

## IHE, Solution for integration of information systems and PACS

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### ABSTRACT

PACS is used as a way to store images and matches well with the workflow in the radiology department and can spread to other parts of hospital. Integration with other PACS and other hospital systems like radiology information system (RIS), hospital information system (HIS), and electronic patient records has been completely done, but there are still problems. PACS also provide good conditions for setting up Tele-radiology. The next step for PACS is where hospitals and health care organizations share photos in integrated electronic patient record. Among the different ways for sharing photos between different hospitals, IHE (integrating the health care enterprise) standard indexes the cross-enterprise document sharing profile (XDS) and allows sharing photos from various hospitals even if their PACS has different brands and different vendors.

Application of XDS is useful for sharing images between health care organizations without duplicating them in a central archive. Images need to be indexed in a central registry. In the XDS profile, IHE defines an indexing mechanism for printing and indexing images in the central document registry. IHE also defines mechanisms to be used by each hospital to retrieve images, regardless of storing them in hospital PACS.

**Keywords:** PACS, Radiology information systems, IHE

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### Introduction

In the past 10 years, PACS setup in European hospitals has increased a lot. In many cases, setting up of a hospital patient's electronic record is integrated with PACS. The degree of integration of PACS within the hospital is very variable, some centers have PACS that works as a standalone system and cannot be aggregated with other hospital information systems. Other centers have departmental PACS that is integrated with department information system, such as radiology information systems (RIS). Some PACSs are fully integrated with the rest of the hospital through hospital information system. The general interoperability is one of the most well-known issues in the field of health, informatics activities or enjoying the gains of ICT in the health system in the whole world (1). PACS can be expanded so that it can store any type of medical image and does not just store radiology images. With development of PACS concept that include other images, other departments can also take

advantage of PACS, so better investment performance, split costs between all sectors (2).

Combination of PACS and EPR systems and also launching telemedicine projects provide good conditions to optimize costs. Telemedicine provides health care services for remote sites. It makes the use of medical resources more effectively and volume of work can find a better balance in the region. This needs a single certificate for all patients to allow hospitals to share patient information among all health care organizations. Sharing photos and information of patients provide savings in the hardware and maintenance costs. Telemedicine networks also have other benefits. These projects provide solutions to areas where the point to point communication of data is required. For example, radiologists need to have access to previous patient clinical information and previous experiments to justify their diagnosis. All these needs can be answered easily with regional PACS project.

Unfortunately, setting up and preparing the groundwork for regional PACS is complex, especially when hospitals

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have different information systems and different PACSs. It is very difficult in many cases to integrate the PACS, HIS, RIS and EPR that include full patients' information. In these cases, it is best to use the standards of integrity and follow the integrity recommendations of health care organizations (IHE) (3, 4).

**Medical equipment associated with the PACS system**

- X-ray equipment. If their output is not digital, images has to use digitizer device (CR-Digitizer), and the output of CR is usually DICOM and PACS consistent.
- Medical equipment like CT, MRI, US etc. If their output is not DICOM image, they may be converted by the equipment (Converters) to DICOM format and then be sent to the PACS system.

DICOM images for processing and analysis are the type of picture that is actually a frame from the film; the film has a few frames per second (f/sec) (5).

**PACS controller**

• Controller (observer) of PACS is the main engine of PACS. Controller controls all interactions between departments and database server and archiving system. Images and patient information from imaging devices or a computer with radiology information systems (RIS) and hospital information systems (HIS) are transferred to the PACS controller. After receiving the data, the controller processes them continuously; this process involves the following tasks:

- To extract the text information descriptions from other research and studies.
- To update network management system that is available for database.
- To retrieve the archived comparative images automatically
- To optimize the images automatically (optimal brightness and contrast and right rotation).
- To compare the image data
- To archive images and deletion of pictures from computers
- To do requested archive from workstations or other controllers (6).
- The most important characteristic of controller in cooperation with archive system is completion of all data and system performance. The controller should ensure that the data is not wiped out after receiving from imaging devices. (7) PACS always keeps two copies of an image in different storage locations until the image is not archived in the long-term file. In addition, workstations access to the archive should be as quickly as possible. (7)

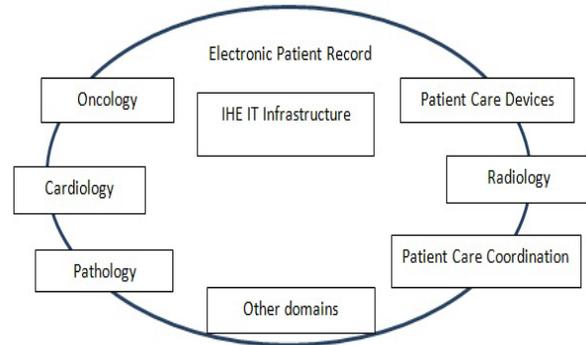
**The IHE integration method**

The IHE is an innovative method designed by healthcare enterprise to facilitate sharing of information. This standard has clouded data for exploration and retrieval, that they are physically and logically separate.(8)

Figure 1 defines a number of domains of the IHE, such as that of radiology, lab, and cardiology. IHE also defines the domain of IT infrastructure (ITI). This domain provides the infrastructure for sharing healthcare information and

defines integration profiles.

**Figure 1.** IHE domains



The consistent time is one of the profiles of ITI that coordinates time across networked systems. The patient's synchronized applications profile allows choosing the patients in a program so that other programs in the same workstation are forced to synchronize with that patient.

The Audit trail and node authentication profile centralized privacy audit trial and node to node authentication to create a secured domain.

The patients demographics query profile allows applications to search the central server of patient information to retrieve patient information. The Personnel White page provides access to workforce contact information for other programs and other personnel. The Cross-enterprise document sharing profile registers electronic health documents, shares between healthcare enterprises, and forms patient electronic health record.

All these profiles are necessary in a regional PACS, but we focus on XDS which provides a document repository to create the record of information about patients with similar clinical domain. Documents are stored in document repositories in a transparent mode and are safe, reliable and permanent. These documents are accessed by actors called by IHE document consumer.

With this method, XDS makes a logical separation between the indexed information, the Meta-data and the actual content. XDS provides a wide range of documents, while there is still a simple and permanent method to list the location of storage and retrieval for clinical use. This allows XDS to share different health care information between health care organizations while it keeps them organized and structured. This logical separation simplifies the addition of an XDS export function to the existing systems and lets them to use Output formats such as PDF, CDA and even simple text format (word) as well as DICOM and JPEG images. On a regional PACS, a PACS archive of hospital acting as a document source provides patient image data to the central registry of the whole region. This PACS archive will act as a repository.

A workstation in every hospital in the region can act as a document consumer, and query the central document registry, making it possible to retrieve images via DICOM

WADO or DICOM.

The basic XDS model has developed to XDS-I model to support certain types of documents like DICOM images. It is important to understand that this profile shares the same central indexing mechanisms as XDS [ 9-11] and differs only in the constraints placed on the stored images. This way we can avoid from doubling the costs of PACS bytes.

### Results

This paper investigated the needs of data sharing between different hospitals in a region. Many Tele-radiology projects that have been formed in recent years have clearly expressed this need. Increasing PACS installation centers and hospital information systems gives us the opportunity to meet this need by additional benefits of sharing the ERP among different hospitals in a regional or national level. IHE with its profiles provides a powerful tool and mechanism to achieve these goals, especially when we focus on the XDS, where all different hospitals in one region can share patient information through the central repository (12-14).

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