and provide storage for old examinations. Since the data in the long-term storage should not be as frequently used, a capacity oriented solution, rather than accessibility oriented solution, was selected.

Today the amount of pictures taken in each examination is much greater than when the system was first introduced. Some examinations may generate a hundred times more data than before or even more. This gives higher resolutions and a better base for making decisions, but it has also put a lot of strain on the system. The growing quantities of data do not only make the short-term storage insufficient, but is also affected by bandwidth limitations within the long-term storage. A high load on the long-time storage results in waiting times far greater than those intended when the system was built.

Aside from the increased need of data capacity there has been incompatibility issues between some interfaces. This has resulted in image being lost due to them being renamed when migrated to the long-term storage\textsuperscript{162}. This has resulted in wishes for a more unified system in order to solve the issue\textsuperscript{163}.

\textsuperscript{161} Appendix G: Technical Annex
\textsuperscript{162} Interview, doctor at UUH, Uppsala, Sweden, 2007-11-16
\textsuperscript{163} Ibid

F - 1
In late 2004, the decision to invest in new RIS/PACS systems was made. The ambition was to be done with implementation of the systems in March 2005. After a while the project size increased. The systems were not only for the radiology department any more but for a few more departments, all with varying needs. This led to an extensive requirement specification, which in turn led to a thorough search for systems meeting the requirements, thus delaying the project further. The new system has been seen as close at hand for a while. This has led to the old system missing out on upgrades, making it even slower. Recently an upgrade to of the systems was made, since it was no longer possible to continue working without an upgrade\textsuperscript{164}.

2 Usability

All personnel that, in any way, will be using the new RIS/PACS system will receive education. The education plan is still being designed but most likely some “super users” will receive education from the developers about the systems features. They will in turn educate their colleagues on what features to use in order to be efficient.

The new RIS/PACS system mean no new ways of working. There will of course be some differences in the user interface of the new system but most principles will be the same. The new system will use thin clients, which means a system architecture where almost all computations are done at a central server and basically only input and output is transferred between the server and the clients. The result of this is that the doctors can work from anywhere they want in the world, through a VPN, using only a laptop.

The new system will eliminate the need for paper copies of referrals. Currently, some of the referrals are in paper form which means that sometimes double work is necessary. To work in a fully non-paper environment will speed things up. The system is still under deployment, meaning that there are no real users yet. It is believed that with the right development and education it will be a useful system.

\textsuperscript{164} Interview, doctor at UUH, Uppsala, Sweden, 2007-11-16
3 Quality of care

The implementation of new RIS/PACS systems should be completely invisible to the patients. However, there will be several benefits with the new system. The new systems will allow for multiplanar reconstructions, which is a way of making a 3D picture from a lot of 2D pictures. Another improvement is the display protocol for scans. The new systems will allow for a much more dynamic way of creating and saving display protocols. Both of these will improve the doctors' speed and ability to diagnose the patients. Aside from these major functionality improvements a lot of minor improvements will be made\textsuperscript{165}.

4 Economy

Due to the increasing demand of higher resolution and the resulting data volumes spending more money on the RIS/PACS system is unavoidable. The options are to upgrade your old systems or invest in a new one. Investing in a completely new system rather than patching an old one comes with the benefit of the opportunity to look over the whole system rather than moving bottlenecks. The new PACS is also built so it can handle formats and picture data that might be produced in other parts of the hospital. This will give coordination options and the benefit to only maintain one system for containing picture material rather than several. There will also be more focus on accessibility, which purpose is to reduce overall waiting times for retrieving examinations. Reduced waiting times will of course makes the usage of the system more efficient, which probably is where the largest benefit will be when the system comes online. However, it has to be taken into consideration that the old system’s upgrades have been put on ice for some time in favour of the new system.

5 Discussion and Conclusion

Making changes to the system used at the Department of Radiology was unavoidable due to the increasing data loads. The hardware, which was judged sufficient when first installed, has been outgrown. The old system could, with the proper updates, still provide reasonable performance, \textsuperscript{165} Interview, doctor at UUH, Uppsala, Sweden, 2007-11-16
although moving to a new system at this point comes with additional benefits. One of which is having the same system in the entire county. With uniformity potential incompatibility issues can be avoided. Also, if one would like to switch workplace to another hospital within the county, one would not have to learn a new system.

The new system has the potential of becoming a great tool for the staff at the hospital. The system is being developed in cooperation between staff at the hospital and developers at the company delivering the system. Staff from different parts of the hospital has been involved in the process to ensure that their needs are looked after.

To switch RIS/PACS systems is no small task. It is not possible to run the old system and the new system in parallel, which means that the new system has to be fully configured and fully functional before it is deployed. The first thought was for this to be done in about four months. In retrospect, this was not a realistic goal. This led to the old system missing out on the latest updates. A longer period of time is needed to collect information about requirements at all different wards and also to make sure everything is set up properly before the system is taken into use. If a transition similar to the one at UUH is to be done somewhere else, it would be preferred to have a plan on how to keep the old system running until the day it is actually replaced, rather than the day the decision is made to replaced it.
Appendix G: Technical Annex

1 Technology

1.1 Systems Introduction

DICOM, Digital Imaging and Communications in Medicine, is a standard used in hospitals worldwide. DICOM is used as both a standard for storing medical imaging and as a standard for transmitting the file. DICOM stores a health care consumer’s information within the file with the image. This means that information cannot be separated from each other. DICOM has many different services included that enable the data to be stored or retrieved locally or remotely and printed. Before DICOM was adopted, only the manufactures of the machines that generated the images could decode them. They could not be stored electronically in a useful format and could be separated from the patient they corresponded with. Now the majority of hospitals use the DICOM standard which helps them to quickly send a health care consumer’s results to most other facilities.

RIS, Radiology Information System, is a similar system to PACS that is used by the Radiology department. RIS is compatible with PACS via software interfaces. RIS was first developed in the 1970's and is currently utilized in the Health Optimum project.

PACS, Picture Archiving and Communication Systems, is a set of systems that are developed for storage, retrieval, distribution and presentation of digital radiological images. It can handle images from various radiological equipments (ultrasound, PET, x-rays, mammograms, etc). It was developed in the 1980s to replace traditional hard-copy system of managing medical images and allowing doctors to view the images from different locations simultaneously. The major challenge for PACS is the standardization of the digital image format as different medical vendors/manufactures, while complying with the DICOM standard, have different implementation details.

1.2 Effectiveness

Of the currently implemented technologies used (DICOM, RIS, and PACS) each has a variety of strengths and weaknesses that impact their effectiveness on the HO project.
1.2.1 DICOM
The DICOM standard, created by NEMA (National Electrical Manufacturers Association) allow for the a common file format amongst a variety of medical images, such as MRIs, CT scans and ultrasound. The DICOM standards are the first to successfully allow the creation of medical equipment that works well with other vendor's devices the utilize the format. These benefits are the result of DICOM's standardization of information objects, networking amongst devices, and the protocol used to transfer data. Unfortunately, this also has the affect of making the standard difficult to utilize initially, due to the high complexity. There are also a number of difficulties in trying to store DICOM messages in other files and how to standardize this process. Furthermore the standards help with connectivity between components but to not necessarily lead to full functionality. The true strength of this system will be contingent upon the number of adopters such that the standard is conformed to by a large range of equipment.

1.2.2 RIS
The tool is effectively used for the storage, manipulation and distribution of radiology images and data. One of the strengths of RIS is that it uses HL7 to interface with PACS, allowing for a cohesive system. While the current RIS is not compatible with HL7, the new RIS will. A combination of DICOM, RIS and PACS standards has been been in use amongst many organizations since the 1990s. There are a number of software packages that utilize RIS allowing for greater customizability to improve its effectiveness for each particular institution. Furthermore, each software application itself is highly customizable to more closely tailor it to an organization's needs.RIS is most effective at addressing patient management, scheduling, patient tracking, film tracking and results reporting. There are a variety ofRIS-based systems that allow for additional features, but there is no indication that any of these are highly effective. The strength of RIS lies in its ability to manage the acquisition, processing and storage of information used in radiology.

1.2.3 PACS
The third standard implemented by the organization is PACS, which integrates with DICOM and RIS for the management of radiological imaging. The primary implementation difficulties with the PACS system are the high costs, complexity and poor integration. These three items all inhibit the effectiveness of deploying a PACS system, however only the integration difficulties impact the system's effectiveness post-deployment. The benefit of PACS is that it allows organizations to
eliminate hard-copies of medical image management. The system itself requires a central server with a database of images and uses networking standards to transfer images. The introduction of web-based PACE is allowing for greater effectiveness of the technology by increasing the accessibility of the images. PACS also has mechanisms in place to reduce redundancy, improve storage, better use or oral reports, and enhanced quality control. Overall, this system is highly effective when combined with DICOM and RIS.

1.2.4 Integration of Systems
Individually, each of the systems currently being utilized are highly effective for most organizations. Each of these items has mechanisms in place to interact with the other systems, and the combined system allows for the management of a wide variety of radiology needs. The systems have high cross-compatibility, allow for open-source formats, and utilize SSL and VPN for security of patient information. Furthermore, the variety of software tools available on each architecture allows for an organization to find the right level of complexity relative to usability for their medical staff. Because these systems are all standardized, patients are able to use a variety of publicly available resources to learn more about the systems that manage their personal information. With the exception of several drawbacks noted for each system, the combined effectiveness of these systems is rather impressive.

1.3 Phones
3G is the third generation of mobile phone standards and technology. 3G technology allows for greater speed by utilizing a spectrum of bandwidths more efficiently. It allows the transmission of 384 kbits /s for mobile devices and 2 Mb/s for stationary devices. In addition to the higher speeds, the 3G technology allows data transfer at cheaper rates. As of June 2007, 6.7% of global mobile phone subscribers use 3G services. "2.5G" are technologies like camera phones that provide some of the 3G services without making the transition to the 3G networks.
2 Bridgit Conferencing Software

Bridgit Conferencing Software allows users to share applications and collaborate remotely. The software enables a user to let others view or even be able to draw on their desktop. The software also allows for voice communication and video conferencing. The software allows the creator or presenter of a conference to control participant's microphones and other privileges. The software allows notes to be saved as a Notebook file or copied into an imaging editing software like Microsoft Paint using an included screen capture tools. This software allows multiple users to simultaneously communicate.
3 vPoint HD Video Conference

vPoint HD allows users to send and receive video and data streams simultaneously. There is full
duplex echo cancellation, automatic noise suppression, and wide-band audio in low-bit calls.
Additionally it allows users to send video e-mails as well as record and play local videos. It also
allows users to share their desktop, files, windows, or a specific region. vPoint HD also supports
encrypted conferences using the H.235 encryption standard. This is very important to keep patient
information secure and to comply to HIPPA standards. These wide range of features combined with
security makes it fit for a medical facility.
4 Conclusion

There are a variety of technologies available for use in radiology. The PACS system integrates well with DICOM and RIS to produce a highly effective system. Each of these systems, individually, could suffice for more organizations but the combination of these tools yields the most effectiveness.

For mobile work, an effective solution involves using a combination of 3G mobile phones and Bridgit for remote collaboration. By also using the vPoint HD video conference system further information can be shared between remote locations.
Appendix H: Security

1 Introduction

When we think of security, we may think about computer hackers breaking into the system and stealing confidential data, or a computer virus spreading havoc to the system deleting data and crippling the network. While those are issues that must be addressed, another less common issue is data integrity. Maintaining high level of data integrity is paramount as changes or alterations made to these digital files could potentially be irreversible.
2 Security in Radiology

The systems used in Radiology utilizes DICOM as the communication standard. Thus it makes sense to emphasize security in this crucial link between the different systems. DICOM uses a Security Profile that can be implemented by manufacturers to address the security issues described below. The current DICOM standard however does not currently mandate this to be implemented by all the manufacturers; this profile is optional.

2.1 Security Profile

Data security mechanisms and policies such as encryption and digital signatures are not currently part of the DICOM standard. However, there is an optional security policy in which can be implemented called “security profiles”. In this security profile, it addresses 3 security concerns:

Secure Transport Connection

This network layer protocol protects the data from being tampered, eavesdropped, and altered during transmission.

Message Authentication Code

This creates a hash or digest of the data via encryption.

Certificate

This allows the electronic document to verifiable by allowing authentication. It includes a digital signature among other things to the document.

2.1.1 Secure Transport Connection

This profile utilizes TLS version 1.0. TLS is Transport Layer Security and it provides secure communication between two parties. While there are slight differences, TLS is very similar to its predecessor: SSL or Secure Socket Layer.
The security profile does not require the implementation of all TLS features (entity authentication, encryption, integrity checks). Also, the different TLS features utilize different cryptography algorithms such as RSA for authentication, SHA for integrity, or Triple DES for privacy. This profile also does not specify how a TLS connection should be established.

2.1.2 Message Authentication Code

Encryption is a cryptography method of transforming information (plaintext) to become unreadable (cipher text) for anyone except holders of the decryption “key”. This conceals the data’s original meaning to prevent it from being known or used. The level of protection provided by encryption method can be determined from its encryption algorithm. A strong and secure encryption could take decades to brute-force using today’s supercomputer processing power.

DICOM standard does not specify which encryption algorithm is to be used. However there are many algorithms available to choose from: RSA, DES, SHA, etc. The use of MD5 hash algorithm however is not recommended.

2.1.3 Certificate

Digital signature is another cryptography method and its purpose is to authenticate the owner of the “message”. The term “message” is being used to describe the data input. Digital signature methods often use two ‘keys’: private key and public key. A sender can authenticate a message by encrypting it with his private key. The receiver can then verify the message authenticity by decrypting it using the sender’s public key. The public key is often obtained from trusted sources such as a certificate authority. This public-key-infrastructure (PKI) scheme allows verification of the message authenticity to be impossible to forge.

The DICOM security profile uses RSA encryption technique for its electronic document certification.

2.2 Secure Use Profile

While the security profile mainly handles security concerns regarding tampering and authentication, the Secure Use Profile is used to track and verify changes. The profile does not utilize a specific
technology or algorithm standard; it however specifies the standard rules to adhere. Some of the required information to be kept are:

UID

Creation date and creation time

Instance status

The application shall change the status to Authorized Original (AO) where the document is Original (OR).

Authorization date and time

Authorization comment if any

Equipment certification number

Attributes of the equipment module

Any overlay data

Any image data

Additional rule is that the application shall not delete documents marked as Original (OR) or Authorized Original (AO) and there can only be one application entity that holds these documents. During communication between application entities, the sender will marked the sent document status as Not Specified (NS) or Authorized Copy (AC).

This profile functional features mimic those found in Adobe's Acrobat PDF regarding usage restrictions.
3 Security in COSMIC

COSMIC is a database that controls patients records. Security is a large concern due to HIPPA (Health Insurance Portability and Accountability Act) regulations. To help prevent unauthorized access, COSMIC is located on a physical intranet. This prevents outside sources from gaining access to the system. The system is further protected from unauthorized access through an authentication process.
4 Security in Plastic Surgery and Dermatology

4.1 3G
For simple video consultations during non-work hours, medical staff utilize 3G phones. The only major security concern of using this cellular network is a computer virus (since 3G phones are essentially Internet connected device). One simple solution could be implementing an anti-virus scanner at the central network, this way the anti-virus application does not have to be deployed to every 3G devices. This centrally managed solution also allows network operators to be able to update computer virus definitions often.

In terms of reliability, the 3G network service are guaranteed by individual network carriers and they are often advertised as always-on and always-reliable. Bandwidth could fluctuate during a video conference and it could degrade the video quality during a call.

4.2 Video Conference
During meetings, a video conference call between two hospitals is currently being used in order to save district nurses and doctors some travelling time. The system setup is a 32" LCD screen with a video camera on top with remote tilt/pan/zoom. Several companies are currently involved in manufacturing the standard compliant hardware for the video conference setup. Joining this video conference however requires no authentication. Thus an individual could join a currently running video conference without an invitation whether by accident or malicious intent.

A simple fix to this issue is to require invitation or password to join a conference.
4.3 Conclusion

There are a lot of factors that contribute to the security of a system. With medical information, it is important to have strong security in place to protect patient rights. By leveraging the built-in security management of DICOM, strong security standards are met. Additionally, the use of web based protocols like SSL, cryptography, and certificates help to strengthen this security. By utilizing a wide range of security systems available today, we can ensure a safe system to protect a health care consumer’s rights.
Appendix I: Cost Estimates

Cost for a doctor: 1,200,000 SEK/year\(^{166}\)
Cost for a secretary: 530,000 SEK/year\(^{167}\)
Cost for an average Cosmic user: 660,000 SEK/year\(^{168}\)
Total number of Cosmic users today: 9,000\(^{169}\)

1. Our calculation is based on a 10% occurrence rate of the problem. Since the majority of the users are not doctors, an average Cosmic user's salary has been used. When the problem occurs, the user has to restart Cosmic and that is calculated to take roughly 5 minutes (including time to log in and bring up the latest patient etc.). With the estimated occurrence rate, the total time loss per year is equivalent to around 9.4 man years of work time which translates to 6,200,000 SEK per year.

2. The various performance issues are very likely affecting users work speed, but it is difficult to say to what extent.

3. The manually updated lists does not seem to be much of a problem for the users once they get use to them, but we suspected that at least a small amount of time is lost on occasion when the user forgets to update the lists. As much as one minute per day is an estimated time loss, but the occurrence rate is very low so the average time is likely only around one second per Cosmic user per day. This is roughly 3.7 man months of work time per year which is equivalent to 220,000 SEK per year.

4. The possible gain of correcting this problem is likely to increase each year since more and more information is entered into patients’ medical records as time passes. We have here given an estimate that covers all the problems related to reading the medical records.

\(^{166}\) The average declared income of all doctors in Sweden 2006
\(^{167}\) The average declared income of all doctors secretaries in Sweden 2006
\(^{168}\) The estimated average declared income of all users of Cosmic. Based on information in FAKTA om landstinget 2007
\(^{169}\) Interview, EPJ at Uppsala Hospital, Uppsala, 2007-11-09
We think that about 1 out of every 40 doctors’ appointments involve some problem with the filter function or some other problem related to reading the medical records and we think that up to one minute can be saved each time if the problems we have pointed out are corrected. 1 out of ever 40 doctors’ appointments would mean 17,000 appointment s per year and one minute each time would equal roughly 1.7 man months of work time. Since doctors are the main user group when it comes to reading patients' medical record, this would mean 170,000 SEK per year.

8. We predict that up to five seconds on average can be saved per doctors’ appointment with a dynamic search function. This is equivalent to about 5.9 man months of work time each year. Doctors are the ones that set the diagnose codes and given their salary the total amount savable reaches close to 600,000 SEK per year.

11. As soon as a user is used to the illogical key presses needed to reach this particular function in the medical record, it will most likely be equally fast as any other key combination. But the users will need to be told about them. They are not likely to figure them out by themselves due to the problem's very illogical nature.

12. Our estimate is that roughly 400 users will use the schedule. We think that every user can save up to 3 minutes a day if a zoom tool or something similar were introduced. A total of roughly 2.2 man years of work time can be saved. Since most of these users are secretaries, this means 1,280,000 SEK per year.

13. Naming inconsistencies can cause a lot of problems to new users, but will most likely not affect the work speed of experienced users. Guessing that there are 100 new users every year who will, on average, loose one minute per day due to problems caused by these inconsistencies (maybe having to enter information more than once due to a miss click) we end up with roughly 2.5 man months of work time. The new users are considered standard Cosmic users and based on that salary we think a cost saving of 137,500 SEK per year is possible.

14. Most patients do not have that many aids prescribed, but this is likely to increase in the future since people tend to live longer, but far from all Cosmic users use this list on a daily basis. We
estimate that an average time-save can be up to two seconds per day which would sum up to 11 man months of work time each year. Basing the calculation on the salary of the average Cosmic user, the total sum is a little more than 600,000 SEK per year.

17. We estimate that this problem is very similar to number 12 above in regards to the number of users, but not in regards to the amount of time that can be saved. It is likely that 30 seconds per day can be saved by correcting this problem. This is equal to 4.9 man months of work time which translates to 216,000 SEK per year.

18. If we assume that around 1 million tests are ordered each year, and that every user could save two seconds per test by having the search field automatically emptied, the total time possible to save every year is a little over 5 man months of work time. Assuming that most tests are ordered by doctors, 500,000 SEK per years should be possible to save.

22. Most of the medical records contain very little text and can easily be browsed through without too much hassle. These problems are probably not causing any time delays today, but problems will likely start to appear in a few years when patients’ medical records increase in size. It is likely that within 5 years the problem will have reached a level where it will start causing measurable time delays in the day-to-day operation. A three minute delay per day is not unlikely when the problem occur. It will most likely not happen too often and the average time delay for all Cosmic users is estimated to be about 5 seconds per day.

With 9 000 users this sums up to a little over 18 man months of work time. Using the standard Cosmic user’s salary, this will be roughly 990,000 SEK per year.

23. A study\textsuperscript{170} says that 5 hospital beds every day throughout the year are occupied by patients that are being treated for drug-related problems. If all doctors started using the Common Drug List this

\textsuperscript{170} Stockholms läns landsting, Läkemedelsbiverkningar som orsak till inläggning på sjukhus, 2005. The numbers have been modified to fit Uppsala University Hospital
can hopefully be reduced to at most 1 hospital bed. Our estimate is that a hospital bed costs around 5,500 SEK per day which means that it is possible to save at least 8,000,000 SEK per year if the drug-related problems can be reduced according to our expectations.

24. The assumption is that it takes roughly 1 minute to fill out a prescription and that 10 seconds could be saved by having Cosmic automatically calculate the amount of pills needed. We estimate that around 300,000 prescriptions are filled out each year and saving 10 seconds per prescription is equivalent to a little over 5 man months of work time. This is equal to roughly 500,000 SEK per year since doctors fill out most, if not all, prescriptions.

25. It is difficult to estimate how much money this can save, but it is a severe threat to patient security and it should definitely be corrected.

26. We lack sufficient data to determine exactly how much time it will add up to. More research needs to be done in order to give an accurate number.

28. We lack sufficient data to determine exactly how much time it will add up to. More research needs to be done in order to give an accurate number.

29. Printing out a copy of a referral, putting it in a post box and making sure it follows the referral in Cosmic adds a lot of time-consuming tasks. It is estimated that it will take at least five more minutes per referral. 35,000 referrals are sent to UUH every year alone and if all of those were to be handled in Cosmic and on paper simultaneously, it would add up to a little more than 18 man months of work time which would translate to roughly 1,000,000 SEK per year. It should be noted that this is the absolute worst case. It assumes that everyone deals with referrals in this way which is not the case today.
30. See problem 1. This time we estimate the time loss to be 2 minutes per case and that 10% of the
users encounter this on average once a day. This means that an estimated 1.4 man years of work
time is lost each year. This translates to 900,000 SEK per year.

31. It is not feasible to estimate the cost of this problem, but there are indications that savings could
be substantial since the problem could add to increased sick listings.

Appendix J: Agreement Plastic Surgery
06-02-06

1 Agreement

This agreement made by and between the Department of Plastic Surgery, of the Neurology division of Uppsala University Hospital, org number SE 2321090-0024, referred to as the Plastic Surgery, and the Clinic of Surgery and Urology MSE/KSK, County Council of Sörmland, org number 232100-0032, referred to as the Surgery, concerns a collaboration of treatment of relevant cases of plastic surgery patients. The collaboration is supported by Telemedicine technology.

§1 Background and purpose

Instead of direct referral of patients to Uppsala University Hospital from the County Council of Sörmland for plastic surgery assessment/intervention a consultation is made according to the procedure described below. With the support of Uppsala University Hospital the patients that will be referred directly to Uppsala University Hospital and patients that can be treated in Sörmland can be sorted out. The gain for the County Council of Sörmland is reduced costs outside of the county’s borders. For recipient patients the gain is reduced transports and waiting periods. The gain for Uppsala University Hospital is more optimal use of special competence for the benefit of difficult cases.

§2 Term of Agreement

This agreement shall become effective 2006-02-01 and shall continue in effect until 2008-02-01.

No later than 6 months before the end of the agreement negotiations concerning possible prolonging of the agreement shall take place.

Within the term of the agreement the parties can, with consensus, amend this agreement.
§3 Commitment definition

The collaboration is estimated to be 25 patients per year where each patient can have one or more sessions. On average each patient is estimated to have 2 sessions, i.e. 50 patient sessions per year. Multiple patients can be treated at the same Telemedicine occasion and the total amount of Telemedicine occasions is estimated to be 25 per year.

Patient documentation is made both at Uppsala University Hospital and Mälarsjukhuset according to the respective hospitals documentation routines.

The Telemedicine field of activities is made with the help of four different tools:

Video streaming, high image quality

Video conference, medium image quality

Video call with 3G phone, low image quality

E-mail consultations

Beside Telemedicine services the agreement contains a part that includes training and distance education through e-learning.

§4 Accessibility, practical arrangements and development
Scheduled consultations are made once per month during 9 months of the year. No activity is planned during the summer months of June-August.

With short notice (within 48 hours) the opportunity for additional consulting should be available during the day on weekdays for an additional occasion per month (all months of the year).

Both Uppsala University Hospital and Mälarsjukhuset are engaged to maintain a working video link at daytime consultation occasions.

The parties also agree upon joint responsibility to follow up and gradually adapt the collaboration to new technological achievements within the field of Telemedicine.

§5 Pricing and reimbursements

For cost estimate for services provided by the Plastic Surgery see appendix.

The surgical clinic, Mälarsjukhuset, compensates the Plastic Surgery, Uppsala University Hospital, with a yearly onetime fee of 200,000 SEK and an additional fee of 4000 SEK per patient session.

§6 Invoice and terms of payment

The established yearly fee is invoiced two times a year (100,000 SEK per half year) while the variable costs are invoiced monthly according to specified patient sessions.

Payment is 30 days net after invoice date. Swedish interest law is applied to regulate how delay interest shall be applied.

§7 Contact
Contact for Plastic Surgery: Morten Kildal.

Contact for Surgery: Peter Gustafsson

§8 Follow up of the agreement

The contact persons shall meet at least once per term to follow up and evaluate the collaboration specified in this agreement.

Additionally the parties should jointly evaluate the agreement after a year. If the content or scope of the agreement have changed considerably in relation to planning the economical aspects of the agreement then the agreement can be renegotiated.

§9 Disputes

Disputes according to validity, interpretation or application of the agreement and therefore continuous legal relations should first try be solved by negotiations between the parties. If then an agreement cannot be met the dispute should be settled in a Swedish court.

This agreement has been established in two (2) copies where each party received a copy.

Uppsala 2006-02-18
Mats Holmström
c Head of department
Plastic surgery
Lennart Persson
Head of division
Neurology division

Eskilstuna 2006-02-07
Johan Raud
Head of department
Clinic of Surgery and Urology MSE/KSK
Anders Ahlgren
Head of division
County health care
### Appendix to Agreement Plastic Surgery

**Estimate of costs Akademiska for SPEX model with Mälarsjukhuset Eskilstuna**

LKP (swedish salary cost charge) % including 12% vacation: 55,00%

- **Salary sek/month**: Doctors 50000, Secretaries 19000, Technicians 23000
- **Cost sek/year**: Doctors 930000, Secretaries 353400, Technicians 427800
- **Cost sek/hour**: Doctors 564, Secretaries 214, Technicians 259

<table>
<thead>
<tr>
<th></th>
<th>Doctors</th>
<th>Secretaries</th>
<th>Technicians</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number patients/year</td>
<td>25</td>
<td>50</td>
<td>25</td>
</tr>
<tr>
<td>Cost/patient</td>
<td>15867</td>
<td>7933</td>
<td>15867</td>
</tr>
<tr>
<td>Number telemedical occasions/year</td>
<td>25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost/telemedical occasion</td>
<td>15867</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Number hours/patient              |        | 0.3         | 0.25        |
| Preparation time                  | 0.3     | 0.25        | 0           |
| Video conference                  | 0.3     |             |             |
| Second opinion                    | 0.06    |             |             |
| Sum time/patient                  | 0.66    | 0.25        | 0           |

| Number hours/telemedical occasion |        | 1           | 1           |
| Time to spare                     | 1       | 1           |             |

| Number months/year                | 1.5     | 1           |             |
| Cost/year                         | 116250  | 0           | 35650       |

| Personnel cost/year               | 139641  | 1339        | 42132       |
| Sum personnel cost/year           | 183111  |             |             |

- **Video studio invest sek**: 200000
- **Depreciation/year**: 30.00%
- **% SPEX**: 5.00%
- **Cost SPEX/year**: 3000

- **PC for SPEX inv**: 50000
- **Depreciation/year**: 30.00%
- **% SPEX**: 100.00%
- **Cost SPEX/year**: 15000

| Server common doc                 | 50000   | OH costs    | 10.00%      |
| Software common doc               | 70000   | sek/year    | 36061       |

| Net cost Sjunet/year              | 79000000| Pers+techn+OH sek/year| 396673     |
| % SPEX                            | 0.5%    |             |             |
| Cost SPEX/year                    | 39500   | Unforseen   | 25.00%      |

| Sum technological costs/year      | 177500  |             |             |
| Sum total SPEX sek/year           | 396673  |             |             |

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# Appendix K: Cosmic – An Evaluation of Usability and Education

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1 Abstract

This is a short evaluation with our thoughts about an educational course in the IT system Cosmic that were held for the medical staff at Heby Vårdcentral in October 2007.

Cosmic is a computerized system that is developed to help health care with administration and information sharing between points of care, as well as internally within each point of care.

Our general view of the course itself was very positive and we think that the course was well handled and pedagogic.

This course gave us a great opportunity to experience the system firsthand, and it also allowed us to notice what kind of questions that were asked and which part of the system the medical staff had most problems with. We noticed a lot of things during this course; some minor problems and some severe problems that should be addressed as soon as possible.

These problems have been evaluated based on our background as technology students, and possible solutions are presented. The problems have been graded to indicate how severe they are believed to be, and the solutions have been given an estimated level of difficulty to implement.
2 Background and Acknowledgements

In connection with the IT in Society course at Uppsala University, we have been asked to look at telemedicine and how it works today in our society. We were specifically asked to focus on the software system named Cosmic that is used within the county council of Uppsala as a tool to ease the communication and information sharing between different points of care.

We followed a three day course in Cosmic in the beginning of October that was held for the staff at Heby Vårdcentral, and we tried to learn as much as possible about the system and the way the course was taught. Our goal was not to interfere too much with the course and we tried to keep a low profile and observe as much as possible.

Readers of this report should keep in mind that we are technology students and have taken a few courses in Human-Computer Interaction and we are therefore inclined to note and discover things that have to do with either the technical part or the usability. We have mainly commented on the negative things and questions that were brought up, even though our overall picture of the course was very positive.

We would like to thank Charlotta Lindberg and Benny Eklund at the county council who invited us to the course and therefore made it easy for us to experience Cosmic first hand. We would also like to thank the course instructors Inga-Britt Talin and Anne Björk who allowed us to join the course and answered our numerous questions.

Last, but not least, we would like to thank all the other attendees at the course who contributed with their thoughts and opinions about the system.
3 Method

The authors of this report are two IT students at Uppsala University. This will likely affect the way we approach the problems we discovered. Our background in computer science and, to a smaller extent, in usability analysis, will also influence our descriptions of the problems and solutions we present.

All data in this study was gathered through participant observations during the Cosmic course that we attended. We kept a low profile during the course and tried to observe as much as possible about the problems that were brought up and how the course was structured without interfering too much. We tried to ask the majority of questions during the breaks, and we also used the breaks to clarify any incomplete notes we had.

All notes were written down on paper regarding which parts of the system that the participants found most problematic, comments from the teachers, questions from the participants as well as the problems that we identified as either existing or likely to occur.

After the course all notes were read through and problem areas were identified. The learning material from the course was used as a memory aid. The problem areas were both those that we identified during the course, and problems that emerged afterwards in the discussion.

The problems were then ranked according to severity and possible solutions to them were found.

The report has been written mainly for the Cosmic course instructors Inga-Britt Talin and Anne Björk as well as Benny Eklund and Charlotta Lindberg at the county council of Uppsala.

Any quotations presented throughout this report have not been translated verbatim, but are free translations from Swedish into readable English. Moreover, all quotes are made anonymously.

The report is written in English since parts of it may be used later on in the IT in Society course we are attending at Uppsala University. However, some key names and phrases in Cosmic have been given in Swedish as well to make it easier for the Swedish users of the system.
4 Cosmic – A Summary

Cosmic is a computerized system that is developed to help health care with administration and information sharing between points of care, as well as internally at the specific point of care. The system is module-based and the medical staff can, just to mention a few things, read and write in a patient’s medical record, handle drug prescriptions and refer patients to other points of care. Cosmic will replace most of the older systems that were used previously.

Something to keep in mind is that not all modules of the system are yet fully developed and all points of care are not yet using all the modules available.
5 The Course

The course started with an informal group discussion where ideas, thoughts and questions about Cosmic were discussed. It was a fruitful discussion and a good start of the course.

Heby Vårdcentral is the last of its kind to introduce Cosmic within the county, and because of this most of the staff had heard a lot about Cosmic before they attended this course. Most of what they had heard were negative things, but they all agreed that a lot of the problems that arise when you introduce a new computer system doesn’t necessarily have to be directly related to Cosmic itself. Introduction of a new computer system will often make the staff think twice about the way they do certain tasks. Problems that arise because of this are often blamed on the computer system, when it is in fact more of an organizational issue.

An important aspect that was brought up was the attitude towards change. Going into Cosmic with your mind already made up that it’s a bad thing will only lead to further problems. Trying to be positive and trying to see the possible positive effects of the new system is very important for it to be successful.

We got the impression that the Heby staff was in general positive towards introducing the new system, and we had expected to see some kind of underlying scepticism, but we didn’t. Everyone seemed interested and willing to learn how the system works and how it would change the way they work.

A short PowerPoint presentation showed us how the new Cosmic system differs from their old system called Profoc. Heby Vårdcentral used Profoc when we attended the course, and had been for many years, and a lot of comparison between Cosmic and Profdoc were made.

One of the many things that are different in Cosmic is the naming convention. Some expressions have been added and some have been changed. This caused some minor confusion in the beginning.

When the presentation was over, the instructors proceeded with explanations on how to log into the system. The instructors had a projector with which they showed everyone how to login and how to use the system. When they were done, the course attendees turned on their own screens and tried it out for themselves. We were very happy with this approach as it allowed us to first see the way it should be done and then get hands-on experience with it immediately after. We felt that is was generally a very much appreciated pedagogical approach since all course attendees had to interact with the system and they had to put the information they had to practical use. The same approach was used, by the instructors, successfully throughout the course.

5.1 The Patient Card (“Patientkortet”):

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The Patient Information Card was the first module to be covered. It is used to view information about the patient, like the patient’s contact information, the patient’s emergency contacts.

Some of this information was automatically gathered from the National Registration (“Folkbokföringen”) every fifth day and any local changes made to this information would be overwritten. The staff commented on this and said they would have preferred the fields to be locked (“grey”). They got a bit confused by this since some of the fields were grey, like the country of residence, while some were not, even though any changes wouldn’t be saved for more than 5 days.

Cosmic also features a warning system that can tell the medical staff if a person is allergic to a certain type of medicine, or if there is any other type of information that is vital to know about. A doctor can put in a warning like this, flagging it as either an ‘observandum’ which is more of a note, or a ‘warning’ which should only be used for conditions that are life-threatening.

The last thing to be demonstrated together with the patient card was the watch-list (“Bevakningslistan”). The watch-list allows the users to put medical records, lab results etc, on a sort of to-do list. They could also put, for instance, a lab result on another doctor’s watch-list to have it looked over by him or her as well. This function is not fully developed yet and is very primitive. For example, the system requires you to log out and then back in again to receive any new things that have been put on the list. The staff generally thought it was a great part of the system that could be very useful, but due to its primitive nature they didn’t think they would use it much. We were told by the instructors that they don’t normally bring up this part of Cosmic due to its primitive nature, but that they did so this time because it was brought up in a discussion.

5.2 Scheduling an Appointment (“Tidboken”):

The second large module we talked about was the Scheduling module (“Tidboken”). This is an important part of the system and everyone should know how to use it. The instructors spent a lot of time on this module to make sure that everyone got time to try out all the different things you can do. The layout is that of any other schedule. You can choose how many days to view at the same time, and you can also view other members of the medical staff’s schedule. The day is split into different blocks of care (customizable by the point of care themselves) like emergency care, phone calls etc and each block is set to be a fixed amount of time. Even though it is possible to change, and relatively easy to do, the staff didn’t like the idea of having set amounts of time for the different care options. And if you reduce the time for each unit to a small number, the schedule will be cluttered and it can be difficult to read anything out of it. This is not a problem directly related to Cosmic, but more a problem of having too many and too short appointments with the patients. This would probably happen with any scheduling software and is most likely a problem on any paper-based schedule as well. We believe though that Comic’s solution to the problem might not be the best. One solution is to add a “zoom tool” that will automatically increase the font size whenever you hover over a piece of text. That will make it easier to read and the users will not have to manually zoom in and out.
One feature that is related to Cosmic though and that the staff really wanted was an automatic update function. As Cosmic is designed today you have to manually update the schedule to see any changes (and this is a recurring theme when it comes to lists of this kind in Cosmic). This is in our experience something that will, without a doubt, cause problems in the future. Users do (and should) expect the system to automatically tell them if anything has changed on their schedule. The requirement of a manual update is a guaranteed source of frustration for the users.

We were told by the instructors that the developer added the manual update requirement due to performance issues. However, we can’t see why an automatic update would constitute a strain on performance. The number of simultaneous users on this system is considerably lower than many other database-based applications and they don’t have any similar problems.

This indicates a more complex and severe problem with the Cosmic system and the solution is most likely not easily implemented.

When all the appointments have been scheduled, the doctor can open up something called the Visitations list (“Besökslistan”). All the doctor’s appointments will end up here and he or she can easily see when a patient has arrived and been registered at the front desk. If it’s a telephone appointment the doctor will register the patient.

This part of the system is meant to work as a base for the doctors. This is where they will get a list of all the patients that are scheduled and this is supposed to be their “home” in the system. The staff all agreed that indeed was a useful tool to have, and that it was relatively easy to manage. But it has the same manual update requirement as the Scheduling module which severely affects its usefulness since the doctor will have to manually update the list once a minute or so to see if a patient has arrived or not.

Something that they also brought up in connection with the visitations list was how they are suppose to communicate with the lab. What if they want to send a patient to the lab before or after the appointment? How should the lab be notified? This is again not a Cosmic related problem, but it still poses an interesting question. The instructors said that it was something that they have to work out when they start using the system. Preferably they should be able to use Cosmic for this communication as well.

After the afternoon coffee break the instructors acted out a small play in which one played a patient and the other one played a confused medical professional who had completely forgotten how to use Cosmic to deal with this patient. The course attendees had to pitch in and help the instructor use the system to carry out the entire chain of events that is required when a patient wants to make an appointment.

It was fun to watch and a nice and relaxed end of the first day, but it was also a very good pedagogical move. It gave the staff an opportunity to see if they really remembered everything and it gave us an excellent opportunity to observe what they were doing wrong and which things they didn’t remember anymore.
5.3 The Medical Record ("Journal"):  

First off on the second day was a short repetition of last day’s modules and how they were accessed and used. Then came that day’s biggest and most discussed module; the Medical Record.  

The instructors brought up one of our test patient’s medical record and started going through the different steps for reading and writing in it. First they showed how to view notes that you have made, how to view notes from other doctors and finally how to view all notes from the entire health care system. This caused a lot of discussions in the group. The doctors said they absolutely didn’t want to see that much information. The question of the patient’s integrity was brought up and heavily discussed. Everyone, including the doctors themselves, agreed that too much information was available to them and that they didn’t want to see things that are not relevant to them. This was perhaps the thing they objected the most against with this new way of information sharing. They feared that the consequence would be that the medical staff will start to put in as little information as possible about a patient in the medical record just to protect the patient.  

The medical record comes with a filter function that can be used to limit the amount of information visible. This sounded good in theory, but turned out to be very weak and almost impossible to use in practise. The entire medical record is divided into parts and only the first part is visible to the user when a medical record is first opened. To get the next part of the record as well, the user will have to click on a button. This could mean a lot of button clicking if a patient has a long medical record. Someone commented on this button pushing as a waste of time.  

If you set up a filter before you have the entire medical record in front of you, the filter will only work on the entries that you can see. This means that the user will most likely be forced to click on the button until the entire medical record is visible before applying a filter.  

The filter will disappear all together if the user clicks the button to see more entries, and it will have to be reapplied when all the entries are visible.  

This weird paging function together with the extremely poor filter function is something that we believe will be very time-consuming for the medical staff and it will take away much needed time with the patients.  

When we had gotten the reading part showed to us, the instructors moved over to the writing part of the Medical record module. The procedure for writing in the medical record was pretty straightforward and we got the feeling that the staff understood quickly how to do this. There were a few things that was brought up, though, when we came to the diagnose part. When a doctor is finished with his or her diagnosis, it must be entered into the medical record. Virtually every diagnose you can think of is represented by a code that must be specified by the doctor. There are nearly 30 000 different diagnoses and the search system in Cosmic wasn’t rated very highly by the medical staff. They thought it was too complicated to search for a diagnose and they feared that this would eventually lead to doctors putting down too general diagnoses just to save time.
The instructors said that this part of the system is what they have been pushing the hardest for to get redesigned, but nothing has happened yet and this is the part of the system they are most disappointed in.

We got a lot of time to explore the medical records on our own after the presentation, and we noticed a lot of things that will most likely lead to problems. We are not sure that the staff experienced all these things though as it will most likely take them a few days of working before noticing them. A list of all the things we discovered can be found at the end of this report.

5.4 Virtual Referrals (“Remisser”):

This is the part we personally found most confusing and difficult to handle. And we got the feeling that the other attendees as well thought this was difficult.

It’s not that it was particularly difficult in Cosmic, but since some points of care still use pen and paper to do their referrals and some use electronic referrals in Cosmic, it gets complicated.

A referral that is being sent out on paper to another point of care must be signed both in Cosmic and on paper.

A good thing in Cosmic that was brought up was the ability to see the status of the referrals that has been sent. The doctors can simply bring up a list of referrals and see if they have been received by the other doctor, if it has been looked at etc.
5.5 List of Dictates ("Diktatlista"):

The list of dictates is a simple list of all the dictates that has been made by doctors. In Cosmic, a doctor can simply open up a new dictate and then save it for a secretary to pick it up and type it in to the medical record. There were a few things noted that you have to think about though. First of all if you open up a dictate that has been saved by another doctor but not yet typed in, and you accidentally press the save button you take over the entire dictate. It might not matter that much if it is the doctor sitting in the room next to you, but it could lead to a lot of problems if a doctor in Heby accidentally takes over a dictate from a doctor at Uppsala Academic Hospital (UAS). Secondly, if you bring up another doctor’s dictate and hit the record button you will erase his or her recording and it will be lost. This poses a sever security risk that should be addressed immediately.

Some kind of mechanics was requested by the medical staff that would make these things impossible. It shouldn’t be possible to take over a dictate without a clear confirmation dialog, and it should most certainly not be possible to erase another doctor’s dictate.

These two things were the most sever threat to patient security we found during our 3 day course and we can’t understand why this hasn’t been fixed earlier.

5.6 Common Drug List ("Läkemedelslista"):

The entire first half of the last day we focused on the Common Drug List module in Cosmic.

Its purpose is to facilitate a common drug list that every doctor can access and see which medications a patient is on. It is a good system, but it requires all branches of the health care to use it. Unfortunately, the doctors at UAS are very reluctant towards using it and that keeps the entire system from being a real success. The decision has been made that the doctors should use the system, but apparently they are not which in turn means that it is the doctors in the smaller points of care that will have to clean up and try to maintain the drug list.

Most of the attendees were disappointed that the UAS doctors weren’t using the system.

Prescribing a drug to a patient can be done relatively easy in Cosmic, especially if you use the templates that comes with the system and that every point of care can add to.

They make searching and dosage much faster for the doctor.

The instructor told us about a bug that they have asked the developer to remove from the system. The bug makes a window pop up every time you fill in a prescription, and you have to manually close it down in order to continue.

Some question about how to handle the so called ApoDos came up and was discussed briefly.
There were some inconsistencies throughout this module that made the staff a bit confused concerning the different buttons, like ‘save’, ‘sign’, ‘send’, ‘print’ etc. In some dialogue boxes one button meant something completely different from another dialogue window. I think most of them learned rather quickly though which buttons not to push, but it could be something to think about for the developer.

There was also a wish from the medical staff to be able to change the text on the dosage instructions which is not possible today. Just to bring up an example; if you want to prescribe one pill once a day to a patient, you would end up with the text “1 pills once a day”.

The instructors also told us to take a close look at how much we prescribed. Apparently Cosmic chooses the smallest box size for all the drugs which might not always be suitable. It also lacks any functionality of automatically calculating the needed amount of drugs based on the dosage you have specified.

### 5.7 Aids ("Hjälpmedel")

We only covered the Aids module very briefly, but the one thing we noticed most clearly was the inability to sort the history in chronological order. It is now sorted per doctor, which makes it difficult to see exactly which aids a patient already has.

### 5.8 Orders of Tests ("Provtagningsunderlag")

The first thing we noted here was the excellent search function. It is a dynamic search utility that automatically shows the results while you are typing in your search word. One could wonder why such a search isn’t implemented in the Diagnose part of the Medical record.

There were some inconsistencies between this part and other parts. Here you are only supposed to press ‘Save’ while you had to press ‘Save and print’ in another window.

One thing that was brought up was the inability to communicate with the lab without ordering any tests. Some “tests” like EKG, length, weight etc is not considered a test in Cosmic and can’t be ordered. How do you let the lab know that you want them to measure length etc without ordering any tests? It will have to be done through some other means, maybe the messaging function that is built-in in Cosmic.

### 5.9 Incoming Referrals ("Inkommande vårdbegäran")

One of the instructors said that is “very difficult to understand the first time you see it”.

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That basically summarize the reaction the staff had. It was difficult to make out the different parts of the module and when to use which one.

Someone expressed that he or she would have liked a link to KoVis from the referral itself. As it is now you have to bring up the patient’s medical record and follow the link from there.

When a referral comes in, it doesn’t show up on the list with unsigned things where everything else ends up. The referral shows up only at a special list called the unsigned referral list. In practise, this means that the doctor will have to keep track of two different lists to make sure he or she doesn’t miss anything. This is time-consuming and there is always a risk of extending the time it takes for a referral to get signed simply because the doctors might forget to look at the unsigned referrals list.
6 Discussion

This course gave us a great opportunity to experience the system firsthand, but it also allowed us to notice what kind of questions that were asked and which part of the system the medical staff had most problems with. We noticed a lot of things during these three days; some minor problems and some severe problems that should be addressed as soon as possible.

One of the things that we noticed was that it was quite rare that someone said “Yes, this will be very good”. But it was also rare to hear someone say “Oh no. Why did they do it like that?”. We got the feeling that the staff had already prepared themselves for the fact that introducing a new computer system will mean more work, at least in the beginning, and that they accepted it without too many protests.

The course was taught by one doctor and one nurse who were actively working within the health care system when Cosmic were introduced. We firmly believe that it was a very good choice to hire medical professionals to do the teaching. Not only did it allow the attendees to keep the discussion at a practical level with a lot of medical terms and expressions, but it also made it easier to ask difficult question about the systems. These questions might not have been asked if it had been two instructors from the developer that gave the course.

We also noted several times during the course that the difference between the test version of the program and the real world program was quite big. “This has been fixed in the current release”, “This dialogue looks different in the current release” and statements of that kind were made many times.

We got a feeling that the system is not functioning well when it comes to system maintenance and updates. One of the instructors put it this way:

- “Be sure to print out a copy of all schedules the day before a patch is released”

This is a clear indication that something is not right and that the program no longer have the trust of its users. This is something that should be addressed as soon as possible since the users trust is an essential part of a computer system.

We think that overall the course was well handled and pedagogic. However we would have liked it to be a bit longer so that there would have been more time for acting out real-life scenarios instead of practising the various parts of the system separately.
7 Things brought up by the Medical Staff

Except the specific questions about the modules and things we learned during the course, there were also some general questions and concerns that were brought up at coffee breaks and in connection with other discussions.

One of the doctors said that the system as a whole was too big for you to get a good overview of it. She missed a place she referred to as a “home” in the system. She wanted a place where she could customize the look and feel to fit her personal style where she can put up links to the things she uses most in the system.

She said that the Visitations list feels like it should be the base of a doctor’s work but that it fails to be so. Not all the information that needs attention can be found there such as the incoming referrals and test results. A “home” in the system should provide all these things in an easy to grasp manner.

Another member of the medical staff wished that they had been given more opportunity to be apart of the development process and affect parts of the software.

Another thing that everyone agreed on was that there was too much information available that they had no use for and couldn’t change in any way. They wished for a login-based graphical user interface that changes depending on who you sign in as. Cosmic utilized a system like this already and hides certain modules from you depending on if you sign in as a doctor, nurse, secretary etc. But all members of the same profession see the same information regardless of where they are employed.

The general feeling among the medicinal staff was that Cosmic has been developed primarily for use in the hospital, not in the smaller points of care.
8 Bugs and Problems

All of the problems we have discovered that has to do with Cosmic are listed on the following pages. The first table is a list of the problems, their description, severity and a reference to the corresponding part of this report. The second table contains the suggested solutions and an estimate on how easy it is to implement them.

Some problems have already been discussed earlier in the report, and to those we will only give short solutions here. Please refer to the indicated section of the report for more detailed information.

We have graded the problems on a scale from Low to Severe based on our experience in Computer Science, Graphical Design and Programming. Problems that could potentially constitute a risk to patient safety, or have a major impact on the usability of the system, have been graded Severe. Problems that don’t fall under the above category have been graded with either Medium or Low depending on how much trouble we believe it will cause for the users.
## 8.1 Table of Problems

<table>
<thead>
<tr>
<th>Problem</th>
<th>Area</th>
<th>Description</th>
<th>Section</th>
<th>Severity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>General</td>
<td>The program runs out of memory after a long up-time.</td>
<td>n/a</td>
<td>Severe</td>
</tr>
<tr>
<td>2</td>
<td>General</td>
<td>Performance issues are limiting usability</td>
<td>5.2</td>
<td>Severe</td>
</tr>
<tr>
<td>3</td>
<td>General</td>
<td>Lists are not updated automatically</td>
<td>5.2</td>
<td>Severe</td>
</tr>
<tr>
<td>4</td>
<td>Medical Record</td>
<td>The filter function is poorly designed and its behaviour is very unexpected.</td>
<td>5.3</td>
<td>Severe</td>
</tr>
<tr>
<td>5</td>
<td>Medical Record</td>
<td>“Now showing 39 of 39 notes” even though a filter is applied that limits the visible entries to, for example, 5.</td>
<td>5.3</td>
<td>Severe</td>
</tr>
<tr>
<td>6</td>
<td>Medical Record</td>
<td>If you change to another category on the left side of the window, your active filter will disappear.</td>
<td>5.3</td>
<td>Severe</td>
</tr>
<tr>
<td>7</td>
<td>Medical Record</td>
<td>If you apply a filter and then click the button “Get next…” your filter disappears</td>
<td>5.3</td>
<td>Severe</td>
</tr>
</tbody>
</table>
and you have to reapply it.

<table>
<thead>
<tr>
<th></th>
<th>Medical Record</th>
<th>Diagnostic codes are very difficult to search for.</th>
<th>5.3</th>
<th>Severe</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>Medical Record</td>
<td>If you select the last row in a record and push the “get next...” button, your selected row gets deselected and you end up at the first row which means you have to manually scroll down to find the row you had selected.</td>
<td>5.3</td>
<td>Medium</td>
</tr>
<tr>
<td>10</td>
<td>Medical Record</td>
<td>If you change category on the left all the downloaded data will be thrown away, meaning it will have to be downloaded again if you visit the same category later.</td>
<td>5.3</td>
<td>Medium</td>
</tr>
<tr>
<td>11</td>
<td>Medical Record</td>
<td>Expanding a dynamic folder in write mode is very tricky and requires weird key presses like ARROW, ARROW, TAB, TAB.</td>
<td>5.3</td>
<td>Medium</td>
</tr>
<tr>
<td>12</td>
<td>Scheduling</td>
<td>Too many bookings in a small period of time will render the schedule cluttered and difficult to read.</td>
<td>5.2</td>
<td>Medium</td>
</tr>
<tr>
<td></td>
<td>Category</td>
<td>Description</td>
<td>Rating</td>
<td>Severity</td>
</tr>
<tr>
<td>---</td>
<td>---------------------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>-------</td>
<td>----------</td>
</tr>
<tr>
<td>13</td>
<td>General</td>
<td>Naming inconsistencies appear throughout the program. ‘Save’ at one place means just save, while it means save and close in another dialogue.</td>
<td>n/a</td>
<td>Medium</td>
</tr>
<tr>
<td>14</td>
<td>Aids</td>
<td>It’s not possible to sort the list of aids in chronological order. It’s sorted per doctor</td>
<td>5.7</td>
<td>Low</td>
</tr>
<tr>
<td>15</td>
<td>Common Drug List</td>
<td>It’s possible to type in dosage texts that are longer than Apoteket can print.</td>
<td>5.6</td>
<td>Low</td>
</tr>
<tr>
<td>16</td>
<td>Warnings/Observandum</td>
<td>There is a - sign next to a folder indicating that is possible to collapse it, but it's not working.</td>
<td>5.1</td>
<td>Low</td>
</tr>
<tr>
<td>17</td>
<td>Schedule</td>
<td>Strange choice of colours in the search result list. Difficult to read.</td>
<td>5.2</td>
<td>Low</td>
</tr>
<tr>
<td>18</td>
<td>Ordering Tests</td>
<td>When you switch the category, the text remains in the search field. It would be better if it was cleared automatically.</td>
<td>5.8</td>
<td>Low</td>
</tr>
<tr>
<td>19</td>
<td>Medical Record</td>
<td>Inconsistency when it comes to sorting by clicking on the headlines. Sometimes it works, sometimes it doesn’t.</td>
<td>5.3</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>General</td>
<td>Weird key combinations throughout the program. Like CTRL-V for an action that is not pasting.</td>
<td>n/a</td>
<td>Low</td>
</tr>
<tr>
<td>---</td>
<td>---------</td>
<td>-------------------------------------------------------------------------------------------------</td>
<td>-----</td>
<td>-----</td>
</tr>
<tr>
<td>20</td>
<td>General</td>
<td>Fields that users shouldn’t change should be grey</td>
<td>n/a</td>
<td>Low</td>
</tr>
<tr>
<td>21</td>
<td>General</td>
<td></td>
<td>n/a</td>
<td>Low</td>
</tr>
</tbody>
</table>
### 8.2 Table of Solutions

The table below indicates possible solutions to the problems mentioned earlier. These are solutions that we have found reasonable based on our experience in this field.

There is always more than one solution to a problem and the solutions we give here should be treated as suggestions rather than absolute truths.

We have tried to categorize the difficulty of implementing the solutions based on our limited knowledge on how the system is built. We have used a scale from Easy to Difficult.

How these different grades translates into implementation time is difficult for us to guess, but we feel that a solution graded as Easy shouldn’t require too much planning or manpower to implement, while a solution graded as Difficult may very well require a lot of planning and manpower to be implemented efficiently.

<table>
<thead>
<tr>
<th>Problem</th>
<th>Solution</th>
<th>Implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Some users have had problems with Cosmic indicating that it is running out of memory when it has been running for a long time. This is most likely due to a memory leakage and the only solution to the problem is to find the leakage and fix it.</td>
<td>Difficult</td>
</tr>
<tr>
<td>2</td>
<td>A lot of reduction is usability (no automatic updates of lists, having to retrieve parts of a medical record by push of a button etc) has been said to be because of performance issues. It’s impossible for us to deliver any solution to the problem since it can reside in a number of places, but something is apparently not right and it must be looked into.</td>
<td>Difficult</td>
</tr>
<tr>
<td>3</td>
<td>Make the lists update automatically wherever possible. See</td>
<td>Moderate</td>
</tr>
</tbody>
</table>
4 See the section about the Medical Records. Moderate

5 Not telling the user that a filter is active can make the user believe that he is looking at all the information there is when there is in fact more, but it is not being shown because of a filter. This is very severe and can potentially lead to misdiagnosis or wrong treatment.

A solution is to update the text that tells the user how many entries he or she is looking at. Or add a warning message that tells the user that a filter is in use. Moderate

6 This is severe in the sense that it may force the user to reapply a filter time after time and thereby wasting time. Easy

7 See the suggested solution to problem 2.

Some kind of warning should be added to let the user know that the filter is not applied to all entries in the record Moderate

8 Our suggested solution is a dynamic search functionality that automatically filters the search results while typing. Moderate

9 This can be solved by having the program not deselecting the selected row when you click on a button Easy

10 This extra download of data is not severe from a user’s point of view Moderate
<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>of view, but it puts extra pressure on the system and it should be possible to cache at least some of the data.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>The weird key presses needed to access some parts of the medical record elements can be solved by adding buttons or other ways of navigating.</td>
<td>Easy</td>
</tr>
<tr>
<td>12</td>
<td>See section 5.2 about the Schedule.</td>
<td>Easy</td>
</tr>
<tr>
<td>13</td>
<td>The naming inconsistency is confusing for the user and it’s easily fixed by going over all of the modules and changing names where necessary.</td>
<td>Easy</td>
</tr>
<tr>
<td>14</td>
<td>See section 5.7 about the Aids.</td>
<td>Easy</td>
</tr>
<tr>
<td>15</td>
<td>One solution is to cap the length of the text that a user can enter in the text field. Another is to warn the user if he or she tries to send text that is too long</td>
<td>Easy</td>
</tr>
<tr>
<td>16</td>
<td>Our suggestion is to either remove the minus sign or make it behave like it is expected by most users</td>
<td>Easy</td>
</tr>
<tr>
<td>17</td>
<td>A more user friendly choice of colour combinations would make it easier for the user to locate relevant data</td>
<td>Easy</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>18</td>
<td>A simple clear of the text field whenever a new category is chosen would solve the problem.</td>
<td>Easy</td>
</tr>
<tr>
<td>19</td>
<td>The obvious solution is to go over the program and implement sorting on all tables</td>
<td>Easy</td>
</tr>
<tr>
<td>20</td>
<td>Some key combinations should be changed. A lot of the users are familiar with the CTRL-V shortcut and they expect it to be related to pasting, which is not the case here. This can cause unnecessary confusion.</td>
<td>Easy</td>
</tr>
<tr>
<td>21</td>
<td>By making all fields grey that a user shouldn’t change, you make the user feel more secure.</td>
<td>Easy</td>
</tr>
</tbody>
</table>
9 References

User manuals given to us during the course

Inspiration, ideas and information:


10 Authors’ contact information

Please feel free to contact the authors of this report if you have any questions. We can be contacted directly via any of the below methods.

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Telephone: +46 705695985
Appendix L: Internal Billing
**Factura / Invoice**

Fakturadatum: 07-11-26

**MÅLARSJUKHUSET**
Redovisningen
631 88 ESKILSTUNA

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<th>904146</th>
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<tbody>
<tr>
<td>Ir referens / Your reference</td>
<td>Vår referens / Our reference</td>
<td>Eko avd 018-6113011, 6113049, 6113060</td>
<td></td>
</tr>
<tr>
<td>Betalningsvillkor / Terms of payment</td>
<td>Förfallodag / Due date</td>
<td>30 DAGAR NETTO 07-12-26</td>
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**Specifikation**

**KONTAKTID:**

**Belopp / Amount SEK**

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<th>SEK</th>
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<tbody>
<tr>
<td>0,00</td>
<td>0,00</td>
<td>2120.00</td>
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</tbody>
</table>

Vi förbehåller oss rätten att debitera dröjsmålshänta, referenslänta +8%.

Please state the invoice number with your payment. Payment must be made for the full amount invoiced free of bank charges.
## Fakturaspecifikation

**Utskriftsdatum:** 2007-11-26  
**Klinik:** Internmedicinskliniken  
**Mottagning:** Akutmottagningen  
**Ref: SRM:** 018-6119390 må-to 9-10  
**Specifikationsnr:** 77500801 879234546

| KUND NR | 904146 | MÅLARSJUKHUSET  
|         |       | Redovisningen  
|         |       | 631 88 ESKILSTUNA

**Patient**  
**Remittent:** Patienten själv  
**Remitterande läkare:**

| Län | 04 | Prassa: 0484 |

**Besöksdatum:** 07-11-13  
**Meddelande:** Riksavtalet Akut  
**Kontakt:**

<table>
<thead>
<tr>
<th>Kod</th>
<th>Produkt/Tjänst</th>
<th>Antal</th>
<th>A-Pris</th>
<th>Rabatt</th>
<th>Pris</th>
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<td>OV00113052</td>
<td>Akutmott nivå 2</td>
<td>1</td>
<td>4839,00</td>
<td>50,0</td>
<td>2 419,50</td>
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<td>OV00340001</td>
<td>Patientavgiftsavdrag öppenvård</td>
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<td>300,00-</td>
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<td>300,00-</td>
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</table>

**Momspl belopp:** 0,00  
**Moms:** 0,00  
**SEK:** 2 119,50

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L - 3
Appendix M: The EU Report
HEALTH OPTIMUM Initial Deployment

HEALTHcare delivery OPTIMisation through teleMedicine
(Grant Agreement No 046273)

Progress Report
Version 1

Work Package:
Version & Date: v1 / 3rd December 2007
Deliverable type: Report
Distribution Status: Confidential
Author:
Reviewed by:
Approved by:
Filename: HO_EUv0_1.doc

Abstract
This document is a progress report of the Health Optimum project conducted in Uppsala County.

Key Word List
Executive Summary

Health Optimum Project Evaluation aims to evaluate the process of introducing new technology in the health care of Uppsala County (UC). The new technology is meant to improve the quality of care and project affects mainly four different departments: Dermatology, Plastic Surgery, Neurophysiology and Radiology. A major system for keeping track of patient records that affects most departments is being implemented: Cosmic. There is also a way for having discharge conferences over the Internet under evaluation.

Cosmic is a system common for all points of care in the county, enabling sharing of medical records and electronic referrals. It is fully deployed at all points of care except Uppsala University Hospital, which lacks the referral part. The system is working, but has several problems that hinder it from reaching its full potential.

The collaboration with Tele-consultation between the Department of Dermatology at Uppsala University Hospital (UUH) and Heby Health Care Centre has not yet started. However, implementation plans are established, and persons responsible for the collaboration have been appointed. The collaboration will probably lead to faster expert opinion for the patient and spreading of excellence from the Department of Dermatology to the Care Centre.

The Department of Plastic Surgery at UUH is going to expand their Tele-consultation collaboration with Mälarsjukhuset Hospital in Eskilstuna (MHE) to new sites and additional personnel. As the current collaboration with MHE the Department of Plastic Surgery these new collaborations will result in less travelling for the patients and the Department of Plastic Surgery will only receive the most difficult cases.

Discharge conferences are held when patients, with present or future needs of home-help service, have been treated at the hospital and are discharged to their home municipality. Video discharge conference, in connection with the staff from Heby Care Centre and municipality travels to UUH, is being evaluated to save travelling time.

The HO project at the Department of Neurophysiology consists of trying a new EEG recording system that enables for embedded video. The project is currently in a pilot state and its evaluation is hopefully going to be accomplished before 1st of January 2008. Expectations are that the project will result in better diagnostics and fewer patients brought back for complementary registrations. It is also expected that it will be possible to use a smaller amount of registrations to diagnose patients.

With the HO project, the major IT systems used in the Radiology Department are being replaced by new that will be common for the entire County of Uppsala. The transition started in 2004 and is soon to be completed. The HO project will lead to several benefits for the users. A hardware upgrade will increase capacity and new RIS/PACS systems have the potential to lead to improved quality of care and more effective work.

The Health Optimum project has introduced much new technology for hospitals participating in the project. However, with new technology comes new working procedures, and reorganisation of work. HO means several new routines at the hospitals which, during a transition period, might be slow and frustrating to users. However, after this transition period, the new technology will hopefully save a great amount of time and money.
Change History

Version History:
1  2007-12-03           Initial Version

Version Changes
1  Initial version

Outstanding Issues
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8. NEUROPHYSIOLOGY

8.2 Evaluation of EEG Recordings with Embedded Video

8.3 Usability

8.4 Quality of Care

8.5 Economy

8.6 Discussion and Conclusion

9. RADIOLOGY

9.1 Background

9.2 Usability

9.3 Quality of Care

9.4 Economy

9.5 Discussion and Conclusion

10. OVERALL CONCLUSION

11. ACKNOWLEDGEMENT

12. REFERENCES

12.1 Interviews

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Table 1: EEG Video Evaluation

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6. DISCHARGE CONFERENCE

6.1 Background

6.2 Usability

6.3 Quality of Care

6.4 Economy

6.5 Discussion and Conclusion

7. NEUROSURGERY

8. NEUROPHYSIOLOGY

8.2 Evaluation of EEG Recordings with Embedded Video

8.3 Usability

8.4 Quality of Care

8.5 Economy

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9.1 Background

9.2 Usability

9.3 Quality of Care

9.4 Economy

9.5 Discussion and Conclusion

10. OVERALL CONCLUSION

11. ACKNOWLEDGEMENT

12. REFERENCES

12.1 Interviews

12.2 Articles & Documents

12.3 Internet

Table 1: EEG Video Evaluation
1. Introduction

For a long time, health care has used sophisticated technology in their main business to treat patients. However, while the trade and industry have accepted and taken advantage of the revolution within Information Technology to use tools that facilitate their main business, the health care has been passive. The technology used for Telemedicine have progressed and matured and has been ready, for some time now, to be used in a larger scale. This is where the Health Optimum project\(^1\) steps into the picture.

Three years after Health Optimum was initiated, Telemedicine have been rolled out in various part of Europe. One year into the Initial Deployment phase the first milestone for the phase has arrived. In the County Council of Uppsala the deployment has been initiated in nine different areas with different kinds of implementations of Telemedicine. Each one of these nine areas has been investigated separately and the report is therefore also structured accordingly.

1.1 Purpose

The purpose of this document is to give an insight to the development of the Health Optimum deployment in respect to the County Council of Uppsala, Sweden. This through addressing the questions of what is happening now and what has happened the first twelve months of the deployment phase. The report will not only address what have been deployed but also what benefits the Telemedicine have had on the health care, what problems and obstacles have emerged and some ideas what can be done about them.

1.2 Limitations

Telemedicine is a vast area, and Health Optimum is a large project. This report deals with the County Council of Uppsala’s, participation in Health Optimum. The Telemedicine is only evaluated in relation to Swedish society. Collaborations with participants outside the Swedish borders have not been taken in consideration.

Moreover, most of the facts presented in this report reflect data gathered through interviews, field studies and participatory observations made during the fall of 2007. Hence, this report gives a description of the present state of use as well of the experience and opinions of the people interviewed.

Because of a limited amount of interviews this report will not be able to go thoroughly into some areas. Instead the coverage is a general view of the systems and all user dependant problems in some areas might not have been detected. Another limitation is that no large patient evaluations have been carried out. And therefore all patient opinions are taken from a small selection of patients. This is also the case with user opinions.

\(^1\) Health Optimum, <http://www.healthoptimum.info>, 2007-12-17
2. Methodology

To obtain the information needed, mainly three different methods have been used. Firstly, interviews with people at the departments have been a very commonly used form for information gathering. Secondly, the Internet as well as other written documentation and reports have been used to gather information in general about different kinds of technology.

Interviews have been done in two different ways. Some interviews have been semi-structured where the interviewing group has prepared a few different topics that they want to discuss and then seen to that every topic is covered. Other interviews have been meetings where the interviewee has briefed the interviewers on a specific topic. During interviews notes were taken and some of the interviews were recorded. Quotations presented throughout this report have not been translated verbatim, but are free translations from Swedish into readable English. Moreover, the majority of the quotes are made anonymously.
3. Shared Clinical Records

3.1 Background

Before computers were widely used in health care, all medical records were kept on paper making it a very time-consuming and costly task each time these had to be shared between points of care. About one decade ago a system named Journal III was introduced at the Primary Care units in Uppsala County. The system made it possible to digitally save records instead of handling paper. It also allowed for day-to-day patient administration to be handled digitally, as for example patients’ contact information. However, these records were still saved locally at each point of care and in order to send them to another point of care they had to be printed and either faxed or posted. Meanwhile, the hospitals still used papers for their records but had started to use a system named IMx for patient administration.

This was not an optimal solution and Uppsala County Council decided it would be best to use one common system in all parts of health care, i.e. at hospitals as well as in Primary Care. The Journal III system that was already in use at the Primary Care units was considered for this purpose, but it was decided that it could not fulfil the needs of the hospitals. Instead, a system called Cosmic\(^2\) was chosen in 2001 for its ability to suit all parts of the county’s health care system.

Cosmic uses a central database, which stores all records, and every point of care connects to it using a client. This enables easy sharing of information to all parties.

3.2 Common Drug List

3.2.1 Background

A study shows that every day of the year there are five people staying at Uppsala University Hospital due to conflicting drug prescriptions\(^3\). The study also shows that this is because doctors can not easily find out what drugs their patients are presently taking, or have been prescribed previously by other doctors. They will often have to rely on the patient to inform them, which unfortunately is not always reliable. In order to reduce the number of patients that are suffering because of this the Common Drug List was created. By using the Common Drug List, doctors can see their patients’ prescription history and use that information to avoid drug-related conflicts. This list is the core of the medicine module and it also supports ordinations and electronic drug prescriptions.

3.2.2 Usability

The Common Drug List is a drug prescribing support tool for doctors. Its purpose is to reduce the number of drug-related incidents. It can warn the doctor if the prescription conflicts with a previously prescribed drug.

\(^3\) Stockholms läns landsting, Läkemedelsbiverkningar som orsak till inläggning på sjukhus, 2005. The numbers have been modified to fit Uppsala University Hospital
In order for this to work the list has to be maintained and up-to-date. When writing a prescription, or making an ordination (used when a patient is admitted at a hospital), the drug is automatically added to the Common Drug List. It is also removed automatically after the prescription time has expired. Sometimes drugs are supposed to be taken "as needed" and thus will not have an expiration date. These will therefore have to be manually removed from the list, which unfortunately is often forgotten, making the list incorrect. This is a severe risk to patient security

Writing and sending prescriptions electronically is convenient for patients since they do not need to hold on to a paper prescription. It also ensures higher security since the risk of misinterpreting a doctor’s handwriting is removed. For drugs that are commonly prescribed, templates can be used to speed up the process. Sadly, they do not exist for less common drugs and the doctor will have to write these prescriptions from scratch. Writing electronic prescriptions can take time even when using a template and it can, in some cases, be faster to write them on paper. This is especially true for very common prescription, which were previously pre-printed on paper and just needed the doctor’s signature. Some doctors are therefore not using the new system and write prescriptions on paper instead. This causes problems with the drug list since the prescriptions are not added to the system correctly, and hence do not appear as prescribed drugs when looking at the drug list.

Ordinations, which are used when the patient is treated in the hospital, are viewable on an Ordination List. The list is supposed to make it easier to administer drugs. Adding an ordination also adds the drug to the Common Drug List.

Due to problems with prescriptions and ordinations in Cosmic, some doctors and nurses have chosen not to use the system, or to use it as little as possible, and continue to use the old paper methods

3.2.3 Discussion

The Common Drug List has potential to improve quality of care. However, the list can at the moment not be used to its full extent due to its possible inaccuracy. It may contain old information about a prescription that should have been made inactive and it may also lack information about prescriptions that were written on paper and not added to the list.

In order to address this problem everyone in health care needs to take responsibility for keeping their patients’ records up-to-date, and those who still use paper instead of Cosmic need to be informed about the consequences of such an approach. Failure in making everyone use the system will most likely result in the list being almost completely useless.

However, even when everyone is using the systems as they should it is important to remember that it will never be possible to completely trust the list. As long as humans are involved in the process, errors can occur. The list should be seen as a complement, not as a substitute, to asking patients what drugs they are using. In some cases it is not possible to ask patients about their current drugs, for example in an Emergency Room, so the list will still need to be maintained.

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4 Problem Inventory, EPJ at Uppsala University Hospital, Uppsala, Sweden, 2007-11-08
5 Ibid
3.3 Referrals

3.3.1 Background

More than thirty thousand referrals are sent to Uppsala University Hospital each year\(^6\). Before the introduction of Cosmic, most points of care used paper referrals both for sending and responding to a received referral. This was a time-consuming task for the medical staff at both the receiving and sending end, as all incoming referrals had to be accepted and the sender had to be notified. In most cases a formal reply to the referral had to be sent back. Uppsala County Council decided that a digitalisation of the referrals was needed to speed up handling and eliminate unnecessary work. Cosmic can handle all types of referrals, both incoming and outgoing. Referrals are sent electronically and the sender will get a confirmation when the referral has been accepted. There are several statuses that a referral can have, for example, booked, under consideration, and answered. These have been implemented to let the sender see if the referral has been dealt with yet, if it is undergoing investigation, etc.

The goal of this complete digitalisation of the referrals is to save time, which eventually boils down to money, and to ensure proper handling of referrals.

3.3.2 Usability

The process of receiving a referral at a hospital is similar for both electronic and paper referrals. The only difference is that all referrals on paper will have to be manually entered into Cosmic. This means extra work for users.

Receiving referrals is complicated. It is considered to be too many steps that need to be taken and this increases the risk of mistakes\(^7\). In order for the sender to see how far in the process the referral has come, the Cosmic system has implemented a way of showing this by using different statuses. A referral can have fourteen different statuses, not all of these have to be used however. A few problems have been reported to exist in the system that can lead to a referral getting a faulty status. Users have complained about having trouble keeping track of what is going on when handling a long-term commitment of patients' care\(^8\). They lack a common thread and a good overview of patients' care from initial contact to the end of treatment.

A good overview is needed for other reasons as well. Some users have problems understanding and trusting the referral statuses. According to a nurse, one of the later updates to Cosmic has caused an increased amount of referrals being given the wrong status\(^9\). Users are likely to double-check a status due to this, which makes the process more time-consuming. These status difficulties are such a problem that one user have said that “I can not trust the things I see”\(^10\). Another user claimed that “it is a damn detective job” when it comes to finding referrals with

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\(^6\) Weiman, Erik, *Yttrande EPI-revisionen*, Uppsala County Council, 2007
\(^7\) Interview, Sävja Care Centre, Sävja, 2007-11-07; Interview, Heby Care Centre, Heby, 2007-10-19; Interview, Enköping Hospital, Enköping, 2007-11-23
\(^8\) Interview, Enköping Hospital, Enköping, 2007-11-13
\(^9\) Ibid
\(^10\) Ibid
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the wrong status\textsuperscript{11}. This has lead to the staff printing out paper copies to make sure that referrals are not lost.

Referrals are sometimes sent to the wrong recipient. The list of recipients that the sender can choose from is problematic and contains units that are not supposed to receive any referrals. Trying to send an electronic referral to a place that can not receive them will result in a printout on paper instead.

3.3.3 Discussion

Electronic referrals have the potential to become a great tool. However, the usability problems, causing mistrust in the statuses of the referrals, have to be solved in order for the electronic referral system to reach its full potential.

The link between Care Commitment\textsuperscript{12} and the referral system would not be a new idea. Paper referrals and care history have always been linked even before the introduction of Cosmic, usually by stapling the papers together. Implementation of this link should be possible since both systems are already a part of Cosmic.

Concerning the list of recipients within Cosmic; the possibility of sending the referral to the wrong place should be removed. One solution to this usability problem would be to make all recipients that are incapable of receiving an electronic referral unselectable. This may not always be a good idea though, since it is human trait, when computers will not perform seemingly easy tasks without explanation, to get stressed or agitated. This does not only create a bad work environment, but also potentially causes mistakes. A better solution could be to divide the recipient list into two separate lists; one containing referral recipients and the other showing a list of the units that particular recipient contains.

Moreover, one should consider the consequences of the perceived lack of control of a referral status and its impact on the users’ work environment. Lack of control is one of the well known stress factors that one needs to avoid when implementing computer systems\textsuperscript{13}.

3.4 Shared Medical Records

3.4.1 Background

Before the introduction of Cosmic all doctors would have to request patients’ medical records from other points of care. The records were sent using the postal service or a fax machine, which required both manpower and time on both locations. This was a time-consuming task, which could be solved using an electronic medical record database. This database should be easily accessible from any point of care without taking up anyone else’s time.

\textsuperscript{11} Interview, Enköping Hospital, Enköping, 2007-11-13

\textsuperscript{12} See Glossary

\textsuperscript{13} Åborg, Carl, How does IT feel @ work? And how to make IT better. : Computer use, stress and health in office work, Uppsala University, 2002, retrieved 03 December 2007, <http://urn.kb.se/resolve?urn=urn:nbn:se:uu:diva-2849>
3.4.2 Usability

With the deployment of the electronic Medical Records Module in Cosmic came changes in work procedures for the medical staff. They no longer had to keep records on paper as everything was stored in a shared database where they could find all patients' medical records.

In order to have patients' old medical records available, without having to go and look them up in a file somewhere, a system called KoVis was introduced and made accessible through Cosmic. All old records, and any new records that are available only in paper form, are scanned and saved as image files and connected to patients' medical records for easy access. This has, however, not worked out very well. Image files are by nature non-searchable which means finding information in them can be difficult. This is not any different from a normal document on paper. The biggest problem is that they are sometimes mislabelled so that they are sorted into the wrong section of the medical record, making them very difficult to find. There are also reports of several duplicates cluttering the system\(^{14}\). One user said that “we usually refer to [any KoVis activity] as ‘Go Fish!’” (referring to a card game where one has to find a certain card in a sea of cards)\(^{15}\).

The general opinion about the electronic medical records in Cosmic seems to be that it is working quite well. A few users expressed a concern that too much unnecessary information is shown when opening a patient's medical record. There is a filter function that is meant to solve this problem, but it is not working very well.

Another problem is the searching of a diagnosis code. Every time a diagnosis is entered into the medical records of a patient, a code has to be specified. Over 30,000 of these codes exist and many are very similar. The current search system has a few problems that severely limit its use.

3.4.3 Discussion

The benefits of shared medical records lies not only in better quality of care, as a result of doctors getting a better picture of a patient's medical history, but also in monetary savings resulting from less time spent maintaining old paper records (faxing and mailing the records when requested by another point of care, storage, etc.).

However, there are several problems that prevent the system from reaching its full potential. Some problems like the one with the filter function is not yet a big problem, since the system is young and most patients do not have enough information in their records to need filtering. But as the records grow in size, so will the need of a well designed filter.

Other problems are more urgent, like the diagnose codes or KoVis, and need to be addressed promptly.

\(^{14}\) Interview, Enköping Hospital, Enköping, 2007-11-13
\(^{15}\) Ibid
3.5 Discussion and Conclusion

Several of the problems could be solved using education. For example, adjusting dosage type is something that several doctors have struggled with. The solution is rather simple but not logical. If they had received a thorough education this would never have been a problem. However, should education be the answer to an illogical system? Is it not better to design the system so that it is possible to discover the correct way on your own? The answer is that you have to find some kind of middle ground; no system of this magnitude can be so self-explanatory that you can learn everything there is to know about it simply by using it. Hence, education and practise is always needed when introducing new computer systems, however, an education can not cover everything; all features of the system should strive to be logical for its users, enabling the users to discover these by themselves, provided that they have been given basic education.

Some of the technical solutions are, from a usability standpoint, not well implemented. Many of these are said to be chosen because of performance issues. This is probably true, however, from a technical standpoint this should not be the case. The filtering function in the medical records is a good example of this. While the current implementation was most likely chosen in order to improve performance, it should never have been an issue to being with. Bigger systems can handle far more information without any performance issues.

The general opinion of Cosmic seems to be that while it currently takes a lot of work it will eventually pay off. One thing that currently is working very well is the support organisation. Responses to queries are made quickly and efficiently and the users have indicated that they are very happy with it.

It has to be said that for a system this size, Cosmic is working surprisingly well considering its complexity. While it has many problems and design flaws there are very few critical errors and it is overall doing what it is intended to do.

Cosmic was introduced in order to improve quality of care and to save money. In the initial budget made in 2001 the break-even was approximated to occur in 2008, but is now believed to be a few year behind schedule. A lot of problems currently exist in Cosmic and they need to be resolved in order to achieve its goals.

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16 Problem Inventory, EPJ at Uppsala University Hospital, Uppsala, Sweden, 2007-11-08
17 Interview, Sävja Care Centre, Sävja, 2007-11-07
4. Dermatology

4.1 Background

At present, when a doctor at a Care Centre has a dermatology case and is uncertain of a diagnosis, the patient is referred to UUH. The idea of this project is that a Care Centre, in this case Heby Care Centre, will use a digital camera to photograph patients. These photographs will be discussed once a week, during a video conference, with the specialist at the Department of Dermatology at UUH. The commencement of the HO project in dermatology has been postponed during the autumn, as a person willing to take responsibility was not found at the Department of Dermatology at UUH. However, after a couple of months a person responsible for the implementation of telemedicine at the dermatology department was appointed.

4.1.1 Technology

A digital camera capable of taking macro shots will be used. At the Point of Care a video conference equipment consisting of a large flat screen TV, a hardware decoder, and a camera will be used. At the Centre of Excellence it is speculated that the specialist doctor will use a PC solution at his office.

4.2 Usability

4.2.1 New Way of Working

The doctors at the point of care will, more or less, continue to work as before. The difference is that if a patient has skin alterations of unknown type the doctor can consult a specialist. During these video conferences the doctors also get the opportunity to ask for a second opinion in cases of uncertainty. The difficulty is not to manage the technology itself, but rather to take good photographs.

4.2.2 User Opinions

At present, the collaboration has not commenced and there are no opinions about the actual collaboration yet. However, there are opinions about the concept itself. One specialist at UUH does not agree with the benefits of using video conference compared to using e-mail as he has experience from a previous project.\(^\text{18}\) The specialist feels that e-mail has the benefit that he can send a reply when he is available.\(^\text{19}\) However, according to a general practitioner, who has been involved in the previous collaboration with the Department of Dermatology, it can be valuable to have an interactive communication between the doctors.\(^\text{20}\) He also pointed to the importance of usable technology to have a successful collaboration.

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\(^{18}\) Eriksson, Leif, *Telemedicin HL-Hud*, Uppsala County Council

\(^{19}\) Interview, specialist at the Department of Dermatology at UUH, 2007-11-12 16/11, Uppsala, Sweden

\(^{20}\) Interview, general practitioner, 2007-11-21, Uppsala, Sweden
4.2.3 Benefits and Side Effects

The specialist at the Department of Dermatology gave a rough estimate that ten percent of the referrals could be avoided, because of the collaboration\textsuperscript{21}. Whether this results in time saving is hard to tell; the specialist still has to look at images and participate in video conferences. One big benefit is that doctors at the Care Centre will learn from the specialist in cases they discuss. This will probably lead to a decreasing need for video conferences in the future.

4.3 Quality of Care

4.3.1 Patient Satisfaction

No patient opinions have been gathered since the project has not commenced. One can still draw some conclusions from previous experiences from a similar project at the Department of Plastic Surgery\textsuperscript{22}. If the time before patients can get the diagnosis is shortened from one to three months down to one week, it would be an obvious gain for the patients.

4.3.2 Benefits and Side Effects

If the consultations have some element of interactivity the doctor at the PoC can ask questions giving a better understanding of the procedure and therefore learn faster. A benefit is that the doctor, at the PoC, can get a second opinion when they have a possible diagnosis. Previous projects\textsuperscript{23} have shown that the specialist can see immediately if it is possible to diagnose using the photograph and in most cases it is. If it is not possible it could either be because the photograph is unclear or the specialist at the CoE has to look at and touch the skin alteration.

4.4 Economy

The collaboration is kept inside the County of Uppsala and there will therefore be no explicit money transfers. Both Care Centres and hospitals have the county as their financier and the economical aspects are taken care of in their different budgets. At present, the number of documented treated patients is considered in the process of deciding how much funding each department should receive from their division. It is the Care Centre that is reported as having treated the patient even if they consulted the specialist at UUH. So if UUH do not count them they will do more work without getting paid for it. This will most likely lead to less funding since they get fewer patients to the department. Some new kind of documentation must be implemented. The problem is how much a consultation should weigh compared to a treated patient.

\textsuperscript{21} Interview, specialist at the Department of Dermatology at UUH, 2007-11-12 16/11, Uppsala, Sweden
\textsuperscript{22} 5 Plastic Surgery
\textsuperscript{23} Eriksson, Leif, \textit{Telemedicin HL-Hud}, Uppsala County Council
4.5 Discussion and Conclusion

There are no medical or technical reasons why the collaboration between the Care Centre in Heby and the Department of Dermatology should not be a success. The dermatology area is well suited for diagnosis from photographs and previous projects have shown that the risk for an incorrect diagnosis on account of the technology is very small.\(^{24}\)

In the previous projects, the collaboration was conducted through e-mail.\(^{25}\) If the video conferences should be held once a week, the e-mail solution would generally give a faster response. The specialist does not need to have a scheduled time to answer the e-mails and instead small free time slots can be used. Also, the time spent on each case will be shorter compared to video conferences. However, e-mail is not as efficient as video conferencing when it comes to spreading excellence and competence. A combination of the two may utilise all benefits. One scenario could be that only the video conference is used initially. Later on, when the doctors at the PoC start diagnosing, using their new found knowledge, they can use e-mail to confirm their diagnosis and get a second opinion.

Another consideration before fully incorporating the project is the legal issue of which party to hold responsible for a faulty diagnosis.

\(^{24}\) Interview, specialist at the Department of Dermatology at UUH, 2007-11-12 16/11, Uppsala, Sweden; Interview, general practitioner at Årsta Care Centre, 2007-11-21, Uppsala, Sweden; Eriksson, Leif, *Telemedicin HL-Hud*, Uppsala County Council

\(^{25}\) Eriksson, Leif, *Telemedicin HL-Hud*, Uppsala County Council
5. Plastic Surgery

5.1 Background

The Department of Plastic Surgery (DPS) at Uppsala University Hospital (UUH) has two main tasks; plastic surgery and burn treatment within which they serve large parts of Sweden. Between 2005 and early 2007, the department participated in an EU-project called SPEX (Spreading Excellence) concerning spreading excellence through Telemedicine. In this project the department acted as Centre of Excellence (CoE) and collaborated with Mälarsjukhuset Hospital in Eskilstuna (MHE) who acted as a Point of Care (PoC). With SPEX, an agreement was made to secure economical benefits for both parties.  

SPEX allowed Tele-consultation between doctors minimizing unnecessary transports of patients from MHE to UUH which could be treated at MHE with the aid of Telemedicine. Health Optimum will be a continuation and expansion of SPEX. The collaboration with MHE will continue with one additional doctor. Two new hospitals, Gävle and Falun, will be added. As of now the DPS is preparing a sales pitch package with technological solutions.

5.1.1 Technology

The tools used at the DPS at UUH, are shared desktop software called Bridgit, video conference software called VCON vPoint HD (vPoint), high quality streaming video and mobile phones able to send and receive photographs.

Bridgit is mainly used for image consulting allowing both parties to draw on photographs. The video conference technology is used for consultations both with and without the patient being present. vPoint is used by the doctor at the CoE together with an ordinary web camera. If needed a dedicated video conference room at UUH can be used since vPoint is compatible with other video conference technologies in use at UUH. The high quality streaming video camera is used by the doctor at the PoC to show a patient’s wounds. Sometimes a mobile video conference solution similar to the one used in the Discharge Conference project is used at the CoE. Sending photos by mobile phones are used for quick consultations with the aftercare ward after surgery. This may be replaced by a mobile video conference solution.

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26 STEVE Student Evaluation of Telemedicine, Uppsala University, 2006
27 Interview, Fallgren, Anders and Nylund, Ulf at MIT department at UUH, 2007-11-12, Uppsala, Sweden; Interview, specialist at the Departments of Plastic Surgery at UUH, 2007-10-22, Uppsala, Sweden
28 Ibid
30 Interview, specialist at the Departments of Plastic Surgery at UUH, 2007-10-22, Uppsala, Sweden; Interview by phone, specialist at Department of Plastic Surgery, Eskilstuna Hospital, 2007-11-13
31 Interview, specialist at the Departments of Plastic Surgery at UUH, 2007-10-22, Uppsala, Sweden; 6 Discharge Conference
32 Interview, specialist at the Departments of Plastic Surgery at UUH, 2007-10-22, Uppsala, Sweden
5.2 Usability

5.2.1 New Way of Working

Both agility and certainty at the PoC will increase. If uncertain, the doctor can ask the CoE for consultation releasing pressure from the PoC. If a quick consultation is needed the mobile phone solution works well. However, the availability of the doctor at the CoE may be positive for the PoC but a hindrance to the CoE. New agreements for charging consultations may also be needed.

5.2.2 User Opinions

Both the PoC and the CoE are satisfied with the technology though requesting better video quality if possible. Also, the accessibility should be improved: “What you want is to have everything gathered in one place.” Also the ease of use was pointed out: “The idea is that using the technology should be so simple that everyone could use it.” The technology was not experienced as an obstacle. Even though the need of consultations has lessened at the PoC due to a rise in excellence, the doctor still thinks it is very valuable to have this kind of collaboration.

5.2.3 Benefits and Side Effects

The PoC benefits from better consultation which is a kind of teaching ultimately allowing the PoC to treat more patients independently. The technology may be used in other areas within the hospitals. The contact between doctors at different hospitals will increase. A possible side effect is the PoC becoming a CoE for even smaller care units.

5.3 Quality of Care

5.3.1 Patient Satisfaction

According to the doctors involved at both PoC and CoE, the patients are satisfied and feel no big difference since they have the support of their own doctor sitting next to them. The patients generally believed that the consultations with a specialised doctor was a good thing and welcomed that they did not have to travel to UUH to be treated.

33 Interview, specialist at the Departments of Plastic Surgery at UUH, 2007-10-22, Uppsala, Sweden; Interview, specialist at the Departments of Plastic Surgery at UUH, 2007-11-16, Uppsala, Sweden; Interview by phone, specialist at Department of Plastic Surgery, Eskilstuna Hospital, 2007-11-13
34 Interview, specialist at the Departments of Plastic Surgery at UUH, 2007-10-22, Uppsala, Sweden
35 Interview by phone, specialist at Department of Plastic Surgery, Eskilstuna Hospital, 2007-11-13
36 Ibid
37 Interview, specialist at the Departments of Plastic Surgery at UUH, 2007-10-22, Uppsala, Sweden; Interview by phone, specialist at Department of Plastic Surgery, Eskilstuna Hospital, 2007-11-13
38 Specialist 2007-11-13 Loc Cit
5.3.2 Benefits and Side Effects

The CoE will experience a rise in excellence since only harder and specialised cases will be handled. The high workload at the CoE could be lowered as well leading to faster care. The quality of care at the PoC will increase due to the rise in excellence. Finally the patients will benefit from not having to travel to the CoE.

5.4 Economy

The basis of the agreement from 2006 was to create a win-win situation for UUH, MHE, and the patients. The gain for MHE is reduced costs for sending patients to other County Councils' hospitals. For UUH the gain is optimized use of excellence as well as shorter waiting periods for other patients.

MHE compensates UUH in two ways for the consultations; one annual payment of 200,000 SEK per year, plus additional payment of 4,000 SEK per consultation. Since MHE is part The County Council of Sörmland and not The County Council of Uppsala they benefit from reduced costs of transportation.

The agreement lasts for two years and expires February 2008. All parties involved are happy with the agreement. The lesser need for consultations and the rise in competence at MHE should be taken into account when revising the agreement. The County Council of Sörmland and County Council of Uppsala have a general agreement concerning health care in which this agreement could be included.

5.5 Discussion and Conclusion

The Department of Plastic Surgery (DPS) has already come far using Telemedicine, mainly thanks to the previous EU project called SPEX. The DPS is looking for ways to spread these collaborations further both outside of the County Council’s borders and within the hospital and to the County Council’s Care Centres. When doing so it is important that the technological solutions used are marketed and packaged in a comprehensive way to attract key personnel and facilitate commencing with the collaborations.

Due to the large distances in UUH the Telemedicine solutions could be used internally to communicate between wards. An example of this use includes giving instructions for treatment to emergency staff before the arrival of a surgeon, providing adequate health care faster. If by Tele-consultation a doctor could deem a visit unnecessary, time could be saved to the benefit of other patients. Similar solutions could be used when a doctor is on-call at home, saving time from travelling to the hospital. An implementation under evaluation at the DPS is using telemedicine when a specialist doctor is doing the rounds at more than one ward.

Doctors at the DPS at UUH has expressed that parts of the software used on PCs is sufficient, but unsuitable for the purpose. They also expressed a wish for a

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39 Uppsala County Council, AS2006-0174
40 Interview, specialist at the Departments of Plastic Surgery at UUH, 2007-10-22, Uppsala, Sweden; Interview, Eklund, Benny, Project Leader Health Optimum, 2007-10-12
41 AS2006-017, Loc. Cit.
42 Interview, specialist at the Departments of Plastic Surgery at UUH, 2007-10-22, Uppsala, Sweden; Interview by phone, specialist at Department of Plastic Surgery, Eskilstuna Hospital, 2007-11-13
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homogeneous and uniform solution and they want to ensure that the software is easily available, continuously developed, and is kept maintained. The DPS also has an open mind towards implementing the collaboration technology in other areas, such as an operation theatre.

The current collaboration is working well and the expansion to new sites is on the way. The collaboration with Gävle and Falun will initiate in the beginning of 2008. The technology used in the collaboration has been sufficient, but the development of new tools that fits the collaboration better has been delayed. The Department of Plastic Surgery at UUH have moved forward fast and is eager and open-minded to try and find new application for Telemedicine but the MIT department at UUH have not been able to keep up. As shown from SPEX the collaboration has many benefits and works economically. The next step is to adapt the technology better and expand the collaboration to see how it works in a larger scale.
6. Discharge Conference

6.1 Background

When patients', that needs further care, have been treated at the Uppsala University Hospital (UUH) they are to be transferred to their home municipality. If the discharged patient currently have, or in the future will have, home-help service, a discharge conference will take place. This is to ensure that the patient will get the correct care in their home municipality. When the doctor considers the patient to be fully treated, the home municipality and the corresponding Care Centre in the home municipality are contacted.

Regulations state that when UUH have informed the home municipality, the municipality has five weekdays to transfer the patient to the municipality care, after which they will be charged 2,000 SEK per day that the patient is still in the care of UUH. Before transferring the patient, a discharge conference is held. For each conference the staff from the home municipality travels to the UUH. At the beginning of this project only a few of the departments in UUH has participated with the municipalities Heby, Östervåla, and Tierp.

Heby Care Centre (HCC), that will be the focus of this section, has experience with video discharge conference (VDC) with the county hospital of Västerås. VDC’s have been used eleven times between HCC and UUH. The departments involved have been: Emergency and Rehab and the Orthopedic Department.

6.1.1 Technology

The VDC tools used to communicate between UUH and HCC uses the hospital network Sjunet for its communication infrastructure. As for audio and video, they use a video conference standard hardware that is compatible which several different manufacturers. The UUH has two different kinds of systems, a studio and a mobile solution developed by the MIT department. HCC has a single stationary solution.

The mobile solution is located at the MIT department, UUH. The briefcase is mobile but heavy and placed on a trolley for transportation. Plans have been made for the hardware to be fastened on a trolley. The HCC solution is stationary and temporarily in an examination room. The system uses an IP address or a short-number service, giving telephone-like calling numbers to facilitate "calling" with the provided remote control.

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43 Interview Lyttkens, Leif, Chief Medical Officer, MD, PhD, Ass Professor, 2007-10-16, Uppsala, Sweden
44 E-mail conversation, Health care planner at UUH, 2007-11-26
45 Interview, Fallgren, Anders and Nylund, Ulf at MIT department at UUH, 2007-11-12, Uppsala, Sweden
6.2 Usability

6.2.1 New Way of Working

The Participants at the conference are the patient, the nurse responsible for the patient at UUH, an aid-worker, and the district nurse from the patient's home municipality. Other participants are the next of kin and a technician.

HCC estimates that their district nurses and the aid-worker will save three to four hours of travelling for each VDC. At UUH, depending on who is participating in the meeting, either the health care planner or the nurse is responsible for the patient. Previously the health care planner would leave the meeting after the representatives from HCC had been briefed. The health care planner stays for the whole conference because of the use of VDC. When new meetings are scheduled, a technician from MIT must bring the briefcase; there are plans for each ward or department to have their own VDC equipment.

6.2.2 User Opinions

The users at HCC are satisfied with the use of video conferences and the technologies. However, they also believe improvement can be found regarding how the technology is used. One member of the staff at HCC believed that the meetings sometimes were more effective when using VDC because there are less unnecessary discussions. The staff prefers the briefcase when it avoids transportation.

6.2.3 Benefits and Side Effects

VDC, is time-saving for the municipality and Care Centres, Nurses in UUH becomes occupied during the conferences to setup and to keep the patient company. The meetings are easier to schedule, since it is easier find an open one hour slot instead of an open three hour slot. The new way of communicating has effects on how the involved persons interact with each other. Since small talk and social interaction is minimized the "water cooler effect" is lost.

6.3 Quality of Care

6.3.1 Patient Satisfaction

Due to the low amount of patients involved in the discharge conferences the following information is extracted from interviews with the involved medical staff and from participatory observations during video conferences. None of the patients have so far had any specific objections towards participating in the video conferences. Instead the patient often seems to be a bit impressed and curious of

46 Interview, District nurse and technician at Heby Care Centre, 2007-10-19, Heby, Sweden
47 Interview, Health care planner at UUH, 2007-11-06
48 Interview, District nurse and technician at Heby Care Centre, 2007-10-19, Heby, Sweden; Observations, Video conference between UUH and Heby Care Centre 2007-11-13, Heby and Uppsala, Sweden
49 Observations, Video conference between UUH and Heby Care Centre 2007-11-13, Heby and Uppsala, Sweden
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use of technology. Since many of the patients generally are of high age, when using the video conference briefcase, some of them have problems to see the other party because of the limited screen size. If the patient cannot properly see the person talking the communication may become less intuitive. In the dedicated video conference room the atmosphere is very formal and strict which can make the patient and next of kin unfamiliar to video conference, tense, and uncomfortable.

6.3.2 Benefits and Side Effects

During the initial discharge conferences, nothing implies that the quality of care has a negative impact or that VDC has any clear benefits to the quality of care. Because of time-savings at the patient's home municipality, the conferences should be able to be scheduled sooner. This could in the long run make patient queues shorter. If the technology is malfunctioning the quality of the meeting will suffer. Also if the patients or next of kin feels uncomfortable with the technology, they may be reluctant to express their opinions.

6.4 Economy

With the new way of collaboration, the main beneficiaries are the municipalities and Care Centres. Not only will the district nurses be more effective but also because they can treat more patients the Care Centre will get more funding. There is a downside for the Care Centres with VDCs; in today's system this VDC does not get registered as a patient session and the Primary Care does not receive funds for it. Depending on the future implementation of the conference, UUH will get additional costs. If they need to have a person to keep the patient company during the video conference it will cost in man hours.

Even though, most of the benefits are at the Care Centres and in the municipality, UUH can also save some money due to the VDCs. If the patient is able to be transferred to the municipality care faster, the hospital and the society will save money because a bed at the hospital is far more expensive than a bed in the municipality care. But even though this is a saving for the society in a larger perspective the municipality loses money. Because the municipality have five free days before they need to pay for the patient at UUH it will only be a cost to take over the patient earlier.

Two kinds of new reimbursements might be necessary. First, UUH needs to have an economical incitement to have the VDCs. UUH could have economical compensation for the more work in connection to these VDCs. Second, reimbursement does not affect the VDC but the whole hospital care. The municipality needs some motivation to take care of patients as soon as possible. This could be done with a small bonus if they can take over the patient before the 5 days have expired.

The cost of the actual technology is not a large obstacle for the introduction of this in additional departments/wards. The technology can be used in other contexts and the purchase of the technology is a one-time cost.

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50 Interview, District nurse and technician at Heby Care Centre, 2007-10-19, Heby, Sweden; Interview, Health care planner at UUH, 2007-11-06
51 Health care planner Loc. Cit.
52 E-mail conversation, Lindberg, Charlotta, Project Assistant Health Optimum 2007-12-11
6.5 Discussion and Conclusion

The technology infrastructure and hardware is well-founded and needs only minor peripheral adjustments known by the MIT personnel. These issues are easily solved and will give great results. The main problems are related to human computer interaction.

The personnel have only had a few VDC’s and therefore it is natural to have an untransparent relation to the technology. To achieve transparency you need time and experience. To speed up the process, routines for how a VDC should be performed are needed. These routines would aid health care staff to use the technology as a natural part of a VDC and benefit the patient and the next of kin. This will most likely be a great tool for future collaborations at the early stage of deployment for the staff. Routines and technical manuals should be made for the staff to achieve technology transparency sooner and ensure better experience for the patient.

There should also be information for patients and next of kin to prepare them for a VDC. After observations of the VDCs, indications of the next of kin and patient participating in VDC feeling discomfort was noticed. Especially the studio solution can be a discomfort factor since the next of kin and patient enters unprepared into an unknown, unnatural, and highly technical environment. The mobile solution can be more adequate in a psychological aspect relative to the patient, since you bring an unknown object to an environment you are already acclimatized to.

When the nurse at UUH has informed all parties of the patient's condition the nurse can leave the conference. Previous to VDC, this was not a problem since members of both UUH and HCC were physically present at the same place. With VDC, if the nurse leaves, the patient and next of kin would be left alone for the remainder of the conference leading to a feeling of abandonment. Also, technical complications could arise in the conference. This can be solved by assigning one of the personnel at UUH to sit in on the meeting. As of now the health care planer does this task. One could choose to keep having this assigned to the health care planner; however, this solution can be unwise since these members of the staff generally are very busy. One solution to this problem could be to have one person at the division responsible for all these conferences who attends these conferences and makes sure that they are performed correctly.

Using VDC has an undisputed gain for the Care Centres, and the further away from UUH they are located, the more time and money is saved when unnecessary travelling is reduced to a minimum. As of now the gain for UUH is unclear. One can argue that time saved at the Care Centres can result in faster discharged patients at the UUH.

The implementation used by the UUH and HCC are well-founded and generally a very good solution to the issues that arise with travelling. Since this project is in an early stage, the staff is naturally lacking experience, but experience and solutions to small peripheral technology issues can probably be hastened with the aid of tools such as technical manuals and routines. Regardless, there are things that could be improved. For example, the problem with leaving a patient in a VDC alone on UUH needs to be considered.
7. **Neurosurgery**

The Department of Neurosurgery has at this time, due to lack of time and personnel and other aspects, no possibility to participate in the HO project. They might be included in the project at a later time but is yet to be settled.
8. Neurophysiology

8.1 Background

Neurophysiologic examinations aim at mapping functions in the central and peripheral nervous system. They are designed individually depending on symptoms and modified depending on the acquired results. The diagnosis aims at being a description and an interpretation of the acquired results. It also contains a summary which should act as guidance to the referring doctor\footnote{Brochure “Metoder och Indikationer” - Department of Neurophysiology at UUH}.

One examination method used at the Department of Neurophysiology at UUH is electroencephalography (EEG). The examination is performed by attaching a number of silver electrodes to the patient’s head. Brain activity is then registered at rest and during provocations, such as hyperventilation for a period of three minutes, and flashing light for a period of five minutes. Total registration time is usually about 40 minutes. If there is a suspicion of epilepsy, sleep is also used as a provocation, which prolongs the examination time\footnote{Ibid}.

The Department of Neurophysiology at UUH currently consists of ten doctors, ten biomedical analyzers, four secretaries, one assistant, two engineers, and one attendant. University employees, such as scientists, secretaries, and engineers, are also a part of the ward. Patients are referred to the ward from both the hospital’s other wards and non-institutional care sites, called satellite labs. When a patient at a satellite lab is referred to the Department of Neurophysiology a biomedical analyzer at the satellite lab performs the EEG registration, which is then accessible to the Department of Neurophysiology via Sjunet\footnote{Carelink, Sjunet - Kommunikationsnätet för vård och omsorg, retrieved 26 November 2007 <http://www.carelink.se/tjanster/sjunet>}. Patients are only referred to the Department of Neurophysiology at UUH when they can not be diagnosed at the satellite lab\footnote{Brochure “Metoder och Indikationer” – Department of Neurophysiology at UUH}.

Current satellite laboratories:

- Gävle (Hudiksvall)
- Falun (Säter, Mora)
- Karlstad
- Örebro
- Västerås
- Eskilstuna
- Stockholm
- Mariehamn
When performing an examination where there is a suspicion of epilepsy it is sometimes difficult to separate artefacts, such as the patient moving, from real epileptic activity. The new project will evaluate the use of embedding video with the EEG in order to address this issue. All EEG registrations with embedded video are analysed at the Department of Neurophysiology at UUH\(^{57}\).

An EEG registration requires about ten megabyte and a video recording about ten megabyte per minute. Video is recorded with a standard MPEG-4 codec which makes it easy to play in other applications at other locations relating to educational purposes. It can also be edited allowing only video containing interesting information to be kept. This allows for faster analysis if the registration has to be reviewed\(^{58}\).

The project is, as of 8th of November 2007, active as a pilot project between the satellite lab in Hudiksvall and the Department of Neurophysiology at UUH. This pilot project will hopefully be accomplished before 1st of January 2008 and consist of about fifty EEG diagnoses. Negotiations are currently also in progress to include the satellite lab in Örebro. The pilot projects will then be evaluated and one will decide whether to incorporate satellite labs in the rest of the country. If incorporated, the satellite labs need to be convinced that this solution is worth the investment\(^{59}\).

Expectations are that the project will result in better diagnostics and fewer patients brought back for the complementary registrations needed to distinguish artefacts from real epileptic activity. It is also expected that it will be possible to use a smaller amount of registrations to diagnose the patient's condition\(^{60}\).

### 8.2 Evaluation of EEG Recordings with Embedded Video

#### 8.2.1 Background

As stated in the previous section, in order to improve the diagnosis for possible epileptic patients an evaluation of using electronic EEG recordings combined with video has started. During normal activity, the EEG recording consists mostly of regular shapes. When there is an epileptic activity the chart fills up with spikes. It is these spikes the doctor looks for when examining an EEG chart. A lot of times it is hard to know whether a spike in the EEG recording is epileptic activity or not. For example, merely touching one of the electrodes can give multiple huge spikes in the EEG recording and thus look like an epileptic activity. Normal movements will also cause registrations in the chart, which makes diagnosing harder. However, if a video of the patient is provided along with the chart, the analysing doctor can more easily see whether the spikes in the chart are due to some external factors or if it is caused by an epileptic seizure. This is time saving for both the doctor and the patient. It is not time saving in the sense that an analysis will take shorter time (to do a diagnosis should take between ten to fifteen minutes), in fact an analysis including video will take a few minutes longer, but saves time by enabling the doctor to do a more exact diagnosis. For example, if the doctor analyses an EEG recording that contains some suspicious activity she might not be completely convinced that the patient actually has epilepsy and wants to do another test. If the doctor had been able to watch a video of the patient during this suspicious activity, the doctor could have been able to either rule out or diagnose epilepsy after merely one

\(^{57}\) Interview, Flink, Roland, Uppsala, Sweden, 2007-10-16

\(^{58}\) Interview, Flink, Roland, Uppsala, Sweden, 2007-11-16

\(^{59}\) Ibid

\(^{60}\) Ibid
There is no real difference in how the doctor works when analysing with video. The doctor analyses the electronic EEG recording and only uses the video as a complement.¹¹

There is an agreement between the Department of Neurophysiology at the UUH and the hospital in Hudiksvall that all the electronic EEG recordings, with video from Hudiksvall, will be diagnosed in Uppsala. The charts and the video are stored locally and can be accessed and analysed in Uppsala using a computer program called “Nervus Study Room”. An EEG registration session normally takes about 40 minutes. It is important that the doctor can see the whole body in the video because epileptic seizures can induce movements in the limbs. The lighting should be sufficient enough to distinguish even small eye movements. The ideal situation would be to have two cameras; one showing the whole body and another showing the face.⁶²

**8.2.2 Method**

The Department of Neurophysiology at UUH has set up a procedure to evaluate this new way of working. For every patient diagnosed using the new system the analyzing doctor evaluates whether the video was a helpful complement or not. The procedure used to evaluate the new system is shown in the table below:

<table>
<thead>
<tr>
<th>Point</th>
<th>Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0+</td>
<td>Not helpful at all, the diagnose could be done without video</td>
</tr>
<tr>
<td>1+</td>
<td>A technical artefact in the chart can be discovered using video, the patient does not need to do another EEG</td>
</tr>
<tr>
<td>2+</td>
<td>A diagnosis of epilepsy can be made using the video</td>
</tr>
</tbody>
</table>

It is estimated that at least 50 evaluations is needed to do a fair judgment of EEG recordings with video.⁶³

**8.3 Usability**

The staff involved with the procedure of EEG recordings at the point of care is the committing doctor, a biomedical analyst (BMA), who connects all the necessary technology, and a nurse that also observes the patient during the procedure. At UUH there is, besides the responsible neurophysiologist, a secretary that prints what the doctor dictates after having reviewed the patient's case. The neurophysiologist reviews the referral and signs it digitally. The referral is then sent automatically back to the committing doctor. The extra work for the neurophysiologist includes a click on the screen when he needs it since the video

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⁶¹ Interview, Flink, Roland, Uppsala, Sweden, 2007-11-16
⁶² Ibid
⁶³ Ibid
feed is included with the EEG recording. To see hold of the video and the chart the
neurophysiologist at UUH logs on to the actual satellite lab server and streams the
chart, and if it is necessary the video, through Sjunet. 64

The initial feedback from the satellite lab in Hudiksvall was positive. This, since it is
very little extra effort is needed by the medical staff to implement the video stream
in their examination. The staff that is doing the examination in Hudiksvall says that it
is less stressful with the video stream, since they will not miss anything of
importance, for instance if the patient moves. It is also easier than they expected to
operate the camera. With time they think they will be able to handle the camera
more proficiently and thus acquire better video recordings. 65

From the patient's perspective, as long as there is a chance of a better diagnosis
using video, it is worth an evaluation. The only thing different in the examination
procedure for the patient, is being informed that there will be a video camera filming
the procedure and what the benefits to expect from this. There is no extra concern
for the patient.

One of the few problems is that all of the satellite labs have to be equipped with the
new Telemedicine equipment, which is a costly investment, and be informed on how
to set the lighting in a correct way. Bad lighting is a problem that can cause the
video stream to be less useful. It was common in the beginning of the deployment
of the system.

8.4 Quality of Care

A normal EEG-recording takes about 40 minutes when patients is treated by a
neurophysiologist. If this exam is done in one of the satellite laboratories and the
evaluation is done in UUH, the evaluator needs more information due to some
suspect signals in the EEG-graphs. The patient must then make another journey to
the satellite laboratory to for an additional exam do determine whether or not the
signal was an artefact. If the satellite laboratory uses video recording during the
exam the examiner at UUH has a helpful asset to exclude artefacts as possible
brain activity that may lead to an epileptic seizure. This leads to faster results from
the examiner and less travelling for the patients, making them more satisfied. It also
helps the specialist to diagnose the patients more rapidly, enabling for faster
treatment 66.

In the future, hopefully several satellite laboratories will be connected to UUH. The
benefit from using Telemedicine and video in EEG-recordings is that, because of
the increased centralized diagnoses, the specialist doctors at UUH will increase
their expertise. By studying the EEG-recordings and read the diagnosis from UUH
the personnel at the satellite laboratories could also develop a greater skill at what
they do 67.

64 Interview, Flink, Roland, Uppsala, Sweden, 2007-10-16
65 Interview via e-mail, biomedical analyst, Hudiksvall, Sweden, 2007-11-28
66 Interview, Flink, Roland, Uppsala, Sweden, 2007-11-16
67 Ibid
8.5 Economy

In the Department of Neurophysiology each session of recorded EEG with video must take no more than fifteen minutes to examine and diagnose. The satellite labs and corresponding county sends a request for UUH to examine all newly recorded EEGs. For each of these examinations the county charges 400 SEK. As there is a steady flow of three to five requests for EEG recording examinations per day, the county receives somewhere between 1200-2000 SEK a day for a relatively short amount of man hours.\(^68\)

8.6 Discussion and Conclusion

Neurophysiology is well suited for combining with Information Technology, since in order to do a diagnosis for epilepsy the doctor is mostly interested in the EEG recording. These recordings can very well be transferred electronically from the PoC to another location for analysis.

By including video with the recording it is possible to reduce the number of registrations needed, since a completely healthy person might need to do another registration because of artefacts making the doctor uncertain. If the doctor had the possibility to watch a video of the patient during the activity he could exclude the diagnose epilepsy. Furthermore, EEG recordings with video increase the chance of a faster diagnosis because the doctor can confirm an epileptic movement. A more exact diagnosis done early can possibly shorten the inconvenience for the patients, since it allows control of the disease at an earlier stage through ordination of the right medication.

The use of EEG recordings with video looks promising and has the potential to be really useful and help doctors make an exact diagnosis early, without being at the PoC. The evaluation being done at the Department of Neurophysiology at UUH will show if this is something to continue to use in the future.

\(^{68}\) Interview, Flink, Roland, Uppsala, Sweden, 2007-11-16
9. Radiology

9.1 Background

The radiology department at UAS has been using a digital system, called RIS/PACS\textsuperscript{69}, since 2001. Before this, the x-rays and other picture materials were handled in paper form and stored in large underground archives. The digitalization meant storing x-ray data in digital form on disk, and implementation of both fast short-term storage and slower long-term storage. The short-term storage was designed to give quick access to recent examinations from the last six months. The capacity of the short-term storage was matched to the number of expected examinations at the time, while the long-term storage was supposed to act like an archive and provide storage for old examinations. Since the data in the long-term storage should not be as frequently used, a capacity oriented solution, rather than accessibility oriented solution, was selected.

Today the amount of pictures taken in each examination is much greater than when the system was first introduced. Some examinations may generate a hundred times more data than before or even more. This gives higher resolutions and a better base for making decisions, but it has also put a lot of strain on the system. The growing quantities of data do not only make the short-term storage insufficient, but is also affected by bandwidth limitations within the long-term storage. A high load on the long-time storage results in waiting times far greater than those intended when the system was built.

Aside from the increased need of data capacity there has been incompatibility issues between some interfaces. This has resulted in image being lost due to them being renamed when migrated to the long-term storage\textsuperscript{70}. This has resulted in wishes for a more unified system in order to solve the issue\textsuperscript{71}.

In late 2004, the decision to invest in new RIS/PACS systems was made. The ambition was to be done with implementation of the systems in March 2005. After a while the project size increased. The systems were not only for the radiology department any more but for a few more departments, all with varying needs. This led to an extensive requirement specification, which in turn led to a thorough search for systems meeting the requirements, thus delaying the project further. The new system has been seen as close at hand for a while. This has led to the old system missing out on upgrades, making it even slower. Recently an upgrade to of the systems was made, since it was no longer possible to continue working without an upgrade\textsuperscript{72}.

9.2 Usability

All personnel that, in any way, will be using the new RIS/PACS system will receive education. The education plan is still being designed but most likely some "super

\textsuperscript{69}Fel! Hittar inte referenskälla.
\textsuperscript{70}Interview, doctor at UUH, Uppsala, Sweden, 2007-11-16
\textsuperscript{71}Ibid
\textsuperscript{72}Interview, doctor at UUH, Uppsala, Sweden, 2007-11-16
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users” will receive education from the developers about the systems features. They will in turn educate their colleagues on what features to use in order to be efficient.

The new RIS/PACS system mean no new ways of working. There will of course be some differences in the user interface of the new system but most principles will be the same. The new system will use thin clients, which means a system architecture where almost all computations are done at a central server and basically only input and output is transferred between the server and the clients. The result of this is that the doctors can work from anywhere they want in the world, through a VPN, using only a laptop.

The new system will eliminate the need for paper copies of referrals. Currently, some of the referrals are in paper form which means that sometimes double work is necessary. To work in a fully non-paper environment will speed things up. The system is still under deployment, meaning that there are no real users yet. It is believed that with the right development and education it will be a useful system.

9.3 Quality of Care

The implementation of new RIS/PACS systems should be completely invisible to the patients. However, there will be several benefits with the new system. The new systems will allow for multiplanar reconstructions, which is a way of making a 3D picture from a lot of 2D pictures. Another improvement is the display protocol for scans. The new systems will allow for a much more dynamic way of creating and saving display protocols. Both of these will improve the doctors’ speed and ability to diagnose the patients. Aside from these major functionality improvements a lot of minor improvements will be made.

9.4 Economy

Due to the increasing demand of higher resolution and the resulting data volumes spending more money on the RIS/PACS system is unavoidable. The options are to upgrade your old systems or invest in a new one. Investing in a completely new system rather than patching an old one comes with the benefit of the opportunity to look over the whole system rather than moving bottlenecks. The new PACS is also built so it can handle formats and picture data that might be produced in other parts of the hospital. This will give coordination options and the benefit to only maintain one system for containing picture material rather than several. There will also be more focus on accessibility, which purpose is to reduce overall waiting times for retrieving examinations. Reduced waiting times will of course makes the usage of the system more efficient, which probably is where the largest benefit will be when the system comes online. However, it has to be taken into consideration that the old system’s upgrades have been put on ice for some time in favour of the new system.

9.5 Discussion and Conclusion

Making changes to the system used at the Department of Radiology was unavoidable due to the increasing data loads. The hardware, which was judged sufficient when first installed, has been outgrown. The old system could, with the proper updates, still provide reasonable performance, although moving to a new

73 Interview, doctor at UUH, Uppsala, Sweden, 2007-11-16
system at this point comes with additional benefits. One of which is having the same system in the entire county. With uniformity potential incompatibility issues can be avoided. Also, if one would like to switch workplace to another hospital within the county, one would not have to learn a new system.

The new system has the potential of becoming a great tool for the staff at the hospital. The system is being developed in cooperation between staff at the hospital and developers at the company delivering the system. Staff from different parts of the hospital has been involved in the process to ensure that their needs are looked after.

To switch RIS/PACS systems is no small task. It is not possible to run the old system and the new system in parallel, which means that the new system has to be fully configured and fully functional before it is deployed. The first thought was for this to be done in about four months. In retrospect, this was not a realistic goal. This led to the old system missing out on the latest updates. A longer period of time is needed to collect information about requirements at all different wards and also to make sure everything is set up properly before the system is taken into use. If a transition similar to the one at UUH is to be done somewhere else, it would be preferred to have a plan on how to keep the old system running until the day it is actually replaced, rather than the day the decision is made to replaced it.
10. Overall Conclusion

To conclude, we found that every section of HO covered in this report would benefit from using Telemedicine. Many of the services that the project includes are already working to some extent, and we can already see the benefits. For instance, break even for the Cosmic project is expected to occur as soon as 2008. The idea is to expand the use of this system and by doing so freeing even more resources that can come to better use in for example, the Emergency Room (E.R.). Cosmic is also a system that increases the quality of care if used properly. If the system could be used as intended, patients would receive better and faster treatment and lives could possibly be saved.

Departments still having problems with their projects or departments starting up, despite having problems now, are expected to prosper in the near future. One department with good prospects is the Neurophysiology, where the procedure to diagnose patients goes very well with a Telemedicine approach.

One of the main advantages of Telemedicine is the possibility for smaller Care Centres to learn from experts, which results in a lesser need for patient transportation. They will not have to be sent to Centres of Excellence (QoC) in cases where the analysis can be done via Telemedicine. Travelling costs are a major part of the health care system expenses in general. Less transportation is also an important aspect these days as it will help to reduce CO2 pollution in the environment. As long as patients are given the same high quality care as before everyone will benefit from this project.

So far, the gains of the HO project can be measured in human capital, time saved, patient's appreciation of the QoC, and resources saved. On the issue of human capital, the project has successfully demonstrated that the education and further research of the involved parties has improved. While the improved research for the doctors involved was not part of the project specification, it has shown to be a positive side-effect. It has also shown positive results in spreading excellence from experts to general practitioners all over the county. We can further conclude that most of the staff involved with Telemedicine in their practice has been positive to the possibilities that the new technology brings.

Among negative effects it should be said that some technological devices will have to be installed at the wards and that this could be met with resistance by the staff, as proven by earlier attempts to change work structure and methodology. Therefore careful analysis of the future work situation created by the computer system should be done. Changes in work procedures are likely to happen when introducing new technology, and this needs to be carefully considered in advance. Technological devices are also usually expensive, which might prevent the wards from adapting to the project. To encourage the wards to do necessary and costly investments, a well worked out plan of introducing the project to the wards is required. This will help the wards to understand the long term benefits of using Telemedicine in their daily work. Furthermore, wards are today using different systems using different standards in order to perform similar tasks. This causes a lot problems and leads to ineffective work. It would be difficult for everyone to invest in and use the same system but discussions between developers could allow standardised file formats as a possibility, and should be something to strive for.
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In some of the wards the extra work put in by the staff is sometimes incommensurable to the gain of Quality of Care. With this in mind we believe that as many wards as possible should at least evaluate the use of Telemedicine.
11. Acknowledgement

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