

# EVALUATION OF A TELERADIOLOGY SYSTEM

## *Impact and User Satisfaction*

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Abstract: Teleradiology is the acquisition and transmission of radiologic images and respective diagnosis from a different location where the patient performed the exam. A teleradiology system was implemented in the ACES Alto Trás-os-Montes I Nordeste, in the Northeast of Portugal in 2008, aiming to overcome the shortage of this healthcare resource and expertise in the region. The main objective of this paper is to assess users' satisfaction with the use of the teleradiology system presented above and investigate the main changes and impact that this system had for the patients and healthcare professionals involved in the process. Focus groups were applied and allowed to ascertain the users' perspectives regard the system. The main characteristic of the participants was that they used the system to perform their work on a daily basis or they benefited from its use. A focus group was performed for each of the three categories: Radiology Technicians, Primary Care Physicians and Patients, and they lasted one hour on average. Both healthcare professionals and patients have benefited with the introduction of the teleradiology system. The methodology applied allowed to better explore why it is so for each different group and for the various aspects of the system.

## 1 INTRODUCTION

With the increasing use of technology, the distance has virtually ceased to be a problem; the "approximation" by electronic means of health resources is a reality today. Telemedicine is a proof of this "approximation", because even without the physical presence of certain health services, populations have the opportunity to use and benefit from them as well as get advice from experts in various areas, even when they are miles away and without needing to travel (Romero et al, 2008). However in most cases, the impact of these new health services provided by new technologies together with users' satisfaction is not properly studied and evaluated.

In this perspective there are certain qualitative research methods that have proved important in the area of healthcare, in that they provide for the knowledge perceptions and ideas of the people and further explore the main reasons why it is so (Coelho et al, 2009). One of these methods is for example the Focus group. This method is an important method of qualitative data collection and is characterized by guided discussions among a small group of people about a relevant issue or topic to be explored (Curry et al, 2009).

Focus group is a method that has been increasingly used by health professionals.

This method is, not only, very useful for developing strategies, needs assessment, evaluation of health promotion, but is also considered a great

challenge for the researcher (Rabiee, 2004). This method can help going beyond the perception of satisfaction. It is possible to understand the key issues related to the main theme, the strengths of the system, the concerns of each target group and gather and explore views and experiences related to specific themes (Ferreira et al, 2010).

In this context, Focus Group method is suitable to explore and understand the degree of satisfaction of the teleradiology system by different types of users: those who use the system on a daily basis to perform their work and the patients who benefit from the services provided by that system. For this reason this method helps to achieving the aim of this article.

### 1.1 Telemedicine and Teleradiology

Telemedicine provides health care at distance (Thrall, 2007) with resource to information technology. The main objectives of telemedicine are the equal access to specialized medical services, increased quality of care, decreased costs, increased cooperation between primary health care and specialized medical resources and easy access to health specialists' care at a distance. There are a number of areas where this practice can be applied such as teleradiology, teledermatology, telecardiology, teleophthalmology, among many others (Romero et al, 2008).

The evolution of radiology to a digital level opened several doors for medical imaging, new opportunities for different clinical applications and new models of practice (Thrall, 2005), including teleradiology.

Historically, teleradiology has been explored for nearly 50 years, within the area of telemedicine, with the provision of health services at distance (Thrall, 2007) and is today an active practice in the world and has a enormous potential for the future (White, 2002).

According to the American College of Radiology (ACR), teleradiology is by definition the electronic transmission of radiological images from one location to another for the purpose of interpretation and / or your query (White, 2002). With this system the same image can be viewed simultaneously by a large number of users in different locations. Properly used, this valence can improve access to quality radiological interpretation and consequently increase the quality of patient care.

Over the years, teleradiology followed the evolution of technological means, seizing opportunities and new equipment that was emerging,

readjusting itself and becoming increasingly effective. It searches through information technology improvements to deliver health care in regions that are most deprived of these resources.

The major contribution of technology to the success of teleradiology focuses on the following points: the possibility of rapid and reliable transfers of radiological images and their diagnostic studies; archiving and communication - PACS (Picture Archiving and Communication System); high-speed Internet access and secure virtual private networks (Kenny and Lou, 2008).

Another important factor for the success of teleradiology was the creation of DICOM standard (Digital Imaging and Communications in Medicine). This standard was developed by the ACR and the Electrical Manufacturers Association (NEMA) in 1985 and enables digital communication between diagnostic and therapeutic equipment and systems from various manufacturers (RSNA, 2010). This was very important for teleradiology because it facilitated communication amongst different systems.

The ACR stresses as the main benefits of teleradiology: the interpretation of radiological examinations by appropriate specialists; the possibility of these being viewed simultaneously by different users of the system; improvements in access to quality interpretations with consequent improvement of patient's health care; and the fact that teleradiology can provide new experiences for education (White, 2002).

However, apart from the numerous advantages for people who use this system there are some problems, doubts and failures.

There is also a great concern about the transfer and quality of images that are received and this may bring problems to their interpretation. The failure to use exactly the same standards increases the possibility of error (Kenny and Lou, 2008). It is important to stress also that the difference of equipments, such as the monitors that display the images, may be a determinant factor in the image quality and its interpretation. A fault in the equipment can also endanger the entire system's functionality.

Still on the technological aspects there are sometimes some problems in integrating the various systems needed for operating the network of teleradiology, this is a major technological challenge (Thrall, 2007).

On the other hand there is the question of training in this area, it is important that whoever works with these systems has the necessary know-

Table 1: Number of radiographies and examinations performed by the teleradiology system (each examination can have more than one radiography). This data was obtained from the ACES Alto Trás-os-Montes I Nordeste report.

Year	No Radiographies	No Examinations Made	No Examinations that were reported	Number of Patients examined in the 10 centers using teleradiology
2008	36246	22416	19139	-----
2009	44594	27317	22497	17573

knowledge and that there is cooperation between the professionals involved in the process for the smooth functioning and success of the system.

For the teleradiology system to work properly it is essential that the sites involved are endowed with the necessary conditions both of qualified personnel and appropriate equipment so that, at the time of implementation, all the necessary changes to the organizational level and the whole environment are taken into account.

## 1.2 Teleradiology in ACES Alto Trás-os-Montes I Nordeste

The ACES (Group Health Centre) Alto Trás-os-Montes I Nordeste, currently covers 14 health centers that provide basic health care to approximately 105,392 patients in the northeast of Portugal. Figure 1 presents the northeast region of Portugal with the health centers that are aggregated in 10 groups and where teleradiology is available.

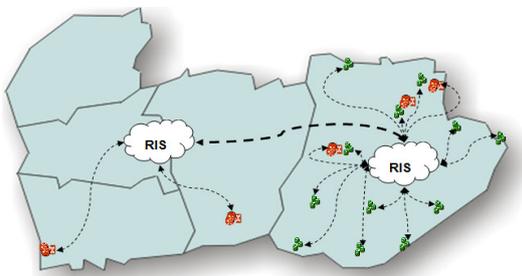


Figure 1: Portuguese northeast connections among health group centers where teleradiology is available.

In an attempt to remedy the shortage of specific health resources in this region, the ACES mustered equipment and qualified professionals in various areas. Radiology was one of the sponsored areas in this project, hence the investment in the implementation of a teleradiology system.

This system tried to fill the lack of expertise of this medical speciality in this region and as such it is important to quantify this shift, as well as the benefits and/or problems brought to this predominantly elderly population, with difficulties

in transportation.

Teleradiology currently exists in 10 of the 14 health centers in this region: Alfândega da Fé, Bragança, Carrazeda de Ansiães, Freixo de Espada à Cinta, Miranda do Douro, Mogadouro, Torre de Moncorvo, Vila Flor, Vimioso e Vinhais.

As can be seen in Table 1 there is a considerable number of examinations made every year. All radiology services have digital equipment acquisition, image processing and local servers for teleradiology, linked by computer to the ACES in the town of Bragança. The radiographic images are archived on the PACS system that is also located at the headquarters of ACES and the service provider (Radiologists) has access via a private network, where the reports are made. With the PACS software, all the Primary Care Physicians can see their examinations and reports conducted in ACES.

At this moment, when performing their workflow, the radiology technicians take an average of 3 days for a regular exam and 1h to emergency ones.

It is very important to investigate the real change and impact in the healthcare services provided for this region by this teleradiology system, especially the degree of satisfaction for its population and healthcare professionals, which are the users of the system. This is therefore the main objective of this paper.

## 2 METHODS

### 2.1 Focus Groups

The focus group sessions consist of a discussion with six to ten participants in the areas of investigation and are led by one or two moderators. All the discussion is recorded and transcribed later for analysis. Throughout the conversation, the pertinent points will be explored, giving participants the opportunity to share their experiences and views and discuss them among themselves (Ferreira et al, 2010).

As the success of the Focus Groups depends on

the interactions between participants, the discussion must generate information that reflects the full spectrum of opinions and experiences. The moderators of the group should guide the dialogue in order to allow a free exchange and ensure that participants feel comfortable expressing their views even in disagreement (Curry et al, 2009).

## 2.2 Population

The selection of participants was done according to the area of interest for each group session and their connection with the teleradiology system.

Thus, two of the focus group were selected by occupational group, including Radiology Technicians and Primary Care Physicians, since they are the principal users of the teleradiology system on a daily basis. In the focus group with the Patients, the selection was specific for people who had used the system to treat some healthcare problem. In either case, the involvement was not confined to a place where the system is in place.

Two moderators participated in the three focus groups and were careful to avoid commenting as much as possible and give opinions on the subject.

For each discussion group it was essential to use some recording material to capture the sound and image. To this end a laptop with a program for audio recording and a video camera for recording audio and image were used. In addition, it was important to find a comfortable room, and organize the furniture according to the objectives of the discussion and so that to capture the image of all the participants. The video record allows to capture body language that can be important in the construction and analysis of the data (Rabbie, 2004).

## 2.3 Line of Discussion

The group sessions were flexible and open to potential issues raised by participants.

As in a Focus Group, there are no fixed questions to ask the participants, there is the use of a line of discussion to help in structuring and leading, in an informal and non-structured way, the subsequent discussion.

The initial part of the line of discussion, followed by the moderators, was similar in the three groups:

- a. A brief explanation of the issue to the participants and other information about the processes that would follow along the discussion group;
- b. Each participant was asked to give their consent to participate;
- c. Each participant was initially asked to give details about the profession, age and experience with teleradiology in general and with the system in question specifically.

Then, the line of discussion was specific for each group but with some similarities.

- 1) Radiology Technicians Focus Group (FG1):
  - a. User experience with teleradiology;
  - b. Training needed to use the system;
  - c. Usability (graphical interfaces, access);
  - d. Technology (system functionality, uptime, workflow);
  - e. Trust in the system (information security);
  - f. Helpdesk - if there is an adequate support in solving the problems;
  - g. Level of satisfaction;
  - h. Influences in the activity with other professionals (teamwork);
  - i. Improvements to the region;
  - j. Difficulties with the system;
  - k. What can be improved.

Table 2: Description of each Focus Groups data collection.

Focus Group	Date and time	Recording	Audio	Video	Moderators	Number of participants
FG1	24/03/2010 15h	1h15min	Y	Y	2	7
FG2	07/06/2010 14h45min	50min	Y	Y	2	8
FG3	07/06/2010 16h45min	1h	Y	Y	2	5

- 2) Patients Focus Group (FG2):
  - a. Experience as a patient using the teleradiology system;
  - b. Perception of increased speed in medical consultation after the introduction of this new system teleradiology (waiting time for implementation and for obtaining the results of radiological exams);
  - c. Greater or lesser facility in performing radiological examinations;
  - d. Decrease or increase the distance needed to perform radiological examinations;
  - e. More or less comfort in using this service compared with the previous alternatives available;
  - f. Level of satisfaction with the system teleradiology;
  - g. Improvements to the region;
  - h. What can be improved.
- 3) Primary Care Physicians Focus Group (FG3):
  - a. User experience with teleradiology;
  - b. Training needed to use the system;
  - c. Technology (system functionality, uptime, workflow);
  - d. Trust in the system (integrity of information / security);
  - e. Usability (efficiency obstacle / enhancer, graphical interfaces, access);
  - f. Helpdesk - if there is adequate support to solve problems;
  - g. Perception of increased speed in medical consultation after the introduction of this new system teleradiology (waiting time for implementation and for obtaining the results of radiological);
  - h. Level of satisfaction;
  - i. Influences in the activity with other professionals (teamwork);
  - j. Contribution in service to users;
  - k. Improvements to the region;
  - l. Difficulties with the system;
  - m. What can be improved.

ding made in each session. Data analysis was done with the transcription of the whole discussions to Word documents. Selected main issues and opinions were placed on a table in another document, along with the profile of each person. Those issues that were most discussed during the course of the discussions were selected and ordered.

### 3.2 Results from FG1

In this group discussion participated seven radiology technicians: two women and five men whose work is distributed by the 10 health centers that provide teleradiology. They work with the teleradiology system on a daily basis and are aged between 24 and 30 years. This was a very dynamic and participatory group. Two participants started to use this system from the beginning and went through all the intermediate stages until the actual state of the system. Other participants just know the system exactly as it is now, so the contribution of this group for this analysis was indeed important. The results of a preliminary analysis of this discussion are presented in Table 3.

The main issues that dominated the discussion were:

- a. Workflow;
- b. Evolution of the System / Turning Points / Equipment;
- c. Limitations / Main problems;
- d. Training;

Many different experiences were described: the experience of a mother with her baby, the routine tests, emergency examinations, and examinations made in a local to be seen by Primary Care Physicians in a different location. This diversity of ages and professions was very important to study because it was possible to obtain opinions from a wider range of people who use these health services. This discussion came to the following results that are presented in Table 4.

The main issues that dominated the discussion were:

- a. Teleradiology - Before / After;
- b. Influences on Attendance;
- c. Security in data transmission.

## 3 RESULTS

### 3.1 Data Collection and Analysis

Data were collected using the audio and video recor-

Table 3: Description of results from FG1.

Issue	Related issues
<b>Teleradiology</b>	The system is an essential tool It has several platforms Interoperability needs are still required The workflow is equal for all the participants
<b>System evolution /Turning points/Equipments</b>	The equipment to treat radiological images is the same everywhere The acquisition of a PACS service was essential to implement the teleradiology service Acquisition of a dedicated line
<b>Usability</b>	The platform Siima (Radiology Information System (RIS), for making the patients report request) could be improved, is functional but not very intuitive
<b>Education</b>	All the participants had education but they agree that it was not a very good one The first professionals to use the system had more difficulties, the others had more help from them
<b>Security and trust in data transmission</b>	All participants Access the system with a login and a password There is a Great trust in the integrity of the information that is stored within the system If the process is done with the correct steps and if there is no human error, the reliability is quite big
<b>Helpdesk</b>	They all know who to report the errors Problems' resolution does not take too long There is rarely feedback regarding the reported problem
<b>Satisfaction degree</b>	4 in a scale from 1 to 5
<b>Teamwork</b>	It has improved at several levels and with the different healthcare professionals that they interact on a daily basis
<b>Service providing</b>	It has lessened patients' waiting time
<b>Improvements to the region</b>	It has shortened the distances It has improved accessibility It has reduced the need for transportation Improvement in healthcare
<b>Limitations/main problems</b>	Interoperability with other systems Bandwith is limited and not enough to satisfy all the needs
<b>To improve</b>	There is the need for some applications to be developed in order to facility the radiologist activities Resolution of the main problems Direct connection with the hospitals in that region

Table 4: Description of results from FG2.

Issue	Related issues
<b>Teleradiology Before/After</b>	With this new system everything is faster
<b>Trust in the system</b>	They trust the system
<b>Service providing</b>	The human factor (healthcare professionals assistance) is essential for them to connect with the system
<b>Security and trust in data transmission</b>	There is some concern that the data may not be transmitted in a secure way
<b>Satisfaction degree</b>	5 in a scale from 1 to 5
<b>Improvements to the region</b>	5 in a scale from 1 to 5
<b>To improve</b>	It can always be improved (they did not specify what)
<b>Suggestions</b>	Possibility to access their own medical records with an access code, similar to other areas, for instance banking

Table 5: Description of results from FG3.

Issue	Related issues
<b>System evolution</b>	<ul style="list-style-type: none"> <li>• Is better now than before</li> <li>• The access to the radiological exams is faster</li> <li>• Saves time and costs</li> <li>• Is possible to manipulate the image</li> </ul>
<b>Usability</b>	<ul style="list-style-type: none"> <li>• Access to the image should be even more straightforward</li> </ul>
<b>Education</b>	<ul style="list-style-type: none"> <li>• All the participants had education to use the system</li> </ul>
<b>Security and trust in data transmission</b>	<ul style="list-style-type: none"> <li>• Everybody access the system with their own login and password</li> <li>• There is a great trust on the information integrity that is stored within the system</li> </ul>
<b>Helpdesk</b>	<ul style="list-style-type: none"> <li>• They know to whom report the problems</li> </ul>
<b>Satisfaction degree</b>	<ul style="list-style-type: none"> <li>• 4 in a scale from 1 to 5</li> </ul>
<b>Teamwork</b>	<ul style="list-style-type: none"> <li>• 4 in a scale from 1 to 5</li> </ul>
<b>Service providing</b>	<ul style="list-style-type: none"> <li>• 4 in a scale from 1 to 5</li> <li>• Faster consultations</li> </ul>
<b>Improvements to the region</b>	<ul style="list-style-type: none"> <li>• 4 in a scale from 1 to 5</li> <li>• It has shortened the distances</li> </ul>
<b>Limitations/main problems</b>	<ul style="list-style-type: none"> <li>• General difficulties in using informatics equipment</li> <li>• Sometimes it is slow to access the radiological images (bandwith problems)</li> </ul>
<b>To improve</b>	<ul style="list-style-type: none"> <li>• Resolution of the main problems</li> <li>• Faster and more direct access to the images</li> </ul>

### 3.3 Results from FG3

Five Primary Care Physicians (three women and two men) attended this discussion group. Four of them work in the same location and one works in a different one. This group was the hardest to get together to make the group session, due to limited availability and scheduling conflict. Nevertheless, those that were present were very participatory thus giving a positive contribution to the study. This discussion came to the results that are presented in Table 5.

The main issues that dominated the discussion were:

- a. System's evolution;
- b. Limitations / Main problems;
- c. Security and trust in data transmission.

## 4 DISCUSSION

In the analysis of the obtained results we can observe that there are several issues related to this system of teleradiology common to all the Focus

Group: great satisfaction, increased ease of access to this feature of health and the major improvements that brought to the region. These common aspects show the importance that the implementation of this system represents for this region.

Apart from all the positive aspects mentioned by participants of the Focus Groups, all groups showed improvement suggestions. The group of Radiology Technicians (FG1) was even interested and willing to contribute to the progress and further evolution of the system. They also added that the participation of a Radiology Technician is very important in the process of developing and implementing a system like this. Results show that in addition to the dedication that this group has for the success of this system, which claiming to be in a large part in their daily work, another key factor for this success is the age of the elements of this team. Being a young group that lives surrounded by encouraging new technologies helps them achieve more effective results when using a teleradiology system with technological characteristics.

By contrast, some physicians from FG3 reported that they had some problems with the use of the system such as the difficulty of working with a computer.

An important issue that emerged within FG2 was the fact that they would be very much interested in accessing their electronic medical record using a computer or other emerging technologies.

The major difficulty of this study was to bring together health professionals on the same day, same time and keep them in a room for at least one hour, taking into account that there is a big mismatch in schedules and, in this case, with the aggravation of having to move to a different place.

With the patients it was the difficulty to find people willing to participate with time available, and who could move to the place of the meeting.

This difficulty was increased by the fact that it was important the presence of participants from at least two different locations, in any of the groups, as it was a Teleradiology system that was being evaluated.

Another difficulty was that there is not published material available on this specific research that aims to evaluate the satisfaction of the System teleradiology using focus groups.

## 5 CONCLUSIONS

Although the study has not yet been completed and these results are only an initial analysis, which still need further examination, the authors found that all groups were mainly satisfied with the teleradiology system and they felt that it was an important asset for the region.

Moreover, we can infer that it is extremely important not only to know the degree of satisfaction but what leads to this satisfaction and what are the main advantages and concerns regarding the system. In short, it is important to hear those who work and use the system so that, with their collaboration, can be possible to improve further the existing conditions. In this point, the focus group method has proved to be effective and very important for this study because it allowed knowing the opinions and various relevant aspects experienced by all the intervenient such as radiology technicians, patients and primary care physicians.

The authors intend to conduct a second phase of the study, where they will apply structured questionnaires, preferably to the same participants or the same category of participants that took part in the discussion groups. The questionnaires will be used to further explore the issues that came up and were summarized with this preliminary analysis of the discussion groups' data.

One can also conclude that Focus Groups can be interesting method to study other health information systems, where it is important understand the impact of its implementation, use and the satisfaction and suggestions for improvement of those who use the system.

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