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ACQUISITION AND PROCESSING INFORMATION CONCERNING THE RÖNTGEN (X-RAY) RADIATION DOSAGE IN MEDICAL

BY

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Abstract. This paper proposes a method for design and implementation a medical management system for radiation *dosimetry*. The system will acquire information about time and intensity of *radiation from X-rays (Röntgen)* which was absorbed by tissues of each patient. The system conformance follows the *European Norms* and regulations in this area, using the medical IT standards, DICOM and HL7 over TCP/IP, to acquire, transfer and store the radiation data to a central data base.

Key words: DICOM; HL7; dosimetry; X-ray.

1. Introduction

Progress of investigative methods that are based on X-rays, an ever larger of these types of investigations, as well as extending the applicability of radiotherapy in the treatment of tumor diseases have led to increased radiation dose to patients in various situations. It is known that X-rays accumulates biological effects over time. For this reason it is necessary to have a centralized individual radiation dose received by patients.

Information systems and standardizing protocols for transmission of

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information have become an important component of modern medical world. Software helps medical personnel and adjacent institutions to take in medical decisions in a short time and very well reasoned. To use information technology in medical area helps to secure information and its propagation through computer systems in a very short time.

Currently there are no central records to provide information on the amount of radiation to which each patient was exposed. At this time there is a quarterly reporting system on paper, patients who were exposed to X-rays by age and sex (according to the MSP Order 1003 of 2008). This reporting is not effective and does not help the patient.

Even if imaging centers or medical facilities that are equipped with X-ray generating devices have a local database to store information on the amount of radiation to which the patient was exposed, this is not enough for the patient investigation for a specific diagnosis in many medical units and imaging centers that do not have a centralized record of the radiation dose that the patient was exposed. Please note that the dose of radiation to which the patient is exposed and can accumulate to generate a wide variety of ailments ranging from dermatitis to dental abnormalities in malignant tumors.

HL7 and DICOM standards are used as communication support to interconnect software applications that are used in medical facilities, imaging centers, treatment centers, medical equipment or medical public institutions.

2. Data Acquisition

Acquisition of data concerning the radiation intensity and exposure time can be done in two ways namely

a) Automatic acquisition using DICOM standard. Using DICOM standard the information about dose of radiation to which the patient was exposed during imaging investigations can be obtained by reading the data embedded in the image header.

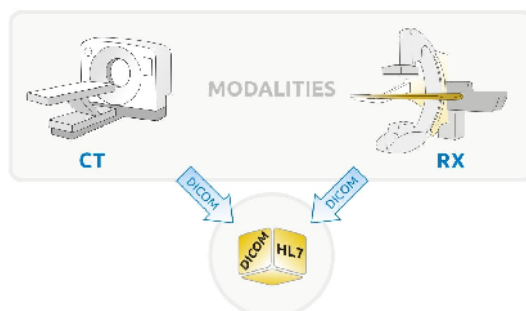


Fig. 1

b) The acquisition is done manually by completing electronically a form by an operator who works on X-ray generating equipment. These data

contain information about patients and the amount of radiation to which the patient was exposed.

3. Data Transmission

The information transmission concerning the amount of radiation received by patients after imaging investigations are done using TCP/IP and using international medical information standards (DICOM and HL7).

Information extracted from the images in DICOM format is processed and converted into HL7 format. After converting the information in HL7 format this one goes to the central server.

To maintain the character of “open application” and no proprietary formats we have chosen to implement a HL7 interface for collecting information from providers of medical imaging centers. By using this interface any developer of any healthcare software companies can develop applications to connect to the server and transmit the information needed to track X radiation doses received by patients during medical investigations. Access to the secure server is based on log-in and using the SSL protocol for encryption.

HL7 messages that are used in data transmission are ADT on the transfer of information from patients and ORU for radiation doses transfer to the patient that was exposed separately for each medical procedure.

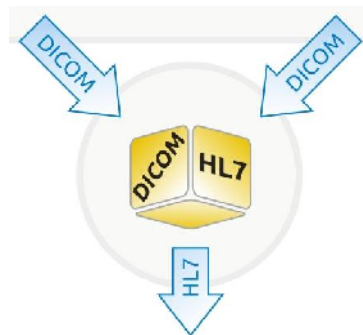


Fig. 2

4. Data Store

Storing data on investigated patients as well as information on the amount of radiation they were exposed are stored on a central server. The database engine used to manage the information is Microsoft SQL Server.

Access to the database is not directly. To enter the information in the database needs to develop a server application compatible with the HL7 standard. This application is utilized for user authentication and processes the receiving HL7 messages that come from imaging centers. The application

server is decoding data from HL7 format and insert information into database. Central server is responsible for database consistencies and concurrent access to the database.

The operation system is windows based server with http and https services installed.

The client application is web based using https or https access depending of security level. A security level access is defined in server. Based on security design we will have “user profiles” defined by group of user rights. Any user should belong to one group of rights. In this way the system will identify the user and his rights to access the resources of the system.

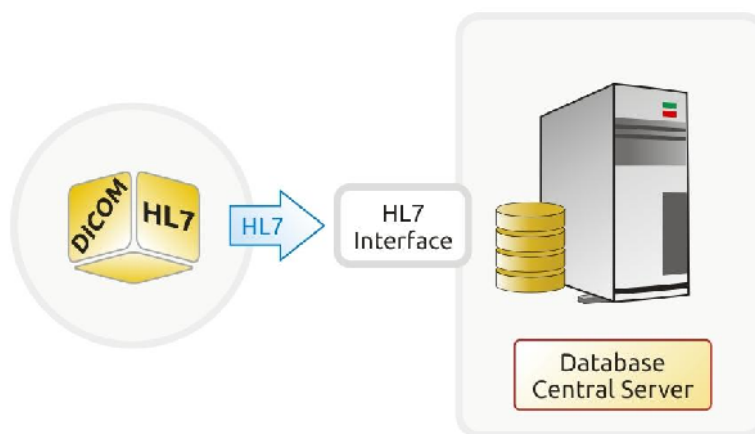


Fig. 3

5. Information Processing

The received information from medical equipment and stored in the database is post-processed and after it generates reports and medical statistics related to information collected on the amount of radiation in medical investigations for each patient over a period of time. The statistics are useful to keep very strict evidence of how much quantity of radiation received any patient and what type of image investigations did he do.

There are two major types of customers that use data stored in the database:

a) Users of the institution and radiation hygiene laboratories in the health system. They need such information for the preparation of studies on the direction of imaging investigation. They keep the information about all X-ray devices from Romania.

b) Users of medical imaging centers can obtain information on the amount of radiation collected up to that point for a particular patient to be exposed to other imaging X-ray generators. Based on this information the user knows how many investigations have each patient in specific anatomical area.

The imaging centers can interrogate automatically the central server, in real time, to find any constraints for current patient.

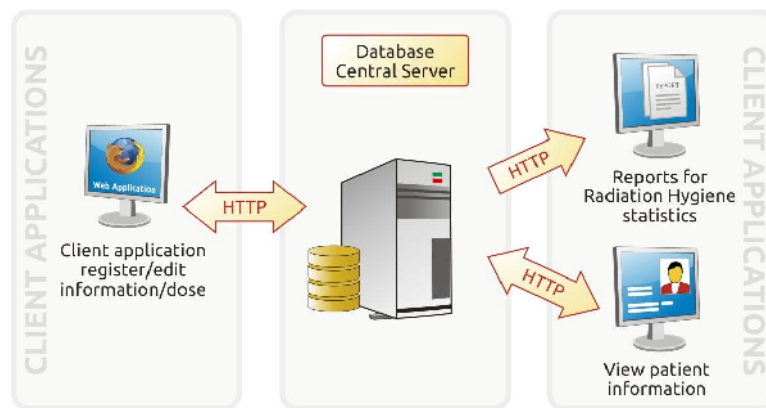


Fig. 4

6. Conclusions

Using software developed from the work in research / development stemming from this project can get a real-time information on the level of radiation to which the patient was exposed and alerts on situations which represent contraindications for patients suffering from certain chronic diseases or pregnant women especially in the first three months of pregnancy when all X-ray investigation method is an absolute contraindication because of the risk of fetal malformations.

From an economic perspective, by implementing solutions the costs related to the operation of medical and administrative infrastructure are reduced. This costs are reduced by eliminating paper, storage and most of the human operator of the current evidence. Streamlining the process of recording X-ray dose by eliminating the hard copy of dosimetry which are completely ineffective at this time because the patient are doing investigation or treatment in many places (medical centers). This benefit is due to the proposed solution to monitor in real time the amount of radiation to which each person was exposed, representing a powerful tool for analysis and human resource management at regional or national.

Romanian health system can provide, for the first time, by implementing this solution, the ability to keep under tight control complex processes taking place in a medical institution or center for diagnosis and treatment. It results

- a) a significant improvement of health services by improving and streamlining activities for patients;
- b) strict control of investigations and X-ray treatments and evaluation their effectiveness on patients;

- c) improved methods of preventing disease and reducing the chances of worsening the disease;
- d) very good coordination of the medical staff to deal with critical situations.

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ACHIZIȚIA ȘI PROCESAREA INFORMAȚIEI REFERITOARE LA DOZAREA RĂDIAȚIEI RÖNTGEN ÎN IMAGISTICA MEDICALĂ

(Rezumat)

Se propune o metodă nouă de proiectare și implementare a unui sistem de management a dozei de radiație incasate de fiecare pacient în urma investigațiilor de imagistică medicală. Sistemul va obține automat informații despre timpul de expunere și intensitatea radiațiilor (Röntgen) la care a fost expus pacientul. Sistemul urmărește specificațiile și normele Europene impuse în domeniul radiațiilor și folosește standardele informatice de comunicație DICOM și HL7 care se aplică peste protocolul TCP/IP. Datele se centralizează într-o bază de date care asigură stocarea acestora la nivel regional.