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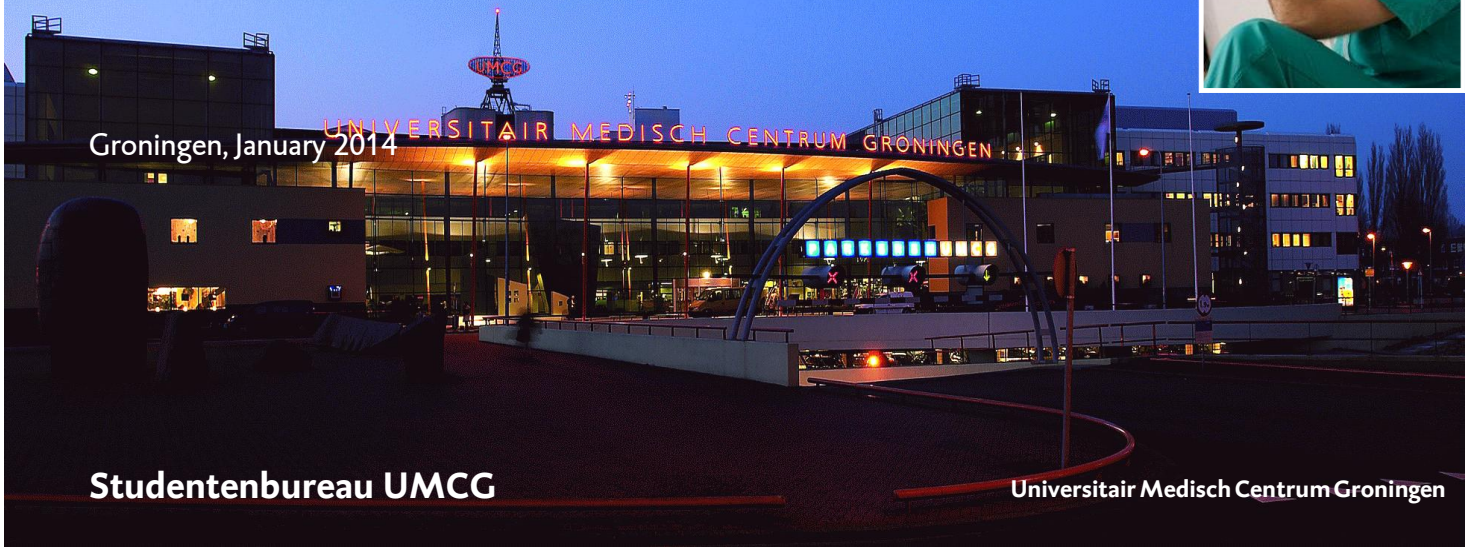
A comparison between XDS and portable media to share medical images

Erik Lugtenberg

UMCG, Radiology
Hanze University of Applied Sciences,
Business Administration



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Author	Erik Lugtenberg
Studentnumber	337659
Thesis fur the purpose of	Business Administration Financial Economical Management Hanze University of Applied Sciences
Internal attendant	P.M.A. van Ooijen, MSc, PhD, CPHIT Radiology, UMCG
Supervisor onderwijsinstelling	H.C.M. Bruggink Business Administration Hanze University of Applied Sciences
Supervisor UMCG	P.M.A. van Ooijen, MSc, PhD, CPHIT Radiology, UMCG

Trefw XDS, image sharing, information security

Foreword

This report is the result of a study performed at the University Medical Center Groningen. This report will show how cost-effective XDS can be towards the current situation of sharing medical images with other hospitals in the region. This research study was initiated by Mr. P.M.A. van Ooijen, MSc, PhD, CPHIT of the Radiology Department. This research study was completed as final leg of my study program Business Administration BSc at the Hanze University of Applied Sciences.

Erik Lugtenberg

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Abstract

Purpose: The purpose of this study was to investigate how XDS can solve the issues with the current method of sharing medical images between hospitals. This study was initiated by the Radiology Department of the UMCG. Before this study a clear overview of the current sharing process was absent. This also caused the unclear situation about the costs and security of the current method. XDS is a standard developed by the IHE, which is an organization to improve the IT in healthcare for users and suppliers. XDS is a standard to share images between healthcare organizations in a certain region.

Methods: To visualize the current image sharing method, observations and a questionnaire were conducted. The observations served as a starting point for the questionnaire. Therefore the observations were conducted without any prescriptions or guidelines. After some observations the main steps in the process were clear, but at the same time the differences in the process between departments in the UMCG became clear. This was an extra motivation to conduct a questionnaire. The questionnaire, consisting out of 38 questions, was send to all employees who imported images from September 2012 until October 2013. Another part of the method was literature research. A lot of research was already done and next to this, due the regulations in the healthcare industry much information can be found on government or government associated organizations websites. The UMCG preferred an IHE XDS based system, by doing this the direction for a solution was already given. IHE XDS provided a lot of information on their website as well. Results regarding the amount of CD's and images were extracted from the database which is currently in use for uploading images from CD's. To wrap up, the cost part is described quantitatively and the process and security parts are described qualitatively.

Results: According to the reports from the database, the amount of received images increased from 1.67 million in 2006 to 8.89 million in 2012. When this trend will continue, the amount of images will increase to 28.06 million in 2016

The results of the questionnaire and observations were remarkable, though not surprising. Major differences were the storage time, shipment method and method of destroying the received CD's. Some employees are not informed about information they might need to know. The method of shipment, for example, is 55% mail including 36% shipped by regular mail without insurance or such. This is one of the highest security issues. When this is expressed in absolute numbers, this affects in 2006 0.6 million and 3.2 million images in 2012. XDS has been suggested as a good replacement which will be able to solve issues with security, speed and costs. Just the shipment of regular mail can take up to 4 or 5 day while XDS can transport images in a few seconds to minutes. In 2013 XDS would not have been profitable to implement, but with 15.3 million image received, XDS at Stichting GERRIT can be profitable for the UMCG which will be achieved in 2014. Implementing XDS in the northern part of the Netherlands is currently under development by Stichting GERRIT. With measures as requiring username and password and using secured connections, the security can also be improved. However, XDS cannot solve all the issues with security in the way Stichting GERRIT is offering.

Conclusion: According to this study it appeared that XDS can solve a lot of issues with sharing images at the UMCG. The process of sharing images itself will be executed more identically, the speed of sharing will be much higher, security will be improved and according to the increase of the images over the past years, XDS can be more profitable than the current method of sharing images. Therefore it is recommended that the UMCG should implement XDS. However, some issues with security will still remain when XDS would be implemented in the shape Stichting GERRIT is offering. But there is room for improvement here.

Samenvatting

Het doel van dit onderzoek was om te kijken of XDS de problemen kan oplossen voor de huidige methode van het delen van medisch beeldmateriaal tussen ziekenhuizen. Het onderzoek is geïnitieerd door de afdeling radiologie van het UMCG. Voor de start van het onderzoek was het niet duidelijk wat precies de huidige methode was voor het delen van medische beelden met andere ziekenhuizen. Een bijkomend probleem was dat de kosten voor het huidige proces ook niet duidelijk waren. XDS is een standaard ontwikkeld door de IHE. De IHE is een organisatie die IT in de zorgsector probeert the verbeteren. Het is een standaard om medische beelden te delen tussen zorginstellingen in een bepaalde regio.

Om het huidige proces te visualiseren zijn er observaties gedaan en is er een enquête verstuurd. De observaties hebben gediend als startpunt voor de enquête. De observaties werden gedaan zonder enige vorm van voorkennis. Na een aantal observaties waren de belangrijkste stappen in het delen van medisch beeldmateriaal duidelijk. Er werd ook meteen duidelijk dat er verschillen waren in het proces tussen afdelingen in het UMCG. Dit was een extra motivatie om de enquête op te stellen. De enquête, bestaande uit 38 vragen, is verstuurd naar alle medewerkers die medisch beeldmateriaal hebben geïmporteerd van september 2012 tot en met oktober 2013. Een ander onderdeel van het onderzoek was het doen van literatuuronderzoek. Veel onderzoek was al gedaan en naast dit is er veel wet- en regelgeving op het gebied van gezondheidszorg te vinden. Het UMCG gaf de voorkeur aan de XDS standaard , daardoor was de richting van het onderzoek al aangegeven. IHE heeft ook veel informatie over XDS beschikbaar op hun website. De resultaten met betrekking tot het aantal verwerkte CD's is verkregen uit de database die nu wordt gebruikt voor het uploaden van de CD's. Om af te ronden, de kosten zijn kwantitatief beschreven en het proces en deel veiligheid zijn kwalitatief beschreven.

De gegevens uit de database laten zien dat het aantal ontvangen afbeeldingen zijn gegroeid van 1,67 miljoen in 2006 naar 8,89 miljoen in 2012. Als deze trend doorzet zal er in 2016 een hoeveelheid van 28,06 miljoen afbeeldingen zijn ontvangen in het UMCG. De resultaten uit de enquête en observaties zijn opmerkelijk maar niet verrassend. Er zijn veel verschillen tussen afdelingen in de opslagtijd, methode van verzending en manier van vernietiging. Sommige medewerkers die de CD's verwerken beschikken niet over de informatie die ze tijdens hun werkzaamheden nodig hebben. De verschillen zitten onder andere in de verzending. Van de verzending gaat 55% via de post, 36% is reguliere post, zonder verzekering of aantekening. Dit is een groot risico voor de veiligheid. Als dit wordt uitgedrukt in absolute getallen, dan gaat het in 2006 om 0,6 miljoen afbeeldingen en om 3,2 miljoen afbeeldingen in 2012. XDS zou allerlei problemen rond, snelheid, veiligheid en kosten op kunnen lossen. Alleen de verzending van afbeeldingen kan al 4 tot 5 dagen duren waar XDS dit in enkele seconden of minuten kan afhandelen. Echter in 2013 zal XDS nog niet rendabel zijn tegenover de huidige methode. Maar als de grens van 15,3 miljoen afbeeldingen wordt bereikt zal XDS bij Stichting GERRIT wel rendabel worden. Deze grens zal in 2014 worden bereikt. Het implementeren van XDS in Noord-Nederland is op dit moment al gestart. Door het gebruik van gebruikersnamen en wachtwoorden en beveiligde verbindingen zal de veiligheid sterk worden verbeterd. Maar XDS zal de problemen rond veiligheid niet helemaal wegnemen zoals Stichting GERRIT het aanbiedt.

Gezien het onderzoek zal XDS veel problemen oplossen rond het delen van medische afbeeldingen tussen het UMCG en andere noordelijke ziekenhuizen. Het proces zal meer eenduidig worden uitgevoerd, de snelheid van het delen zal een stuk hoger zijn, de veiligheid zal sterk worden verbeterd en in de nabije toekomst zal XDS ook goedkoper afbeeldingen kunnen delen dan de methode die de afgelopen jaren is gebruikt. Het is daarom aanbevolen om XDS in het UMCG te implementeren. Toch zullen een aantal veiligheidsproblemen blijven bestaan in de vorm zoals Stichting GERRIT XDS aanbiedt. Maar dit kan natuurlijk worden verbeterd.

1 Introduction

Security and cost reduction are hot topics in times like these. Because of the economic crisis revenues are falling and costs are rising. This is not only the case in the commercial world but also in health care. Since 2006 the contributions to health insurances has risen with over 20% from 2006 to 2012 (Gerritsen, 2013). To reduce costs, the health care organizations need to collaborate more. To do so, they need to share information, and this is where security comes in. At this moment there are a lot of discussions about the way health care organizations share information. A very good example is the Electronic Patient Record (EPR). This project was set up by the Ministry of Volksgezondheid, Welzijn en Sport to make patient records digitally available to the patients themselves and let the patients manage their own records. This project has failed due to security issues.

At this moment the UMCG shares medical images with other hospitals by burning the images on CD or DVD and ship them to other hospitals. Even more important, the UMCG receives a lot of CD's with medical images because a lot of patients are referred to the UMCG in its function as a university hospital. Sharing images using CD's is already an advantage compared to the method that was used before. When a patient was referred to another hospital the second hospitals had to make their own images. Later the medical images were printed and send to other hospitals. Making new images cost a lot of money. And using CD's is already an advantage compared to send printed images. The developments in the digitalization of medical imaging accompany the development of IT systems in healthcare.

When using CD's, the images are accessible for everyone who has access to the CD. Next to this, it costs time to burn and there are also a lot of CD's used for image sharing. This is where XDS (Cross Enterprise Document Sharing) can be more efficient. XDS is a standard established by the IHE (Integrating the Healthcare Enterprise).

This report will cover a comparison between XDS and CD's to share medical images from the Radiology Department in the UMCG with other regional hospitals.

2 Organization profile

In this chapter the organization is described. First the history of the UMCG is described. After that the core activities are described according to the website of the UMCG. Later on the type of the organization is described.

2.1 History

The roots of the UMCG go back to 1614 with the establishment of an academic institution in the City of Groningen. With the establishment of this institution, providing academic medical education in Groningen became possible. At the end of the 18th century the demand for practical healthcare increased. Therefore the precursor of the UMCG was founded in 1797 by Evert Jan Thomassen à Thuessink. But this hospital was very basic and small and only 6 years later a better academic hospital opened its doors. In 1817 a general hospital was founded by the city authorities and both hospitals merged in 1852 into the Algemeen Provinciaal Stads- en Academisch Ziekenhuis. The buildings of those hospitals were too small and therefore a new building was built in 1889 on the current location at the Oostersingel. In 1971 the educational & research and healthcare tasks were separated into the university and hospital. In 1997 the current central medical building was opened. Because of the integration of the medical faculty and the hospital both organizations bundled their forces into the UMCG in 2005.

2.2 The core activities

The UMCG is one of the largest (university) hospitals in the Netherlands and with over 10,000 employees it is the biggest employer in the northern part of the Netherlands. The three core activities are providing health care, conducting research en providing education.

The first core activity is providing health care. Some patients visit the hospital for general healthcare while others come to the UMCG for special treatments. Nearly all inhabitants of the northern part of the Netherlands visit the UMCG if they have a special disease. For some diseases the UMCG is the only hospital in the country that can treat this. But patients from other regions in the country and even from abroad are coming in the UMCG for treatment.

The second core activity is conducting research. To improve treatments or develop new pharmaceuticals, research is necessary. Again the cooperation with the University of Groningen is very important here. The fundamental en clinical research of the UMCG is regarded among the best internationally and scientifically. The facilities provided by the UMCG, attract many international scientists.

The last core activity is providing education. The study programs provided in Groningen have a good reputation. About 3,400 students are being educated in the UMCG to become physicians or dentists and about 450 are physicians who will become medical specialists. The UMCG has a close cooperation with the University of Groningen. The UMCG also provides education on lowers levels and also support education outside the medical world.

2.3 Organization type

In general the UMCG is a non-profit service providing organization in the field of healthcare and education. Most of the activities are regulated by the federal government. Although the UMCG receives its income mostly through healthcare insurance companies which are mostly for profit organizations, the UMCG itself has no profit targets and only an idealistic target. Next to the income from healthcare insurance, the UMCG receives subsidies from the government and contributions from the University of Groningen. The UMCG also operates some commercial activities like offering their Surgery Room's when not occupied to commercial eye laser companies for example. To get a good view on the size of the UMCG, a comparison

can be found below (Table 1). This comparison can be beneficial when reading this document. Another fact which is good visible in the comparison is the relevance of the academic part of the UMCG. The amount of beds and inpatient days in the UMCG are respectively only 37% and 47% higher than in the Isala klinieken, but the Amount of employees, fte's and the operating income are about 100% higher than in the Isala klinieken. First thoughts can be that the UMCG is less efficient but it is more likely this indicates it is an academic hospital and this is confirmed regarding the figures from the Erasmus Medical Center (University Hospital Rotterdam). The Erasmus MC is almost the same size university hospital and therefore the figures are also more or less the same as in the UMCG.

	Inpatient days	Beds	Employees	fte	Operating income
University Medical Center Groningen	306.045	1.339	11.586	8.326	€ 1.023.919.000
Medisch Centrum Leeuwarden	159.295	623	3.146	2.377	€ 288.144.000
Martini Ziekenhuis	148.667	642	2.918	2.068	€ 235.852.000
Isala klinieken Zwolle	208.157	976	5.577	3.657	€ 454.203.000
Erasmus Medical Center	286.155	1.320	11.206	9.487	€ 1.236.701.000

Table 1 Size comparison between several Dutch hospitals.

2.4 Organization and the research area

This research study was carried out for the Department of Radiology. The department would like to improve the current process of sharing medical images with other hospitals in the region. The department thinks the current way is time consuming, too expensive and lacking security. The department expects the process can be improved by implementing a new system. This research study will cover cost effectiveness analyses about the current situation and the Cross-Enterprise Document Sharing profile.

3 Research accountability

3.1 Occasion

There are several reasons which led to the occasion of this research project. Those reasons are described below.

The first reason to explore the options regarding medical image sharing is the increase of the amount of shared images[1]. This can be attributed to the increase in referred patients that the UMCG, in this case, receives due to its status and expertise. Especially university hospitals receive a lot referred patients because those hospitals usually offer the most specialized treatments. University hospitals in particular are mutually specialized. For example, according to the website of the Nederlandse Transplantatie Stichting (Dutch Foundation for transplants) the UMCG is the only hospital in the Netherlands, and according to the website of the UMCG one of the few hospitals in the world, that performs all organ transplants which are available. Also combinations of multiple organs transplanted at the same time is not an exception in the UMCG. Another development is that the Minister of Healthcare, Wellbeing and Sport granted the UMCG the license for offering proton therapy.

Another very important reason to investigate other possibilities of sharing images was the establishment of Stichting GERRIT. This is a foundation which was founded in 1996 with the purpose to improve the information sharing of healthcare organizations in the northern region of the Netherlands. Originally Stichting GERRIT stimulated the exchange of electronic mail between family doctors, pharmacies, hospitals and laboratories in the province of Friesland. In 2010 GERRIT expanded their catchment area to Groningen and Drenthe and broadened their focus area. This organization also provides an XDS environment and related services for healthcare organizations in the northern region of the Netherlands. Examples of related services are providing a data connection and storage for XDS. Related services are, for example secured connections and consulting about XDS.

3.2 Research targets

The aim of this study is to assess whether the implementation of XDS solves the disadvantages of the current method for the sharing of medical images from the Department of Radiology. The following three elements have been included in the study based on the priorities listed by the UMCG: process, costs and security.

The choice for 'process' as an element has been made because the current process is unclear. To evaluate a process, it should be clear what the exact process is. Without prior knowledge and using open questions, this element will be examined and described qualitatively.

The second element, 'costs' has been set by the UMCG. The choice for the costs resulted from the unclarity regarding the costs of the current process. This is also related to the fact that the current process is unclear. When the process unclear, all other related facts are unclear as well. Therefore, the costs will be described in a qualitative way as well as a quantitative manner.

The final element is security. This element will also be described in a qualitative way because the security in the current process is unclear.

At this moment it is unclear which issues can be improved with another system or process. Therefore after analyzing the research results, every issue in the current situation will be compared to XDS. The information on XDS is gathered from XDS documents and interviews with employees in the UMCG.

1 http://www.umcg.nl/NL/UMCG/overhetumcg/Pages/default.aspx

This study will only compare XDS and CD/DVD as a way of sharing medical images. Therefore no advice will be given on how to improve the current method or advice on

3.3 Research questions

Out of the research targets and occasion the following main research questions can be drawn up:

'How can the process for sharing medical images with other regional hospitals be improved?'

Regarding the three main elements discussed in the previous paragraph it will be likely that when the process of the current method of sharing images will become clear, it is only a little step to determine the elements of costs and security. Because of those elements, the main research questions can be cut into three sub questions, which are:

- What is the current procedure for sharing medical images and what are the differences between departments?
- What are the security issues of the current procedure that using XDS could solve?
- How can XDS cut down the costs when for sharing images with other hospitals?

3.4 Research methodology

To answer the first sub question, what the current procedure for sharing medical images is and what the differences are between departments in the UMCG, a view on the actual process is required. Because there are no process descriptions, available information on the current procedure has to be obtained differently. During a previous internship and employment with tasks to describe business processes I had very positive experiences with observing employees who execute the concerning process. In this way the current situation will be described. To determine the execution of the actual process employees have been observed while processing the received images. At this

another system to share images. The focus of this study is on sharing medical radiology images and does not take other patient documentation into account.
moment there is no information at all on how employees processed the received images, therefore the observations will be as open as possible. There will be no questions prepared in advance.

Additional information of the process will be obtained by sending a questionnaire to the involved employees. Those questions will be partially based on the outcome of the observations. In the questionnaire the employees are asked about specific steps during the import process of the images.

To answer the second question, most information can be obtained directly from the questionnaire and more indirectly from the observations. Like mentioned earlier, the questionnaire can only be set up after the steps in the process are clear. The observations will likely not give direct figures about how much time employees spend on the individual steps in the process. It is more feasible to obtain this information from a questionnaire. When enough employees fill in the questionnaire, the figures and their averages will be more reliable.

The third question can also be answered with the results from the observations and questionnaire. This is because when the issues in the current process of sharing images will become visible, the costs of this process will also become more visible. But this will only show what the issues are in the current process. To assess whether XDS can solve these issues desk research about XDS has to be carried out. Next to this, some (expert) employees involved in implementing XDS will be interviewed. Information about the quantity of processed images can be gathered from the temporary storage which will be explained later.

4 Theoretical framework

This chapter will discuss some basis about digital medical imaging en relevant research studies about sharing medical images.

4.1 Digital imaging

Since the discovery of X-rays in 1895 by Wilhelm Conrad Röntgen the world of medical imaging has developed a lot. A very important development for digital imaging was the introduction of PACS (Picture Archiving and Communication System). This is a system which receives, archives and distributes medical images to and from DICOM clients. The system can be implemented in several ways. The UMCG implemented it hospital wide in 2000. This improved the ease of sharing medical images with other departments in the UMCG.

The current PACS are set up according to the DICOM (Digital Imaging and Communication in Medicine) standard which was developed in 1993. The DICOM standard was developed to standardize handling of medical images and covers the following elements:

- Producing,
- storing,
- displaying,
- processing,
- sending,
- retrieving,
- querying,
- printing.

The DICOM standard is developed for healthcare providers, manufacturers of medical information systems and medical peripheral equipment. DICOM is the de facto worldwide standard for medical imaging. This means that images can be easily shared with other hospitals on physical media such as CD's and DVD's. The images are burned on the CD according to the DICOM standard and therefore the images can be easily imported by the receiving hospital. With the introduction of the IHE PDI (Integrating Healthcare Enterprise, Portable Data for Imaging) profile sharing images became easier. The IHE PDI profile reduces errors and improves accessibility of the medical data on the CD's. IHE is an international collaboration between users and suppliers of IT in healthcare. IHE utilizes already established standards as DICOM.

Due to the introduction of digital imaging, the Department of Radiology moved from physical film to digital images 12 years ago. After the digitalization (creating and storing) of the imaging itself, the sharing of these images moved from physical film images to the current situation on CD/DVD. This type of storage has some risks in relation to privacy and security. Beside this the costs of production, sending and processing these CD's/DVD's are a big issue. Some new methods have been developed to share these images like "Cross Enterprise Data Sharing (XDS)" which has been established by IHE (Integrating the Healthcare Environment) organization. This method enables the possibility to share medical images through a network instead of using physical media. By using the network, the original images stay on the original location and no local copies are made. This solves the security issues partially, but the costs are again significant. Another advantage of XDS is by using the internet, image sharing is considerably faster. However, the implementation of XDS is not widely accepted yet, partly because the costs and benefits are unclear. Currently XDS is being implemented at the Cardiology Department in the UMCG. Because radiology is handling even more medical images than cardiology they could also greatly benefit from a new system instead of the current sharing using portable media.

To have a correct view on the amount of images which are received by the UMCG, an explanation of the relation between patients and images is required. The relationship is shown in the figure 1. One specific patient has a one-to-many relationship with a study. A study is usually connected to a single visit to the Radiology Department to a specific modality (CT, MR, Ultrasound, etc). Most studies contain multiple series. Examples of series are the left-to-right and front-to-back projection of an X-ray or the scout,

pre-contrast, contrast-enhanced, and delayed-enhancement series in an MR exam. Furthermore a series, usually consists of multiple images. For example, a CT scan of the human brain is usually a 3D model. To create a 3D model, hundreds of images are taken in one series to get this 3D model.

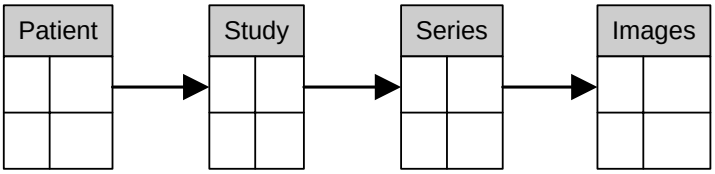

Figure 1 Relationship between patients and images.

4.2 Literature

At this moment there is only a little amount of research studies available about XDS. Furthermore there might be other relevant study cases applicable to this study. Some relevant theoretical underpinnings are discussed here. In this report, the most parts of the study are divided in the subjects costs, security and process and therefore this separation will be partially maintained here.

As mentioned earlier, the amount of images has increased significantly. A study by Aryanto, K.Y.E., Van de Wetering, R. , Broekema, A., Van Ooijen, P.M.A. & Oudkerk, M (2013), shows that the amount of images which has been received in the UMCG has increased from around 160,000 in 2006 to around 890,000 in 2012. It is likely this number will increase in the coming years. This shows there is more need for medical image sharing.

Due to this increase the demand to manage and control this information is increasing as well. An easy way to manage and control information is to digitalize the information as much and as fast as possible. In this study the information is already digital, but their speed of sharing is slow. Therefore sharing medical images over the internet is a hot topic, but this has some risks. Zhang, J., Zhang, K., Yang, Y., Sun, J., Ling, T., Wang, G., . . ., Peng, D. (2011) have set up a test environment based on XDS. They also developed their own security solution including an auditing trail to offer a high level of security. Still there is a possibility that data can be accessed by unauthorized persons. This is possible when systems are hacked, for example, what happened with DigiD in 2011[2] or that organizations like NSA intercept and crack protected data which is a huge topic nowadays. But there are also studies on preventing the cracking of protected data. For example, Chen, W. and Tso, H. (2013) have experimented with a solution to embed the patient data into a medical image. Then the images are divided into multiple images which are shared. The dividing of the original image is done on pixel level. Only if the recipient has all images they can stack all images and see the original image.

The current process using physical media is usually much slower than image sharing with XDS would be. When a CD is shipped by a courier to share images a mean delay of 5.8 hours and a median delay of 4 hours is added to decision making. In comparison, sharing through a direct system with a mean delay of 6 minutes and a median delay of 0 minutes is much faster when it comes to decision making. (Crocker, M., Cato-Addison, W.B., Pushpananthan, S., Jones, T.L., Anderson, J., & Bell, B.A, 2010). Although Zhang, J., Zhang, K., Yang, Y., Sun, J., Ling, T., Wang, G., . . ., Peng, D. (2011) don't give exact numbers, they conclude that they have sent medical images over the internet in an XDS environment with a limited bandwidth and achieved an acceptable.

[2] http://tweakers.net/nieuws/76558/overheid-mogelijk-digid-inloggegevens-gestolen-door-hack.html

To improve a process, it must be "in control". This requires analysis and clear understanding of the whole process. A very simple but effective method is the Plan-Do-Check-Act cycle which was developed by William Edwards Deming. It is a widely known and used method in IT and Management sciences to control and improve processes. Another effective but less know method is the Ishikawa diagram which was developed by Kaoru Ishikawa. This diagram is also known as the fishbone diagram and can be used to detect the causes of a problem. This diagram will be used later in this study.

A very recent study by Ranschaert, E.R. and Wander, A. J. T (2013), showed that 77% of the images used for second opinion are shared by using DVD's and another 7% by using e-mail. Only 9% is using a dedicated image transmission network to share images. 68% of the 9% is using a secure digital network which complies to IHE standards. 16% is using an XDS based standard of sharing images via a digital network. One remark here, only 43% of the respondents know what XDS is.

Another study by Kalia, V., Carrino, J.A. and Macura, K.J. (2011) showed that there are several problems with the exchangeability of medical images, especially when using optical disks like CD's. A significant amount of optical disks are not readable or importable. 10.8%, 21.6% and 60.8% of their respondents indicate that respectively 26% to 50%, 51% to 75% and 76% to 100% of the received media is readable or importable. Although the study does not give exact numbers, this still results in considerable percentages of received portable media which are unreadable. Subsequently 53.9% and 11.8% of the respondents indicate that respectively less than 10% and 10% to 25% of the patients undergo a repeatable examination due the malfunction of media. Even 1% of the respondents indicate that 76% to 100% of the patient undergo a repeated examination due damaged media. This study also shows that while DICOM is widely accepted and known, IHE PDI is more unknown and therefore it is, in most cases, unknown if the images processed by the respondents comply to IHE PDI. This lack of compliance to available standards could be one of the main reasons for the problems that occur in image exchange. Of the respondents, 72.5% indicates they do have some sort of policy for handling received images. However, the study does not indicate if the policy is the same at the entire institution and how rigorous this policy is complied to. The study shows sometimes significant differences between respondents from university hospitals and non-university hospitals.

Some more image sharing issues are studied by Mendelson, D. S., Bak, P. R. G., Menschik, E and Siegel, E. (2008). A first limitation of optical disks they state is the requirement of physical transportation, which sometimes takes a lot of time and brings security risks. These security risks are not only the fact that everyone handling the disks might have access to the data on it, they also mention the risk for the spread of viruses on the optical disks. While the previous study mentioned showed the possible lack of standard implementation, most portable media do include an image viewer compatible with the burned images. This means that installation and/or executable files are included on the portable media which are vulnerable to contamination with viruses and other malware. Furthermore, in most cases including the viewing software on the portable media will not solve the problem of interoperability because usually computers in hospital are preventing regular users from installing third party software from, for example, optical disks. This means that the image viewer provided on the disk with images cannot be installed. This study does also mention real-world solutions which comply to IHE. The solutions are based in the region of Philadelphia-New Jersey (Mid-Atlantic region) and Canada. Both those regions share medical information by using digital networks. Both networks have implemented Cross-Enterprise User Authentication (XUA) and Audit Trail and Node Authentication (ATNA) To offer a proper level of security.

5 Results

This chapter contains refined results of the questionnaire and the observations. More detailed data of the questionnaire en observations can be found in the appendix.

5.1 Response

The names of the employees were queried from log files of the temporary storage which is used by the DICOM uploader. The DICOM uploader is the software which the employees use to upload the medical images to the temporary storage. This storage is temporary because the images are stored in the PACS after the application managers of the Radiology Department release the images. The PACS is the permanent storage for the images. The PACS is the image source for Poliplus. Poliplus is used by the employees of the UMCG including the physicians to view patient data.

By using the query report from the DICOM uploader, an invitation for the questionnaire was sent to 271 recipients by e-mail. An amount of 31 e-mails were bounced, this could be the result of changes in the e-mail address of employees (e.g. moved to another department) or that people are not employed by the UMCG anymore. The invitation was delivered to 240 employees. 24 responded to the invitation that they were not able or willing to participate in the questionnaire. After 21 days 70 employees responded to the invitation of which 22 partially and 48 fully completed the questionnaire. So after 21 days the participation level of people who completed the questionnaire was 20%.

Unfortunately from some departments no one responded to the questionnaire. The distribution of respondents across departments is visible in the table below. The first column with numbers in table 2 shows the number of respondents of the respective department. The second column shows the amount of images processed between from September 2012 to October 2013 by those respondents. The third column shows the total amount of images processed by that entire department. The fourth column shows percentage of processed images by the respondents compared to the total amount of processed images by that department. The last column shows amount of images processed by that department compared to the total amount of processed images in that period. One remark here, not for all respondents the corresponding department could be determined.

Department	# respondents	Responsible for # of images	Total # of images	Respective response percentage	Share department's processed # of images compared to the total # of images
Lungtransplant	2	160	160	100%	0,9%
Paincentre	1	21	21	100%	0,1%
obstetrics gynecology	4	639	678	94%	3,8%
Cardiology	3	48	99	48%	0,6%
Children's clinic	2	74	182	41%	1,0%
Internal medicine	4	79	217	36%	1,2%
Surgery	4	840	2482	34%	13,8%
Stomatology	2	31	101	31%	0,6%
Gastroenterology and Hepatology	1	10	74	14%	0,4%
Otolaryngology	1	70	928	8%	5,2%
Radiotherapics	1	94	1278	7%	7,1%
Neurosurgery	1	19	2047	1%	11,4%
Other	0	0	9664	0%	53,9%

Table 2 Response on the questionnaire and the percentage of images processed by the respondents compared to the total amount of images by the respective department.

5.2 Received and processed portable media

The graphs on the next page show a steady growth of received and processed images and CD's. The last graph shows the average amount of images per CD. This average has been increasing slightly over the last 20 months. However, the increment of the average amount images per CD's did not lead to a reduction of the amount of received CD's.

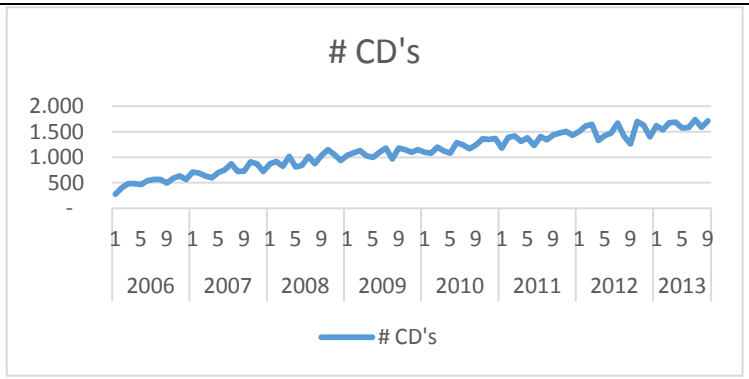

Figure 2 Amount of received CD's the past years

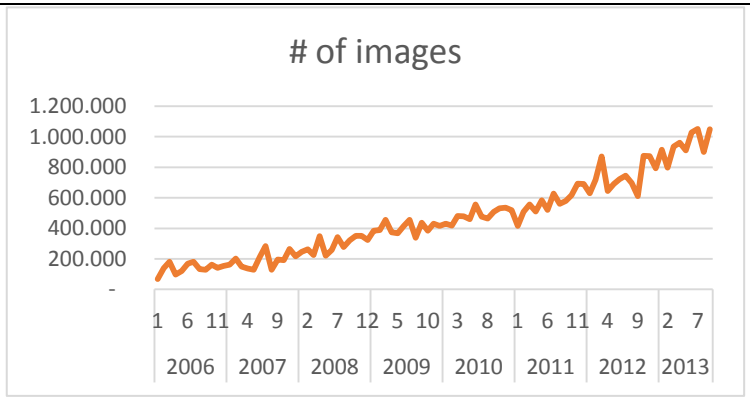

Figure 3 Amount of received images the past years

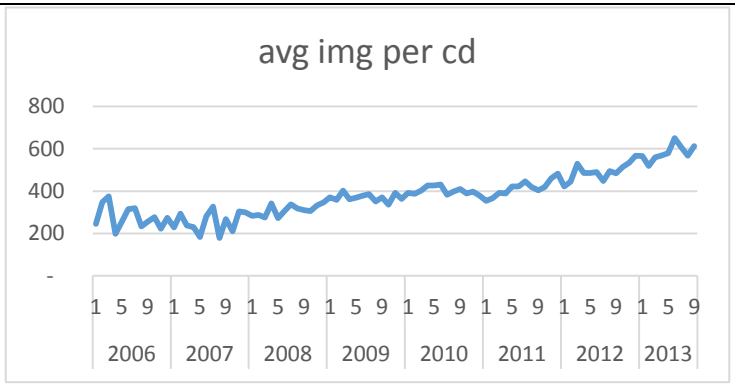

Figure 4 Average amount of images per cd the past years

5.3 Handling process of portable media

After a few observations there was enough information to assume that the process to import medical images from CD's is not executed identically across the different departments involved. Some differences in the process are, for example, the procedure of archiving and storing CD's and how missing images are being requested at other hospitals.

To support this statement some additional information is required. Because the time of this study is limited, the method of observing all involved employees would require too much time. Therefore a questionnaire was sent to all employees who have imported images between November 1st 2012 and September 30th 2013.

To gather the right information by using a questionnaire the right questions have to be asked. Because it became already clear that the process is not executed identically, setting up a useful questionnaire became more difficult. As a result, a lot of questions started with a statement if some subject was applicable or not, if not, the question was skipped. If a subject was applicable some questions about that specific subject were asked. The questions can be found in the appendix. The questions are in Dutch because the questioned employees mostly speak Dutch.

The outcomes of the observations were not very surprising though different to each other. Some distressing findings are that patient data is burned unprotected on the CD according to the observations. Another finding that raises concerns is the shipping method. The observed employees mentioned that regular mail is the common way of shipping CD's with images. Analyzing the information gathered with the questionnaire also demonstrates that regular surface mail is a common way of shipment. Based on the answers of 38 people, nearly the half of the weighted score showed that regular mail is used frequently (figure 5).

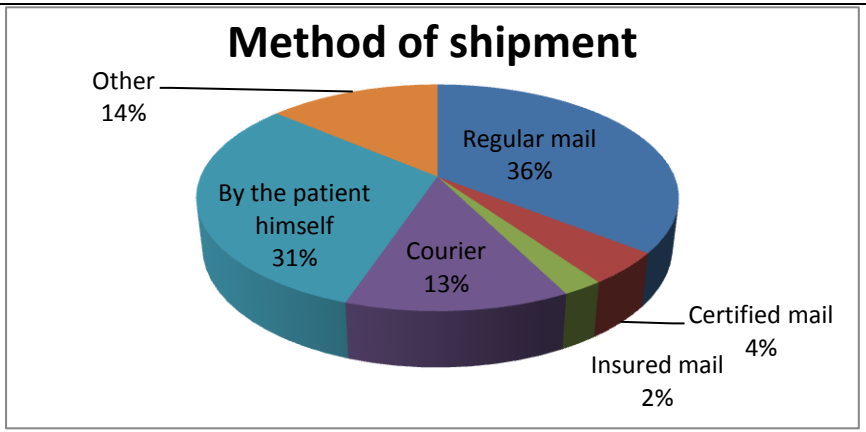

Figure 5 Method of shipment according the respondents

According to the method of shipping, it seems that the security of the data is lacking. But there are more issues in relation to a lack of security. According to the answers on the question if CD's are disappearing, nearly 27% of 37 answers says this happens. Out of this 27%, there are is average of 2,6 CD's disappearing CD's per 4 weeks.

Another distressing issue is the fact that not all the employees are well informed about the entire process. This is apparent when the question about the storage period of the CD's is analyzed. According to the questionnaire it seems that employees are not well informed in two ways. The first being that they are not aware of the storage period (figure 6). Secondly employees are not aware of the mandatory storage time. This might be the case because the employees processing the CD's are not the ones responsible for storing the data.

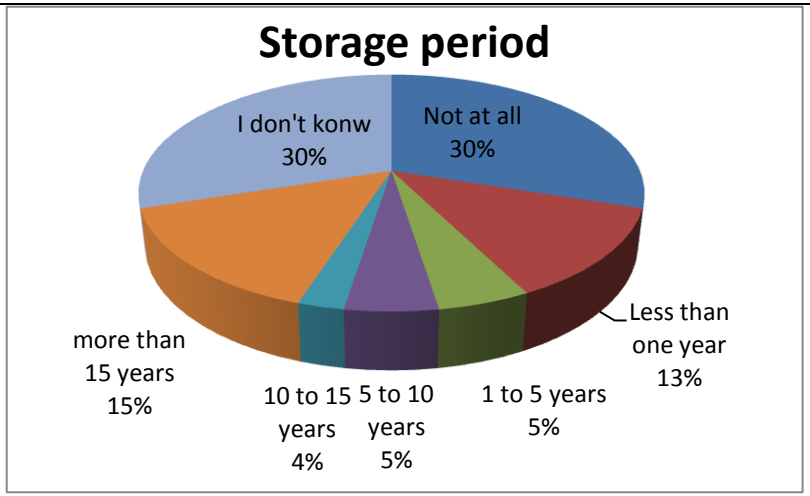

Figure 6 Storage period CD's according the respondents

The method of destroying the received CD's and therefore patient data might be another concerning factor. According the figure below, the most employees are not informed about the method of destroying the CD's. It can be that employees are not informed because they are not involved with destroying the CD's, but still everyone involved process should be informed about important steps like this.

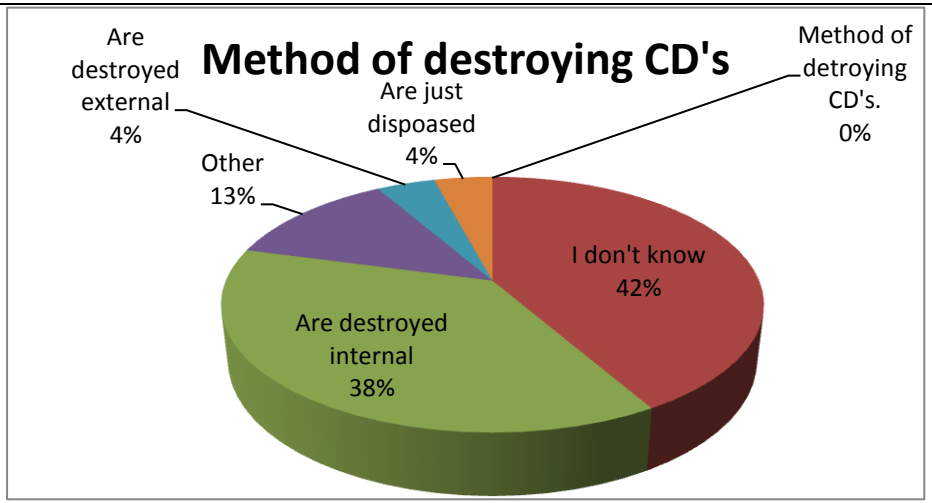

Figure 7 Method of destroying CD's according the outcomes of the questionnaire.

The questionnaire also contained a part where the opinion of the employees was asked. The opinion concerned, for example, subjects if a system to share medical images over the internet would improve their work and if there are improvements towards the patient. 36 employees gave their opinion. It appeared that most employees think that a new system could improve the work for the employees.

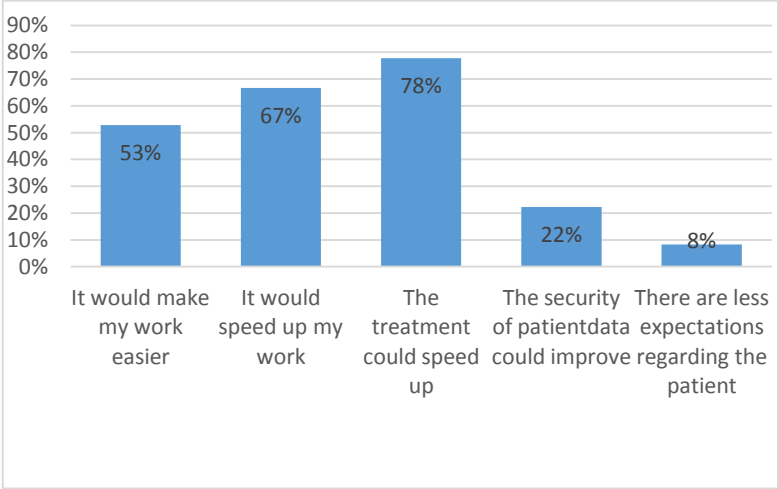

Figure 8 Respondents opinion about a new system

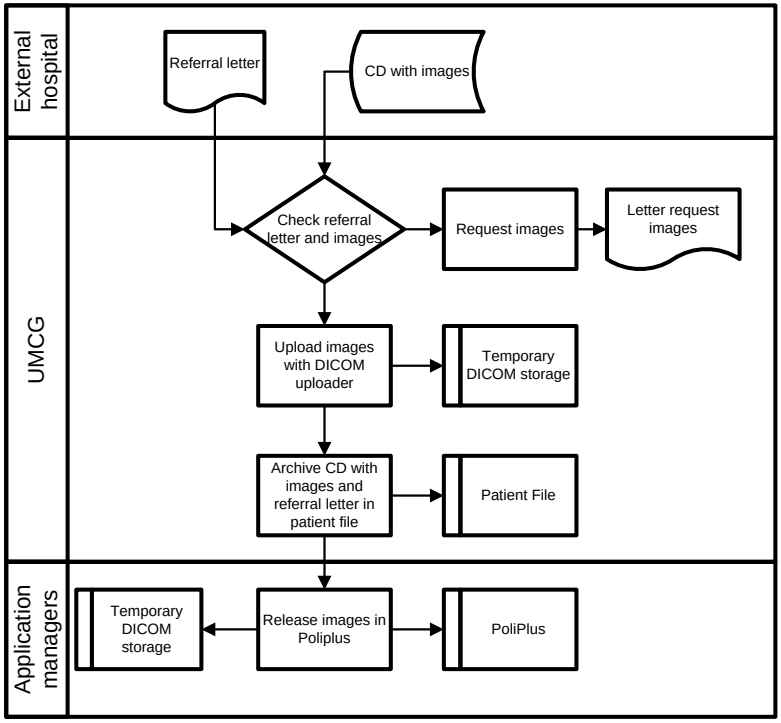

Figure 9 Process scheme importing images current situation

Based on the observations a process scheme could be drawn up. By far most of the departments perform the steps shown below when processing the images.

The process shown in figure 9 is performed as following. A hospital refers a patient to the UMCG because the other hospital cannot come to a diagnosis or they cannot treat the patient. When referring the patient, the hospital sends a referral letter to the UMCG, this referral letter should be checked on things like patient data, disease information and other data which is relevant for treating the patient. When medical images of the patient are available, the referring hospital usually sends these images on CD along with the referring letter to the UMCG. The images should be checked to see if they are about the correct patient and if the CD contains the required images. If the images are not correct or there are no images received at all, the employee of the UMCG should send a request to the referring hospital to resend the correct images. Departments in the UMCG use different applications to fill in request forms to request (missing) images, but this is mostly done by fax. Usually the CD with the correct images is received by regular mail a few days later. Then an employee of the UMCG should upload the images with the DICOM uploader to the temporary storage. When the uploading process has successfully completed, the employee should store the referral letter and CD with the rest of the patient data into a patient record in a cabinet. Within one working day the application managers of the Radiology Department of the UMCG should make the images available in Poliplus, which is used by physicians to obtain all sorts of patient data including medical images. By making the images available in Poliplus, the images are removed from the temporary storage.

According to the outcomes of the observations and questionnaire, the Ishikawa diagram can be designed as shown in figure 10. The Ishikawa diagram is an often used method to demonstrate how smaller issues lead to a bigger problem. In this case the Ishikawa diagram is filled according to the three elements mentioned earlier (process, security, and costs). In this way the smaller issues can be placed into one of those elements to get a good overview of all the issues and their relationship to the process.

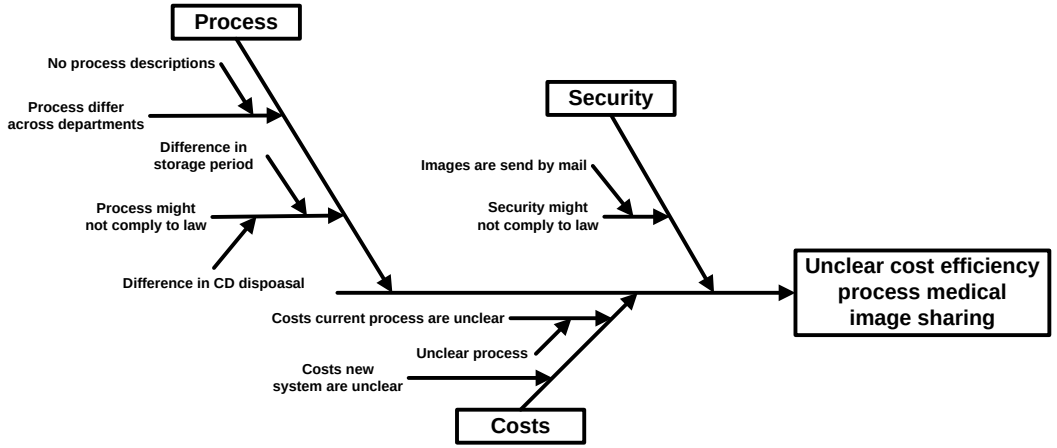

Figure 10 Ishikawa diagram current situation

5.4 Summary

After a global analysis of the data from the observations there can only be one conclusion; the execution of the actual process is not identical for each department within the UMCG.

- The storage of the CD's which are already processed is handled in different ways.
- Not every department has a follow up to check whether the images are available in the permanent system.
- The way to send a request to other hospitals is not the same at every department.

As a result, an exact answer to the first sub question, which is: *'What is the current procedure for sharing medical images and what are the differences between departments?'* is difficult to obtain. However, it implicates that the process is not executed identically across several departments in the UMCG. Because XDS might be able to solve the differences in executing the process, this result does contribute to the main research question which is: ***'How can the process for sharing medical images with other regional hospitals be improved?'***

After an analysis of the answers from the questionnaire for some departments there are even differences between several employees of the same department. Employee 1 at department X says he does not know what happens with CD's when the storage time has expired. Employee 2 at the same department says that the CD's are destroyed internally when the storage time has expired. Employee 3 at this department says the CD's are just thrown away when the storage time has expired. So there are three different answers for one and the same department. The same differences show up when looking at the answers on the question how long the CD's are stored. Employees working for the same department give different answers. The first one says that he or she does not know how long

the CD's are stored, the second says that the CD's are stored for more than 15 years and a third employee says that the CD's are stored between 1 to 5 years.
The standard NTA (Nederlands Techniche Afspraak, Dutch Technical Agreement)8009:2011 describes the minimum requirements for VMS (Veiligheidsmanagementsysteem, Safety management system). The NTA is managed by the NEN (Nederlandse Norm) which is the local Dutch version of organizations like ISO (International Standard Organization) and manages all sorts of standards in the Netherlands. The NTA standard is divided into several subjects, communication being one of them. This subject prescribes that there should be a communication protocol for communication of essential patient data between employees of a hospital. The standard also categorizes some control measures, patient data being one of them. The control measures are not described, but it is clear there are shortcomings in the current way of sharing medical images. This is emphasized by an internal control of the NTA 8009:2011 performed by Det Norske Veritas (a classification organization). They state in an audit report from November 2013 that departments have different systems and that this causes differences in processes across departments. They do not mention specific applications, but departments use different application to fill in image request forms. They also indicate that processes are not monitored according to ISO 9001:2008. They state that because processes are not monitored, adjusting and measuring processes is impossible. Det Norske Veritas highly recommends to improve the previously mentioned issues along with other issues. This does not give a direct answer to the second sub question which is: *'What are the security issues of the current procedure that using XDS could solve?'* But it does give an indication of the issues which should be solved by XDS. To get a more complete answer, a closer view to XDS is required and therefor XDS will be explained more detailed in the next chapter.

6 XDS

There are a few standards available to share medical images between medical institutions. The UMCG has indicated that XDS is a standard which is best suitable for them. XDS stands for Cross-Enterprise Document Sharing which is developed by IHE (Integrating Healthcare Enterprise).

6.1 The XDS standard

XDS is the standard in the medical world for sharing patient data. XDS-I is the standard for sharing medical images between hospitals. In this report, XDS and XDS-I are treated as the same standard unless otherwise stated. XDS was developed by the IHE which stands for Integrating the Healthcare Enterprise. This is a worldwide non-profit organization which develops guidelines for information technology in the healthcare industry with the focus on improvement of the interoperability between systems in healthcare. IHE does not develop software or hardware itself, but it only develops technical frameworks. These technical frameworks can be adopted by vendors and software developers to design software on. These vendors and developers can sell this software under their own brand name and sell it as an, in this case, XDS system. At this moment there are several software developers who based software on the XDS framework. XDS is consists out of different components. Most software developers offer only a few components. A list with the components and the developers can be found in attachment 7.

6.2 Stichting GERRIT and XDS

At an earlier point in this study it became clear that the amount of images received from other hospitals will very likely increase in the coming years. Together with the founding of Stichting GERRIT, which already provides XDS services, it would be most obvious to connect the UMCG to the XDS provided by Stichting GERRIT. In figure 11 you will find a basic scheme how systems are connected to each other. Stichting GERRIT was originally founded by a few Frisian hospitals to share patient data more easily. Since a few years GERRIT started offering XDS services. The XDS standard has a so called affinity domain. In a domain several healthcare providers are connected to each other who share patient information with XDS. In this case, all healthcare providers connected to GERRIT are in the same affinity domain.

The XDS environment for the UMCG will be configured as following. When a patient (patient X) is referred from some other hospital to the UMCG the administrative assistant of the other hospital has to make the images of the concerning patient available in the web application serving as an XDS provider of the other hospital. This web application will create a record in the registry at GERRIT so that employees of the UMCG can access the images of patient X. At the same time the location of the images, in this case the PACS of the other hospital, will be stored in the XDS repository. The PACS (Picture Archiving and Communication system) is the original image storage system of a hospital. Between the PACS and the XDS repository a XDS interface will be deployed to establish the communication between PACS and the XDS systems. Only the employees who have access to the web application in the UMCG acting as an XDS consumer can access the images of patient X. When an employee of the UMCG wants to view the images, they go to their web application. This web application will show all patients with the shared images which are available for the UMCG. When an employee opens an image, it is directly opened from the PACS in the other hospital. When the employee of the UMCG wants to use the image in a patient record, the employee can store the image on the PACS of the UMCG. The PACS of the UMCG can communicate directly with XDS at Stichting GERRIT.

There are some advantages and disadvantages of storing images from the other hospital on the PACS of the receiving institution. The disadvantage is that the original images do not stay on their original location and thus local copies are made. When having multiple copies of the same

data this can increase the risk of data inconsistency. An advantage of making local copies is the responsibility for the image. When a physician is writing a report about a patient he or she might want to create a local copy, especially when the report is based on medical images. When the report is based on images which are stored in another hospital and the image is changed the report does not correspond with the images anymore. This might endanger the patient because possibly wrong diagnoses are made. When making local copies the UMCG is internally responsible for the images and the UMCG is not depending on other hospitals regarding the data consistency.

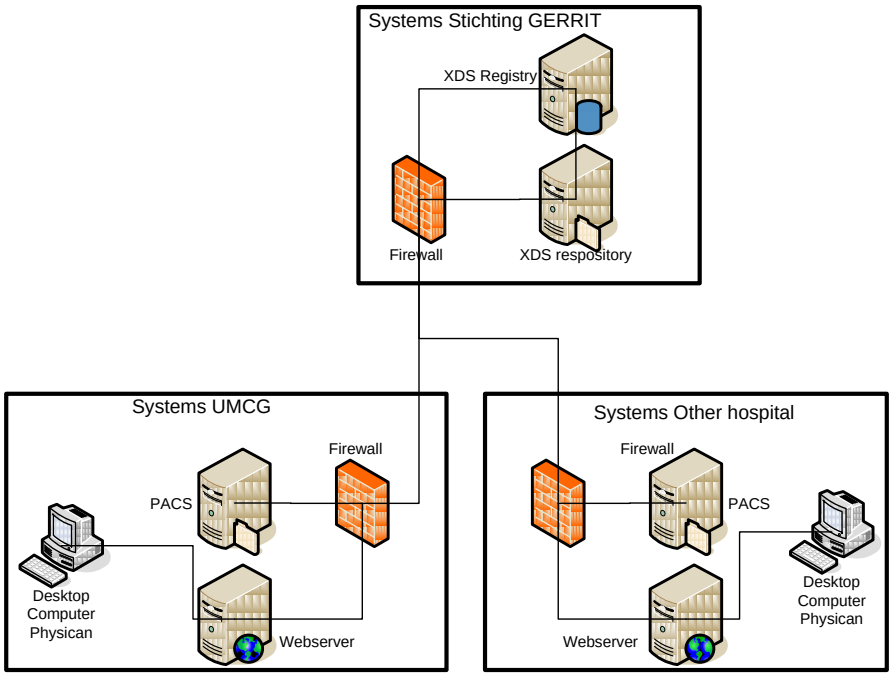

Figure 11 IHE XDS implemented provided by Stichting GERRIT

Regarding the second research question, which is: *'What are the security issues of the current procedure that using XDS could solve?'*, the UMCG can improve the security by using XDS. This paragraph gives an answer to the second sub question.

6.3 The costs

The costs for XDS can be roughly divided into external costs and internal costs. The external costs are the fees which are paid to Stichting GERRIT. According to internal resources at the IT Department of the UMCG the fees are based on the revenue of the hospital in this case the UMCG. The internal costs concern hardware and software for the internal webserver and the employment of a system administrator for the webserver.

As mentioned before, the fees for Stichting GERRIT are based on the revenue of the hospital that uses the XDS environment from GERRIT. Compared to other hospitals in

the northern part of the Netherlands it will be very likely that the UMCG will pay the highest fee because the revenue is the highest. However, the UMCG might have the most benefits from the XDS system. This is because a lot of patients are referred to the UMCG and not vice versa. This means that the referring hospitals are burning a lot of CD's right now and the UMCG has to import the CD's which cost a lot of time. Off course the importing part will be cut out when using XDS. But the share of burned CD's by the UMCG is much lower than in other hospitals. The UMCG does not refer as many patients as the surrounding hospitals.

7 Comparison

To compare the current situation, sharing images on CD with XDS, the comparison has been cut into three subjects. These are process related issues, security issues and costs which are the three main comparison points.

7.1 Process

According to observations and the answers from the questionnaire it became clear that the current process of sharing images is not executed identically across different departments in the UMCG. There are several reasons why the process should be executed identically. The first being the fact that there is no oversight regarding the process. Consequently, it cannot be reviewed and checked on possible problems in the process.

In some cases this could be lifesaving and costs can be cut down. This can be beneficial especially in emergency situations. According to the outcomes of the questionnaire is became clear that mail is used a lot to ship the CD's. In total 73% of the CD's are received by mail. This reveals that it takes a least one day before the CD has arrived in the UMCG. Although the UMCG cannot cut down on shipping costs when other hospitals participate in the XDS project, employees of the UMCG mention that both patients and employees can benefit from sharing medical images through the internet. 78% of the employees say that the treatment can speed up, 67% say that it can speed up their work and 53% say that it would make their work easier.

Based on interviews with several employees who are involved at the XDS project at Stichting GERRIT the process of sharing medical images would be as in figure 12.

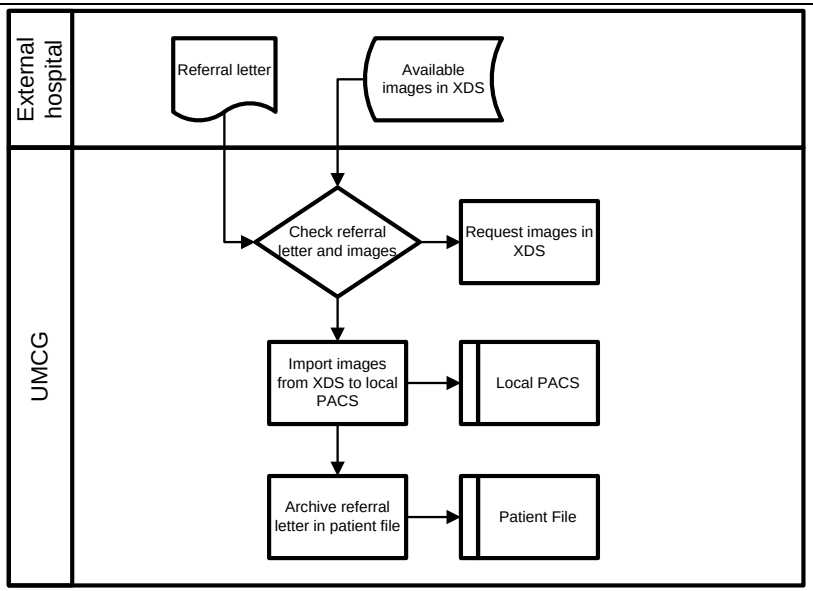

Figure 12 Image sharing process when using XDS

7.2 Finances

7.2.1 Current situation

The costs of the current process differs a lot across departments. Like already mentioned this is the result of a non-identical execution of the current process. Some departments store the received CD's for a long time while others do not store them. However some costs can be calculated. The employees were asked in the questionnaire to give an estimation of the time they need to process a received CD. Out of 40 respondents the average processing time was 11 minutes. The employees who are processing the CD's can be generally described as medical administrative employees. According to loonwijzer.nl the average gross salary of a medical administrative employee is € 2,763 per month. In the table below a calculation of other allowances and the total monthly costs can be found. Figures regarding the employers' share come from the Dutch Tax Authority. The figures regarding Holiday allowance and Holiday hours come from the collective labor agreement for the UMC's in the Netherlands. The UMCG has to comply to this agreement. All the previous mentioned figures are included in the salary costs because those costs proportional. All the costs mentioned here are included in the calculation to attribute a share of all costs to processing the images.

€ 2.763,00	Gross salary	1620	Average amount of CD's per month
€ 207,23	Employer's share ZVW (7,5%)	11	Average minutes processing time per CD
€ 221,04	Holiday allowance (8%	17820	Total processing time per month
€ 248,67	Holiday hours (9%)		
€ 3.439,94	Monthly employee costs	**€ 6.549,11**	**Monthly processing costs**
€ 41.279,22	Annual employee costs	**€ 78.589,28**	**Annual processing costs**
€ 22,05	Hourly employee costs		
€ 0,37	Employees costs per minute		

Table 3 Processing costs current situation

Other costs are the shipping and material costs. The monthly average of shipped CD´s by the UMCG is 173. Most CD´s are shipped by regular mail and only a few are given to the patient. CD´s are very rarely send abroad, but because CD's which are send abroad are not distinguished from the rest and this amount of CD's is very small, this is not included in the calculation. A calculation of the costs can be found below. The costs of the CD's consist out of € 0.50 for the medium and € 0.30 for the jewel case. The shipping costs consists out of € 1.28 (PostNL rates 2014) for the shipment and € 0.10 for the packaging (Aryanto, K.Y.E., Van de Wetering, R. , Broekema, A., Van Ooijen, P.M.A. & Oudkerk, M. (2013)). The shipment rates are based on the fact that all shipments fit thought a regular letterbox according to PostNL.
For both the shipped as well as the received CD's there are other indirect costs like the internal mail service in the UMCG. Because it is not clear by how much those costs will be reduced when the mail load will decrease as a result of sharing medical images through the internet, this is not included in the calculation.

2076	Annual amount of CD's
€ 1.660,80	CD's costs (€0,80)
€ 2.864,88	Shipping costs (€ 1,38)
€ 4.525,68	Total annual costs

Table 4 Costs shipped CD's current situation

7.2.2 XDS

According to an IT co-worker of the UMCG, who is involved in the XDS project at Stichting GERRIT, the costs for XDS running at GERRIT will be shared proportionally depending of the revenue of the hospital. The total costs for XDS at GERRIT are approximately € 200,000 annually. These are only the costs for the XDS environment at GERRIT. These costs consist out of:

- XDS license fees and support on XDS from E.Novation.
- Central IT environment at GERRIT (network, servers, etc.),
- XDS services (maintenance, support and project management).

Although the revenue figures of all the participating hospitals are not available, the IT co-worker stated that the fee for the UMCG would be around € 66,000 annually. In 2014 8 hospitals or hospital combinations (e.g. OZG and Zorgpartners Friesland) will participate in the XDS project Stichting GERRIT. This means the UMCG pays a 33% share of the total XDS project and the total revenue of all the hospitals participating in the project is a little above three billion Euro's. One remark here, these are the costs for 2014. When the XDS environment is subjected to change, the costs also might change. This is also the case when more hospitals will participate in the project at Stichting GERRIT, then the costs per hospital might decrease.

Next to this the UMCG will have to invest in some IT hardware itself. This hardware will be the webserver as described in § 3.3.2. Some additional hard- or software might be necessary to connect with XDS at Stichting GERRIT. It became already clear an additional converter is not necessary because the PACS in the UMCG is XDS compatible. But a firewall or other communication devices might be desirable to connect safely with Stichting GERRIT. An IT employee of the UMCG estimated that a budget of € 10,000 annually for IT hard- and software should be sufficient. This budget includes depreciations and annual costs for the internal systems to run XDS.

Next to the hard- and software costs, 0,5fte has been budgeted for IT system administration and application management. This 0.5fte equals € 35,000 annually. IT system administration should maintain the system which is used by XDS. Application management should fulfill user support, implementation support and application knowledge.

The XDS project was originally initiated by the UMCG. The UMCG invested a lot of money and time in XDS since 2009. However, these costs will not be included in this study. First of all because these costs are not documented and second because this study is focusing on XDS as it is desired to be. Of course the investments of the UMCG were necessary to initiate the project, but most of the money and time were invested in an XDS environment which was different from the environment at Stichting GERRIT. The original environment which was established in 2009 in the UMCG, was designed for a few departments in the UMCG and Martini Hospital. The hospitals in Assen, Emmen and OZG (Winschoten and Delfzijl) joined this in the years 2011, 2012 and 2013 respectively. But this environment is situated in the UMCG which might not be desirable, because the UMCG has the supervision over the system and the other hospitals might not always agree with these policies. A system at an independent organization as GERRIT should represent the interests of all participating hospitals. Next to this, the structure of the small environment is not designed for larger deployment.

There are some possible costs which are not included in this study. Those costs might be, for example, training for employees and implementing XDS in the UMCG. These costs are not included because the costs are not clear. For example, the departments in the UMCG might deal differently with training costs. Some departments or employees might have budget for training while others do not. The implementation costs are not included either because the UMCG is moving towards a new PACS, therefore the implementation costs are not clear.

Project fee	€ 66.000,00
IT Hard-/Software	€ 10.000,00
IT specialist	€ 35.000,00
Total	**€ 111.000,00**

Table 5 Annual static XDS costs

The annual costs are, unlike the current situation, very stable and can therefore be considered as static costs. Next to the static costs there might be some dynamic costs. When new images are available for a referred patient, the patient data still needs to be checked and if the images have to be stored in the PACS of the UMCG the images need to be linked to the already existing patient data in the UMCG. However it takes considerably less time than importing images from a CD. During the observations the checking and linking of patient data steps took a mere 30 seconds on average. Between October 2012 and September 2013 the average amount of received CD's per month was 1,620 and a total of 19,435 CD's were received over the whole period. Assuming all CD's will be gone when XDS is fully implemented, but in the calculation for dynamic XDS costs (table 7) the amount of CD's and image imports from XDS are assumed to be the same. This is because in the current situation every CD contains no more than images from a single patient and every XDS import contains no more than images from a single patient as well. A calculation of the dynamic can be found in table 7.

19,435	Amount of CD's
€ 0.31	Employee costs per minute
0.5	Minutes checking/linking time
€ 3,012.43	**Total annual costs**

Table 7 Expected Dynamic costs XDS

In the table below a costs comparison sheet is displayed. The percentage stands for the percentage of 'Received CD's' and 'Shipped CD's' used in the sheet compared to the amount of received and shipped CD's from October 2012 and September 2013. The 'Costs current situation' and 'XDS costs' are calculated with the same numbers mentioned in the figures above. At the bottom lines of the table the break-even point and the cost comparison based on the amount of images can be found regarding the 12 month period discussed earlier. Further below a graph of the table can be found.

Percentage	Shipped CD's	Received CD's	Costs current situation	XDS costs
90%	1.869	17.500	€ 75.299	€ 114.238
103%	2.136	20.000	€ 86.056	€ 114.700
116%	2.403	22.500	€ 96.813	€ 115.163
129%	2.670	25.000	€ 107.570	€ 115.625
141%	2.937	27.500	€ 118.327	€ 116.088
154%	3.204	30.000	€ 129.084	€ 116.550
167%	3.471	32.500	€ 139.841	€ 117.013
180%	3.738	35.000	€ 150.598	€ 117.475
193%	4.005	37.500	€ 161.355	€ 117.938
139%	2.879	26.956	€ 115.986	€ 115.987
100%	2076	19.440	€ 83.646	€ 114.596

Table 6 Cost comparison table current situation and when using XDS.

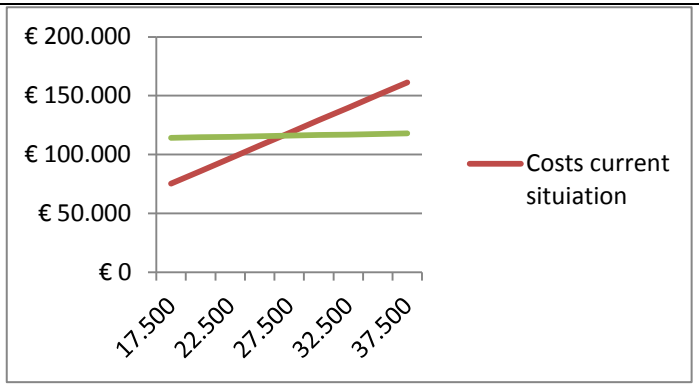

Figure 13 Cost comparison graph current situation and when using XDS.

In the previously mentioned 12 month period, the average amount of images per CD was 570. This means to reach the break-even point an amount of about 18,7 million images (570 times 32,909) have to be processed. The average annual increase of the amount of images between 2007 and 2012 is 21%. For the following years, the break-even point of 15,3 million images will be surpassed in 2014. More specifically the UMCG will receive over 16,2 million images that year.

Furthermore it is assumed that the costs per image for storing images in the PACS will not change. The costs per image are not different when images are shared using XDS or CD's. Next to this the use of XDS should neither have positive of negative effect on the amount of images because all and only the necessary images should be imported.

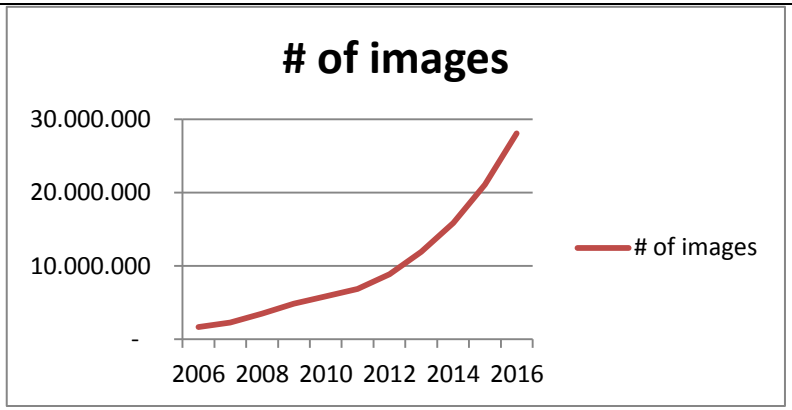

Figure 14 Increase of images in the coming years.

To summarize this paragraph, XDS will not cut costs at this moment. This gives an answer to the last research question which is: *'How can XDS cut down the costs when for sharing images with other hospitals?'.* Although XDS does not cut down costs compared to the CD sharing method, it can in the nearby future. Because implementing a system like XDS can take some time, it might be desirable to start implementing soon.

7.3 Security

There is room for improvement regarding security in the current situation. At this moment a lot of CD's are shipped with mail or a courier. This reveals that unauthorized people have direct access to patient data, e.g. the mailman and mail sorter. Beside this it appeared in a conversation with an observed employee that medical images have been received on a USB memory stick, but this is very rare. With USB memory sticks unauthorized people can even change patient data, which might be imported by the hospital. This is a very high security risk because this can affect the treatment of the patient. Even when using insured or certified mail there is a security risk that unauthorized people have access to patient data, the same goes for the courier. Hospitals have to comply to the Wpb (Wet bescherming persoonsgegevens, data protection act). When sending patient data unprotected by using mail the UMCG seems not to comply to this act.
With the use of user identification, using secured connections and preventing unauthorized users to have access to the patient data, XDS can solve the security issues partially. User identification is achieved by requiring a username and password when using the system. The secure connection can be achieved by using encrypted data transferring technologies. Unauthorized access to the patient data can be prevented by, for example, using firewalls. Images cannot be changed at the source so all the responsibilities stay internal.

7.4 Speed

Based on general assumptions it can be predicted that significant differences in the speed of sharing medical data between the current situation and XDS do exist. Most information presented in the table below are assumptions based on the experience from observations and the responses from questionnaires which were conducted. When comparing the two methods based on these assumptions it can be derived that XDS will be much less time consuming. The steps described in table 9 are based on using mail (regular, insured and certified) to ship the CD. According the response from the questionnaire this was the most used shipping method. When using a courier shipment might be significantly shorter, but the costs significantly higher.

	Searching and selecting images in PACS	Prepare images for sharing	Transfer images/ship CD	Import images
Current sitaution	Several seconds to minutes	up to 10 minutes	1 to 4 days	11 minutes + 1 day
XDS	Several seconds to minutes	Several seconds	Several seconds	Several second to minutes
Difference	marginal	Significant	Significant	Significant
Note	-	Burn images or make images available in XDS. Burning time may be longer depending on the hardware used	CD ship depend on internal mail service and mail cooperation. Shipping takes longer during the weekend	-

Table 9 Speed comparison Current situation and XDS.

Searching and selecting the images the PACS in the current situation has to be fulfilled by the referring hospital when preparing for burning CDs. This might take some minutes depending on the amount of available data for a particular patient and the required selection of images to be transferred. In case of XDS this selection of data to be shared is also required in the current setup and therefor this will stay likely the same when XDS is implemented.

Preparing the images in the current situation refers to the process of burning the images onto a CD or DVD. This can take up to 10 minutes of even longer, depending on the amount of images and the speed of the hardware used. Another time consuming process is the often used automatic label printing on the CD performed by the publisher machine that also writes the CD. When using XDS the step of burning and labeling is not required, but the employee can make the images available for the referred to hospital with only a few mouse clicks.

The biggest difference in time is required apparent in the step of transferring images. When a CD is being posted on Friday by the referring hospital, this will be delivered on Monday at the internal mail service of the UMCG. To reach its final destination from the central mailroom to the department can add an extra day to this resulting in a delay in the current situation of up to 4 days. If the referring hospitals also operates using an internal mail service, this could even add another day for the current situation in this step. When using XDS, this step is not physically there anymore since the data is now transferred over the internet. However, the employee in the receiving hospital might first want to check and view the images before importing then to the local PACS, but this is a matter of seconds.

Another big difference might be found at the step importing the images. According to the response from the questionnaire, this takes 11 minutes on average in the current situation. But those 11 minutes contain only the steps which are executed by the employee. If the CD contains a big amount of data, the employees usually will do some other work, instead of waiting on the DICOM uploader importing the images. When everything goes well and the patient data can be matched directly, the application managers of the Radiology Department will make the images available the next working day. This stepusually takes another day and over the weekend 3 days. When using XDS this would only just take a few minutes.

8 Discussion

XDS has no benefits at all when only the UMCG participates in it. All the numbers used in the financial calculations are based on the assumption that all hospitals that have ever send CD's to the UMCG will eventually participate in XDS at Stichting GERRIT. That this will happen for all hospitals is unlikely because there are hospitals from abroad which have sent medical images to the UMCG. Because they are subject to different laws it is juridically very difficult to involve them in the XDS at Stichting GERRIT. There are many Dutch hospitals which send images to the UMCG. Because XDS at Stichting GERRIT is focusing on hospitals in the provinces Groningen, Friesland and Drenthe (excluding Meppel) and other regions have their own initiatives, it will be very unlikely that hospitals outside the three northern provinces will participate in this XDS project. However, in the future a connection between the different XDS initiatives within the Netherlands could tackle this problem.

The temporary storage used to upload the images does not specify the hospitals from which the employees can pick one. Instead, the employee in the UMCG can enter the name of the hospitals themselves. When looking at the names the employees are very creative in choosing names for hospitals. Therefore it was impossible to determine a specific amount of images which has been send by each hospital to the UMCG. Another problem here is that there are hospitals in the Netherlands with the same name, like Meppel, Utrecht and Leiden. Hospitals in Sneek, Utrecht, Emmeloord, Leidschendam and Nieuwegein also share the same without being the same organization. And then there is the problem with merging hospitals and hospitals changing their names. At last, some employees use abbreviations for naming the hospitals in the temporary storage.

According to the observations and the data from the questionnaire it seemed that most employees might not have the knowledge concerning the storage periods. Although it is not clear if the questioned employees are responsible for the storage of patient data, it still might be useful to have knowledge about the storage period. If they are responsible for the storage of patient data the employees might destroy or throw away the data without knowing it is subjected to the Archiefwet (Archives Act). This act prescribes that all patient data in University hospitals should be stored for 115 years after the date of birth of the according patient. Patient data in normal hospitals is subjected to the Wet op de Geneeskundige Behandelovereenkomst' (WGBO, Act on the Medical Treatment Contract), which prescribes a storage period of 15 years after the start of the treatment. Both storage periods might be extended in some situations.

A careful attempt has been made to count the images for the hospitals which will participate in this XDS project. Between August 2007 and September 2013, at least 20.8 million out of 38 million images have been send to the UMCG by the hospitals in the northern three provinces which will participate in the project. This is only 54.7% of the received images in this period. But the outcomes of these numbers have to been interpreted very carefully. One remark here, the hospitals of Zwolle, Enschede and the hospital combination of Hengelo and Almelo have respectively send 5.5 million, 0.7 million and 0.9 images in the same period to the UMCG. Because of their geographical location, these hospitals are unlikely to connect to the XDS environment as provided by GERRIT.

Due to a lack of information about costs and security about the current PACS this was not included in this study. However some things still can be said about those subjects. When using XDS with the combination of importing images from XDS into the local PACS, the amount of images can increase or decrease compared to the current situation. This is based on two thoughts. The first is that when using XDS the employees in the referring hospital can be more specific in sharing the images than they are now. In the current situation a lot of referring hospitals burn a lot of, unnecessary, images to CD's and ship them to the UMCG. Usually they burn all available images from the patient onto a CD. For example, a patient with a broken leg

is referred from the Martini Hospital to the UMCG. The employee in the Martini Hospital will burn all available images about this patient onto a CD. These images might be about very different parts of the patient's body like the chest, head or hand. When this CD is being imported in the UMCG the employees here cannot always see what the images are about and therefore they import the entire CD which will cause a lot unnecessary usage of storage space in the UMCG. When using XDS this can be prevented by only importing the necessary images. The opposite situation can be that due to the low threshold of XDS to import images that the amount of imported images might increase even more. When the referring hospital will make a lot of unnecessary images available about the referred patient and the referred to hospital does import all these images the amount of images might increase even more then itdoes now.

A security leak at this moment in XDS might be that if images are available for the UMCG, all the employees who have access to the XDS environment in the UMCG can see the images. For example, the Urology department can see all the images for Surgery Department and vice versa. Although this could be considered as a risk, the impact is significantly lower than when people outside the UMCG have direct access to patient data.

Because the employees do not have a standard for importing the images, patient data might not be safe. Especially regarding the disposal of the expired CD`s. Although the patient data might be very old when it is "just thrown away", some data might still be useful for people with wrong intentions like the patient name, address and BSN number. Regarding several internal UMCG documents, IT related risks are taken very seriously. But in the future a higher level of authentication should be possible with the implementation of XUA and ATNA which are already use or implemented in the Mid-Atlantic region and Canada (Mendelson, D. S., Bak, P. R. G., Menschik, E and Siegel, E. (2008)).

This was emphasised very recently when the hospital Medisch Spectrum Twente was subject to extra surveillance by the Inspectie voor de Gezondheidszorg (IGZ, Health Care Inspectorate) [3]. This is because the hospital did not take sufficient measures to secure and evaluate the safety policy and therefore the Veiligheids Management Systeem (VMS, Safety Management System) of the hospital was not certified by the by the IGZ for the coming year. The CEO of the hospital mentioned this is due to ad reasons, but an internal letter from the IGZ to the MST mentioned is it because of pharmacy safety, infection prevention and vital threatened patients.

According the discussion above, XDS still contains a few issues when is will be used in the way Stichting GERRIT is offering now. Those issues might be desirable to solve when this is technical achievable. The mentioned issues can be drawn into a Ishikawa model as well, which can be found below.

[3] http://www.nu.nl/algemeen/3633767/ziekenhuis-mst-verscherpt-toezicht.html

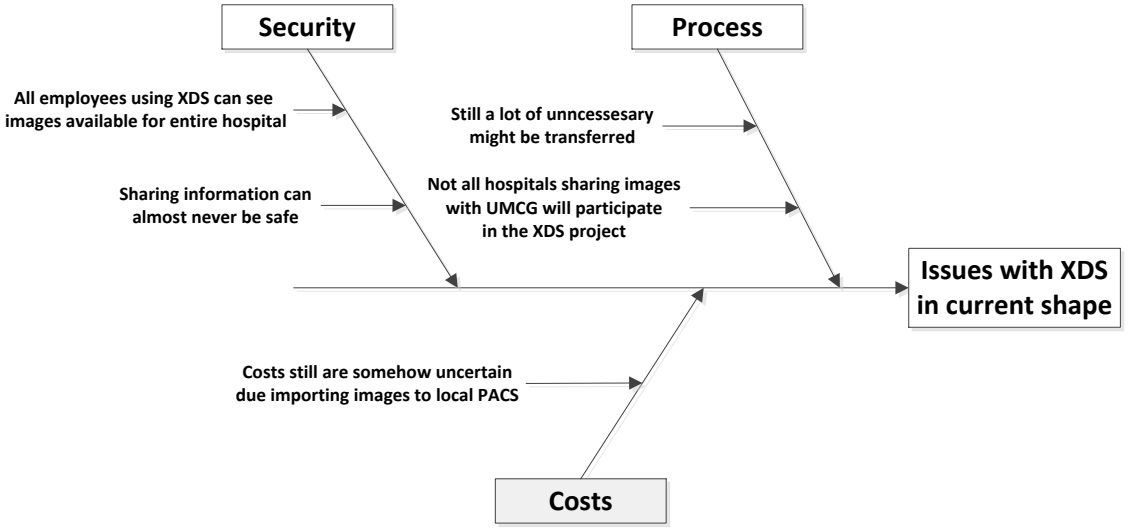

Figure 15 Ishikawa model when using XDS which is offered by Stichting GERRIT

9 Conclusion and recommendation

The aim of this study was to assess if XDS could solve the disadvantages in the current method of share medical images with other hospitals in the region. The main research question was:

'How can the process for sharing medical images with other regional hospitals be improved?'

The study has been cut into three main elements namely process, costs and security. The conclusion will also be drawn up according those elements.

9.1 Conclusions

The process is, at this moment, very unclear. The execution of the process differs very much across different departments in the UMCG. This results in the fact that the process is not controlled and problems in the process cannot be easily found. Departments have developed their own process and tools to execute the process. The previous stated is also mentioned by Det Norske Veritas during an audit in 2013. Potentially this leads to patient data not being stored accurately which might result in problems when treating a patient or extra work because new medical images have to be created which results in dissatisfied patients. Another problem with not storing the patient data accurately is that the UMCG might not comply to one or more laws. XDS can solve these problems when XDS is implemented correctly. In fact, when the images are imported with XDS into the PACS of the UMCG, the storage policies will do the rest.

According to the forms which are used to request missing images at other hospitals it became clear that departments use different software tools. It might even be the case that departments develop their own software to create those forms. The development of this software costs extra, unnecessary money. Next to this, because of these differences, the UMCG does not present itself in a uniform manner towards other organizations, while they do want to act as a single organization. When using XDS this problem can be solved as well. The referring hospital has to share the images of the referred patient with the UMCG. The employee in the UMCG can view and import the images. When the images are not available the employee in the UMCG can request the image of the referred patient in the same system.

The next concerning issue is the disposal of processed CD´s. There is no organization wide guideline that prescribes how to deal with the processed CD´s. Some of the CD´s are just thrown away in the recycle bin, which can be considered a security breach. Using XDS will solve this can be solved because there is no factor of disposing patient data.

It is not very likely that the UMCG can improve the current process without significant change in the process. Process descriptions are not available and therefore new employees will be trained by the experienced employees who will show them the old process. XDS can solve this problem as well. XDS will be implemented according to the specifications of the UMCG and Stichting GERRIT. The employees have to work according to the functionality of the system and therefore a standard has been set.

Because the current process is not clear and not controlled, the costs are unclear as well. In this study it has been attempted to specify the costs as accurately as possible. This has also been attempted for the situation when XDS is implemented. It seems that at this exact moment XDS will not be financially beneficial enough to implement. But in the nearby future it might be.

9.2 Recommendation

According to the conclusions of the previous paragraph it is recommended to implement XDS in the way Stichting GERRIT is offering. Although XDS is at this moment not

financially beneficial it will be in the near future and it does solve a lot of other current issues concerning security and the process itself.

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During this study I also had a course at the University which I needed to complete. For information to complete this course I contacted Mr. G.R. Kleve, MSc for providing me with information about the VMS. I would like to thank him for this information.

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Appendix

I Questionnaire

Do you at least import images from physical media from external hospitals once per 4 weeks?	Yes	82%
	No	18%
For which sector do you work the most when importing images?	Sector A	28%
	Sector B	30%
	Sector C	25%
	Sector D	9%
	Sector E	8%
	Sector F	0%
How much physical media do you process per 4 weeks?	<20	67%
	21-40	17%
	40-60	10%
	60>	7%
How many days per week are you busy with processing the images?	0 days	12%
	1 day	45%
	2 days	10%
	3 days	14%
	4 days	7%
	5 or more days	12%
Does it occur that images are in another hospital than the hospital which is referring the patient? If yes, can you indicate how many times per 4 week this occurs?	No	52%
	Yes	48%
	*3 comments	
Are physical media always send along with a referral? If not, how many times per 4 weeks does this occur?	No	67%
	Yes	33%
	* Average amount in comments 5.3	
If the images are send with a referral, do you always request the images at the referring hospital?	Yes	68%
	No	32%

	*8 comments	
How much time do you need on average to request images at another hospital? (Setting up a letter, addressing, postage, faxing, etc.)	Average 29,8 minutes	
What is the average lead-time between the moment of requesting en the moment of receiving?	Average 3,9 minutes	
Does it occur that when images are send automatically, the images are wrong? For example, the referral is for a broken ankle and you receive thorax images. If yes, how many times per 4 weeks does this occur?	Yes No *Average 1,5	24% 76%
In case of the previous questions, do you request the correct images at the referring hospital?	Yes No	90% 10%
Does it occur that images about a single patient are received double? If yes, how many times per 4 weeks does this occur?	Yes No *Average 4,22	90% 10%
Does it occur that you send physical media to the application managers from the Radiology Department because patient data is not matching? If yes, how many times per 4 weeks does this occur?	Yes No *Average 1,76	53% 48%
How much time in minutes does it take you to get the physical media to the application managers of the Radiology epartment?	Average 12,6 minutes	
Does it occur that the physical media are not readable by the systems of the UMCG? If yes, can you indicate how many times per weeks this occurs?	Yes No *Average 2,87	70% 30%

Does it occur that the physical media are not readable? Because the CD contains scratches for example. If yes, can you indicate how many times this occurs per 4 weeks?	Yes No *Average 1,82	44% 56%
Regarding the previous question, do you always request new images at the referring hospital? If not, why not?	Yes No *5 comments	71% 29%
Does it occur that the patient cannot be found directly by the DICOM uploader? If yes, can you indicate how many times per 4 weeks this occurs?	Yes No *Average 8,75	53% 47%
Does it occur that a physical media contains data about a wrong patient? If yes, can you indicate how many times per 4 weeks this occurs?	Yes No *Average 1	8% 92%
Does it occur that the physician does not have the images on time? If yes, can you indicate how many times per 4 weeks this occurs?	Yes No	47% 53%
If the physician does not have the images on time, does this result in a delay of the treatment? If yes, can you indicate how many times per 4 weeks this occurs?	Yes No *Average 3,46	61% 39%
How much time does it take you to import the images without any problems. You may count this from the moment you open the jewel case until the moment the process in the DICOM uploader is completed.	Average 10,97 minutes	
Can you indicate which three shipping methods are most frequently used for shipping CD's. 1 indicates most used and 3 less used.	Regular mail Certified mail Insured mail Courier	35,6% 4,6% 2,3% 12,6%

	By the patient himself	31,0%
	Other	13,8%
	*This is weighted score	
Are physical media being archived? If yes, how long are they being archived?	Not at all	30,0%
	Less than one year	12,5%
	1 to 5 years	5,0%
	5 to 10 years	5,0%
	10 to 15 years	2,5%
	more than 15 years	15,0%
	I don't know	30,0%
How long does it take you in minutes to finish the importing process? For example, labeling the jewel case, putting the CD in a cover, etc.	Average 8,4	
What happens with the physical media when the storage period has expired?	I don't know	43%
	Are destroyed internal	39%
	Are destroyed external	4%
	Other, give comment	13%
	*3 comments	
Do physical media disappear during the shipping or somewhere else in the process? If yes, can you indicate how many times per 4 weeks this occurs?	Yes	28%
	No	72%
	*Average 2,6	
Can you indicate which hospitals causes the most problem when they are referring patients to the UMCG? 1 indicates the most problems and 5 indicates less problems	Martiniziekenhuis Groningen	32,0%
	OZG St. Lucas, Winschoten	7,8%
	OZG Delfzicht, Delfzijl	5,8%
	Refaja Ziekenhuis, Stadskanaal	6,8%
	Wilhelmina Ziekenhuis, Assen	6,8%
	Scheper Ziekenhuis, Emmen	2,9%
	Bethesdaziekenhuis, Hoogeveen	1,9%
	Diaconessenhuis, Meppel	0,0%
	MCL, Leeuwarden	3,9%
	Nij Smellinghe, Drachten	1,9%
	Ziekenhuis De Sionsberg, Dokkum	2,9%
	Tjongerschans, Heerenveen	3,9%

	Antonius ziekenhuis, Sneek	1,0%
	Isala Klinieken, Zwolle	2,9%
	Medisch Spectrum Twente, Enschede	2,9%
	Ziekenhuis Groep Twente, Hengelo	2,9%
	Ziekenhuis Groep Twente, Almelo	2,9%
	Deventer Ziekenhuis, Deventer	0,0%
	Röpcke-Zweers, Hardenberg	3,9%
	Overig	6,8%
	*weighted score based on indications, not weighted to the amount of received images	
What would it mean for you when images are shared with a system over the internet? Multiple answers may be given.		
	It would make my work easier	21,1%
	It would speed up my work	26,7%
	There will be no difference with current sitation	2,2%
	No opinion/I don't know	2,2%
What could be positive changes for the patient when there will be a system to share images over the internet? Multiple andswers may be given		
	The treatment could speed up	31,1%
	The security of patientdata could improve	8,9%
	There are less expectations regarding the patient	3,3%
	The will be no difference	0,0%
	No opinion/I don't know	4,4%
	Other, give comment	3,3%
	*3 comments	

II Invitation questionnaire

Geachte heer of mevrouw,

Mijn naam is Erik Lugtenberg en ik ben vierdejaarsstudent Bedrijfseconomie aan de Hanzehogeschool in Groningen. Op dit moment ben ik bezig met mijn afstudeeropdracht voor de afdeling radiologie van het UMCG. De opdracht gaat over het uitvoeren van een kostenefficiëntie analyse voor de invoering van een systeem om medisch beeldmateriaal makkelijker uitwisselbaar te maken tussen ziekenhuizen in Noord Nederland.

Om een goede vergelijking te kunnen maken met betrekking tot de kosten heb ik een enquête opgesteld. Deze enquête is bedoeld voor iedereen die regelmatig gebruik maakt van de DICOM uploader om afbeeldingen van CD's en DVD's beschikbaar te maken in Poliplus. Ik wil u daarom vragen of u de enquête ook wilt invullen. Dit is ook gelijk de reden waarom u deze e-mail ontvangt.

Om een aantal vragen uit de enquête goed te kunnen beantwoorden, wil ik u om van te voren een aantal een aantal stappen tijdens het verwerken van de CD's duidelijk te hebben. De aantallen waar hieronder naar wordt gevraagd is per 4 weken.

- De totale hoeveelheid CD's die u verwerkt.
- Hoe vaak het voorkomt dat u CD's ontvangt die verkeerd beeldmateriaal bevatten.
- Aantal dubbel ontvangen CD's.
- Aantal keren dat u naar de applicatiebeheerders van radiologie moet omdat de patiëntgegevens niet voldoende overeenkomen.
- Hoe vaak het voorkomt dat de afbeeldingen niet leesbaar zijn voor de systemen van het UMCG.
- Hoe vaak het voorkomt dat de CD's beschadigd zijn.
- Hoe vaak het voorkomt dat de CD verkeerde patiëntgegevens bevat.
- Of er CD's verdwijnen, bijvoorbeeld tijdens de verzending.
- Een schatting aantal minuten dat u per CD bezig bent om te verwerken, exclusief de tijd die u tijdens het verwerken aan andere werkzaamheden besteed.

Als het bovengenoemde redelijk duidelijk voor u is, kunt u de enquête in ongeveer 20 minuten invullen.

Als u na aanleiding van deze e-mail vragen heeft kunt u altijd contact met mij opnemen via e.lugtenberg@umcg.nl.

Alvast bedankt voor uw medewerking.

Met vriendelijke groet,
Erik Lugtenberg

III Image request forms Urology Department

Universitair Medisch Centrum Groningen
Postbus 30001, 9700 RB Groningen

CORRECTIE EXEMPLAAR

CURP

Afdeling Radiologie
Martiniziekenhuis
Postbus 30033
9700 RM GRONINGEN

11 oktober 2013

Urologie
Afdelingshoofd: Dr I.J. de Jong

Staf
Dr M.F. van Driel Andrologie
Dr I.J. de Jong Oncologische urologie
Drs A.M. Leliveld Oncologische urologie
Drs E.J. Messelink Functionele urologie
Prof Dr J.M. Nijman Kinderurologie
Drs A.J. de Ruiter Endo-urologie

Polikliniek Urologie
Telefoon (050) 361 2167
Hoofdbehandelaar
I.J. de Jong
Betreft
J.A.B.C. Fictief
-Hanzepleinfout 1
42869 Groningen
Geboortedatum: 01-01-1980 Man

Bezoekdatum 11-10-2013
UMCG-NR 77.67.853 BSN
Ref. 7767853-2918/eab

L.S.,

In opdracht van dr I.J. de Jong, uroloog in het Universitair Medisch Centrum Groningen, verzoek ik tot het opsturen van de röntgenfoto's op CD-rom van bovengenoemde patiënt.

Wilt u zo vriendelijk zijn de CD-rom op te sturen naar:

Universitair Medisch Centrum Groningen,
Polikliniekbureau Urologie CB 63
Postbus 30.001
9700 RB Groningen

Bij voorbaat hartelijk dank voor de te nemen moeite.

Met vriendelijke groet,
namens dr de Jong,

,
Polikliniekbureau Urologie. Fax: 050-3619913.

Deze brief is na accorderen elektronisch verwerkt en wordt niet van een handtekening voorzien.

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IV Image request form Surgery Department

Hanzeplein 1 Postbus 30.001, 9700 RB Groningen

Universitair Medisch Centrum Groningen

Chirurgie
Hoofd Prof. dr. E. Heineman

Groningen, ...

Aan de röntgenafdeling van het ziekenhuis: .....

L.S.,
In opdracht van dr. , Universitair Medisch Centrum te Groningen,
verzoeken wij u tot het opsturen van de röntgenfoto's van:

De heer / mevrouw: .....

Geboortedatum: .....

Adres: .....

Woonplaats: .....

De foto's kunnen opgestuurd worden naar:

Zorgadministratie polikliniekbureau Chirurgie
Huispostcode: BA14
Postbus 30.001
9700 RB Groningen

Bij voorbaat dank.

Met vriendelijke groet,

Zorgadministratie polikliniekbureau Chirurgie

Telefoonnummer : 050 - 361 49 11
Faxnummer : 050 – 361 30 23

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V Summary Observation Department of Surgery on October 9, 2013

The CD is usually received automatically when a patient is referred or when the UMCG request images at other hospitals.

The CD is put into the CD drive and the DICOM uploader will first read the entire CD, this might take a while depending on the amount of data on the disk. When the DICOM uploader request for a patient number, this has to be entered. The DICOM matches the patient name date of birth on the CD with the patient record in the UMCG if this already exists. A lot of problems occur here that names are sometimes spelled slightly different especially with foreign names. Another issue here is that the name might have typo's.

When the patient does not patient enough, the DICOM uploader will not complete the import process. But then already 15 minutes might have been elapsed. If the patient data does not match enough, the employees has to bring the CD to the application managers of the Radiology Department. This is often done by internal mail.

When the patient data can be matched, the application managers will see the uploaded data in a sort of working cue and will make the image available the next day.

The CD itself is being labeled and archived. The label contains information about the type of images and patient.

Missing image are requested by fax, see attachment 4. This form is printed in the eForm application.

Reoccurring issues with this steps are:

- Damage CD's.
- Uncompliant CD's.
- Problems with matching patient data.
- Images are missing.
- Wrong images.
- Images are not automatically send along with the referral letter.

VI Notes observation Department of Urology on October 11, 2013.

The CD is usually received automatically when a patient is referred or when the UMCG request images at other hospitals.

The CD is put into the CD drive and the DICOM uploader will first read the entire CD, this might take a while depending on the amount of data on the disk. When the DICOM uploader request for a patient number, this has to be entered. The DICOM matches the patient name date of birth on the CD with the patient record in the UMCG if this already exists. A lot of problems occur here that names are sometimes spelled slightly different especially with foreign names. Another issue here is that the name might have typo's.

When the patient does not patient enough, the DICOM uploader will not complete the import process. But then already 20 minutes might have been elapsed. If the patient data does not match enough, the employees has to bring the CD to the application managers of the Radiology Department. We take the CD's there ourselves.

When the patient data can be matched, the application managers will see the uploaded data in a sort of working cue and will make the image available the next day. The employees importing the images always check if the images are correctly available in Poliplus.

The CD itself is being labeled and archived. The label only contains the patient name and patient number.

Missing images are requested by fax, see attachment 3. This form printed from ZIS (Ziekenhuis Informatie Systeem).

Reoccurring issues with this steps are:

- Long waiting time for DICOM uploader import process.
- Uncompliant CD's.
- Problems with matching patient data.
- Images are not automatically send along with the referral letter.
- Takes long before images are released in PoliPlus.

VII XDS component suppliers

	Patient Identity Source	Document Consumer	Document Registry	Document Repository	Document Source	Embedded Repository	Imaging Document Consumer	Imaging Document Source
Acuo Technologies		*			*		*	*
AGFA Healthcare		*		*			*	*
A-thon S.r.l			*	*				
Carestream Health		*		*			*	*
Cerner Corporation			*	*				
EBM technologies		*		*	*		*	*
EDL		*					*	
ETIAM		*					*	*
Forcare BV		*	*	*	*		*	*
Fujifilm		*		*	*		*	*
GE Healthcare		*			*		*	*
GIE Convergence-Profils			*	*				
Global Imaging OnLine								*
ICT Embedded B.V.		*					*	*
INFINITT		*					*	*
International Business Machines			*	*	*			*
ITH icoserve technology for healthcare GmbH	*	*	*	*	*	*	*	*
Mawell			*	*				
McKesson Information Solutions		*					*	
MEDecision		*	*	*			*	*
Medical Informatics Engineering		*					*	
M.I. Medical				*				*
National Digital Medical Archive, I				*				
Open Three Consortium of the Universities of Padova and Trieste								*
Radiosity S.r.l.							*	*

Rogan-Delft		*					*	*
santeos				*				
Sectra Imtec AB		*	*	*	*		*	*
SIEMENS Medical Solutions		*		*			*	
Softmedical		*					*	*
Tiani-Spirit Gmbh		*	*	*	*		*	*
Tiani "Spirit" Gmbh - Cisco Systems Inc.		*	*	*	*		*	*
T-Systems Austria GesmbH		*	*	*			*	*
Kanrikogaku Kenkyusho		*	*	*				