Improving information flows in bedside radiology activities through an integrated RFID application

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Purpose

Patient identification is a critical issue in order to guarantee patient safety in hospitals. One of the most used methods to avoid patient mismatch and near-miss is the usage of wristbands for all patients. In the UK, for instance, the usage of wristband is mandatory and the information provided are standardized (NPSA, 2009). However, even if a patient has its own wristband, there is always the possibility of a mismatch due to wrong or illegible patient details on the wristband or staff’s reading errors (Svedalis et al, 2009).

In order to reduce this risk and to improve ICT support to clinical processes, the Italian National Cancer Institute (INT) has been developing an RFld-based traceability platform (Sini et al, 2008) integrated to the hospital information system, which includes patient identification with Radio Frequency Identification (RFld) wristbands. The choice of RFld technology is due to its flexibility in terms of readability, re-writable memory, and low infrastructural needs, joined with positive results reached in other hospitals (Tzeng et al, 2007). The introduction of this platform allowed the development of other applications aimed to improve efficiency and patient safety, such as transfusion traceability, chemotherapy administration, staff identification, tissue bank management.

Purpose of this poster is to document the exploitation of the existing RFld and Wi-Fi infrastructure to provide an innovative mobile application to manage bedside Radiology operations through safe and unique identification of patients, x ray plates and staff.

INT 2009 Annual report counts about 6,600 bedside Radiology exams, where 27.5% took place within the surgical room.
Methods and Materials

Methods
First step in the development of the mobile application was to map the standard workflow for INT’s bedside Radiology operations (Figure 1). Thanks to this analysis we were able to identify several critical aspects of the process, grouped in two main scopes:

- **patient identification**: radiologist usually identify patient asking name, surname and date of birth and matching with Radiology exam request (paper document). Patients aren't always awake for confirm, and sometimes there isn't ward staff available for support;
- **phosphor plates management**: before the introduction of the new mobile application, plates were identified with handwritten adhesive paper labels; this implies risk of transcription errors or label damage and, consequently, image mismatch or loss of patient clinical data.

Due to the several critical aspects highlighted, the main causes which can lead to an incorrect association patient-image was analyzed. In order to do so we decided to use the fishbone method (Figure 2).

The fishbone diagram was structured into three main categories (materials, people and methods). Most of the detected causes are related to paperwork (e.g. request forms, plate labelling). It's possible that a colleague does wrong to transcribe a patient's name on a request form, or that a radiologist makes a mistake when copying patient’s data to plate’s label. Moreover, there are causes due to human errors, like wrong selection from the master record during admission in Radiology or from a work-list during image digitalization. For these types of errors it is necessary to improve integration level between ICT systems (e.g. Radiology Information System, Computer Radiography, RFID platform, etc.) in order to avoid patient-image mismatch.

Thanks to the RFID application introduction the bedside work-flow has been reengineered in order to best support Radiology staff with ICT tools (see Figure 3). Every radiologist is equipped with a PDA, to be used to read and write RFID tags. During bedside activity, the radiologist can:

- read information stored in the wristband of the patient
- transfer these information on the RFID tag placed on the phosphor plate
- set the phosphor plate status to "busy", in order to avoid image overwrite (loss of patient clinical data)

When the radiologist comes back to the Radiology unit to digitalize phosphor plates the system allows him to:
• read information previously written on the RFId tag and match images with the right master record on RIS system
• digitalize images
• set the phosphor plate status to "empty".

Materials
The RFId technology chosen for the development of the entire platform is based on High Frequency (13.56 MHz - ISO 15693) passive tags, which allow a proximity reading.

Every radiologist uses a PDA, equipped with a WiFi antenna and an RFId antenna, in order to correctly identify users and patients to be crossmatched with plates.

The application allows to perform the following procedures (see Figure 3):

• "Execute Exam": with this functionality the radiologist can read information from the patient wristband, transfer it to the RFId tag placed on the plate and set the plate status as "busy";
• "View Information": with this functionality the radiologist can read information stored on the RFId tag and match the images with the right master record in the RIS system;
• "Reset Tag": with this functionality, once the image has been digitalized, the radiologist can set the plate status as "empty".
Fig. 0: Figure 1: As Is bedside radiology activities and critical aspects (without RFID application)

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Fig. 0: Figure 2: Fishbone diagram - Plate Misuse / Loss of Patient Clinical Data

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Fig. 0: Figure 3: Bedside radiology activities with introduction of RFID technology

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Results

The fishbone diagram developed (Figure 2) shows the major causes which can lead to a patient-image mismatch, with following loss or mixups of clinical data between patients. With the introduction of the new RFId application, INT was able to reduce the causes of error, especially the ones related to Materials and Method categories (Figure 4). As for People category we were able to avoid transcription errors during the exam execution (thank to the procedure "Execute Exam").

With this application we are able to address problems directly related to the radiologist bedside activity, but the other causes still remain. These are strictly related to the entire process of patient management in Radiology (i.e. request forms, work-list management, etc.) and so, in order to address these problems, Radiology and ICT units are studying further solutions. One of them is the introduction of an Order Management system which aims at digitally manage requests between wards and internal services provider (Radiology, Laboratory, Anatomical Pathology, etc.). Next steps of the solution development are:

- Development of integration interface between RIS and RFId application (e.g. shared Radiology worklist with standard DICOM) in order to automate patient and plate recognition and to avoid selection error in admission steps;
- Refinement of DICOM integration between RIS and Computer Radiography (CR) in order to avoid selection error during image digitalization.
Fig. 0: Figure 4 : Fishbone diagram - Benefits from RFID introduction

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Conclusion

Every radiologist is equipped with an RFId-enabled PDA to be used during bedside activities to safely identify and match patient and phosphor plate. The introduction of the new RFId application helped radiologist to avoid identification errors and patient mismatch during the execution of bedside radiology activities: aiming at block loss or mixups of clinical data between patients.

This innovative application proves RFId technology flexibility in terms of readability, re-writable memory, and low infrastructural needs.

This positive experience lead INT to assess the possibility to extend the usage of this technology to all patients who require radiological exams. As first step all in-patients, at their arrival in the Radiology ward, will be identified through their RFId tagged wristband, they already have received at admission. Next steps in the implementation of the platform will be the usage of RFId tags to identify even out-patients through an RFId personal device (i.e. wristbands, badge or patch).
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