Integrating Medical Thermography on a RIS Using DICOM Standard

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SUMMARY

Introduction: Radiology Information System (RIS) is an integrated system, a stand-alone or a component of the Hospital Information System (HIS), which provides patient information of all the medical imaging pictures and reports. This system manages all the workflows on a medical imaging department, facilitating the capture, storing, archiving and delivery of the images. The storage of medical images, in the Digital Image and Communications in Medicine (DICOM) format, is performed by a Picture Archive and Communication System (PACS).
Methods: There is a need of an information system to convert the image raw data, generated by the camera, to the DICOM standard. However, the infrared camera manufacturer does not provide that application. An implementation of software capture that implements the following functionality is needed, read a DICOM work list, which integrates the patient demographic information; updates the RIS when the capture is complete; and archives the captured image to the PACS with all the associated information. All the necessary reporting should be performed in RIS and all the tools to visualize and transform the image should be integrated in the PACS software. Finally, the report created in RIS, and the image in PACS, should be integrated into the Electronic Health Record (EHR).
Discussion: The inclusion of medical thermography in RIS, and subsequently in PACS, is essential for its widespread use in a hospital setting. The usage of the DICOM standard in medical thermography will facilitate the introduction of this modality on all the HIS. The integration of all the systems is fundamental to facilitate the adoption of medical thermography within clinical practice.

1. INTRODUCTION

Nowadays, hospitals host medical imaging modalities with full integration with the information systems available. Such integration is crucial for information availability and for the introduction of new imaging modalities, in order to improve the accessibility. The information systems, available at a hospital, that require this type of integration, are the Hospital Information System, the Electronic Health Record, the Radiology Information System the Picture Archive and the Communications System.
The Hospital Information System (HIS) is the software that supports the patient medical record system and includes numerous additional components (5), such as, billing, patient management (admission, transfer and discharge), and, sometimes, pharmacy management.
The Electronic Health Record (EHR) is the software responsible for the storage of all the relevant patient history and includes a computerized physician order entry.
The Radiology Information System (RIS) is standalone software or a component of HIS software that provides entry, access and storage of patient registration and exam order data, radiology reports and links the patient to associated medical images, & is usually stored on another system (5).
The system also supports the management of the medical imaging department in a hospital or clinic. It allows the generation of a work list for all requested, current, and completed imaging studies, within a given time range. This allows easy access to scheduling data and enables one to tell at a glance the status of a patient in the radiology suite. It also provides access to the exam history and enables access to reports and images on all studies done on that patient. There is a lack of knowledge among healthcare professionals on the analysis of thermal images, so the reporting is essential to stimulate the

usage of medical thermography. The system has all the information of the modalities available at the department.

Picture Archive and Communication System (PACS) is the infrastructure that hosts the technologies that contribute to generate modality worklists, distribution, and archiving of digital images. PACS components typically include the infrastructure needed to communicate with the digital imaging modality or device, an archive device, diagnostic workstations, archive/routing software, and are integrated with the RIS. The system provides the managing and display of images to clinicians in a timely manner, increases the connectivity and the integration between facilities and departments.

1.1 Digital Imaging and Communication in Medicine

Digital Imaging and Communication in Medicine (DICOM) has become the international standard medical imaging. Its influence was critical in the emergence of multi- vendor technical solutions for PACS, and in providing appropriate solutions for the integration with the other information systems involved, especially the Hospital Information Systems and the Radiology Information Systems (1). The adoption of DICOM by thermal infrared imaging is possible (6). All the required capabilities are contained in the standard and hence such an adoption is indeed possible.

Using the DICOM standard for storage, using binary files, a file structure is as follows. The files are divided in two parts, header and data. The header specifies the meaning of the data in the rest of the file and is organised in a tag-like fashion. These tags are called Information Object Definition (IOD). Each of the IODs has a well defined meaning, for example those in-group 8 contain information about the examination and the modality (e.g. TC and X-Ray), group 10 patient information (such as patient name, sex etc.) while group 28 defines the actual image data. In the current version of the DICOM standard there is a modality type TG for the IOD (0008,0060) defined for thermography (2, 7).

Ruminski (6) proposed a method to convert raw data from thermal images using DICOM and XML configuration files. He proposes, the binary file and XML configuration based, offer a basis to establish a full integration of this modality into the standard and to involve manufacturers of thermal cameras into the process.

1.2 Typical medical imaging capturing workflow

A typical medical imaging department workflow requires that the patient demographics are sent from HIS to the RIS. An order is then entered at the EHR and sent to the RIS. After scheduling the radiology procedures at the RIS, the patient demographics, order, scheduled procedure, scheduled procedure steps, and protocol information are made available to the PACS, and then it communicates with the modality equipment by the means of a DICOM modality work list (MWL) message. The images are acquired and then stored in the PACS (3).

A MWL message is a work list protocol that allows PACS to communicate with the modality equipment and automates the entry of patient demographic information for each exam. The communication between the PACS and the modalities is done or by querying the system or is send automatically. (5).

2. METHODS

To facilitate the capture of medical infrared images, software for thermographic cameras must be developed to query and receive the MWL from the RIS. This can be developed as standalone software or a module for an existing system like CTHERM (4) or any software supplied with the camera, developed by the manufacturer. There is also a need for the development of the functionality to convert the raw data from the thermographic camera to the DICOM format and also all the subsequent communication with the PACS infrastructure.

Having all this software in place, there is also a need to develop, with all the major vendors, a plugin for the PACS viewer to help with the specificities that exist on the interpretation of thermal images, such as different scales, and the definition of regions of interest (ROI), as it is done by the CTHERM software.

To complete the workflow there must be a module developed for RIS that could facilitate the reporting of infrared images. This must module can include image-processing algorithms, creating a simple decision support system, that will help the medical thermography imaging professionals to give the final diagnosis on the report.The workflow could be represented as in Fig. 1.

3. DISCUSSION

The guidance provides an easy way to introduce to introduce medical thermography in a medical imaging department, as it does not rapture the existing workflows. This approach provides the medical imaging modality the same level of

integration with the existing systems as the modalities already in use. The reporting of thermography images is crucial to the adoption of this modality in a hospital setting, as most of the medical staff does not have sufficient specialised knowledge to interpret the images.

There is much work to be done with the camera vendors to support the DICOM standard, to least support the MWL and image format conversion, but this is a gap that can easily be filled with custom developed software. As for the PACS vendors, it is a much more difficult task, because they must be convinced to develop plugins or modules to the existing viewers. This is difficult because there are many different vendors, and their software development cycle is so long, that they take the time to implement the required functionality.

Using this approach the usage of medical thermal imaging could be more widespread within a hospital setting, and provide greater value when use in comparison to other modalities.

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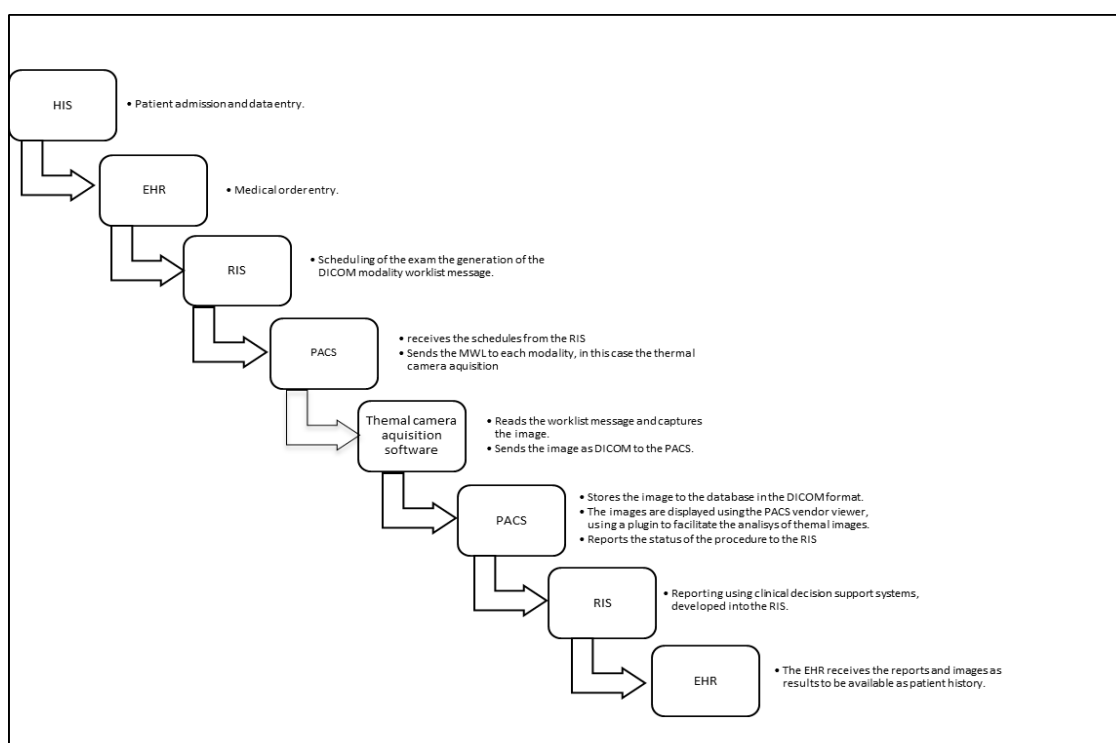jgabriel@fe.up.pt, rvardasc@glam.ac.uk

Fig. 1 - Workflow of the integration of thermal imaging