

# Digital Challenges in Radiology

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## Topics

### Human and Technology Interaction.

Information technology and learning reporting systems.

We identify 4 error types.

## Keywords

Patient Safety, Digital Imaging, Incorrect Image Annotation, Patient Identification.

## Introduction

The change from analogue to digital work processes in radiology poses challenges to work organization and not least patient safety. About 6 years ago the Department of Radiology at Bispebjerg Hospital, Copenhagen, Denmark, became a so-called film-less and paperless department with an integrated RIS/PACS and web-distributed images. At the same time the department introduced a comprehensive quality management system, with deviation reporting and corrective action facilities. The Department was therefore in a position to monitor and control the most frequently occurring errors. However, the introduction of new technology brought with it the awareness of new types of errors and patient risk. In our work with quality improvement we have categorized these errors into 4 types. We will describe these error types, their possible cause

and the corrective actions we have taken to avoid recurrences.

## Methodology

The primary methodology used has been the implementation of **quality circle**. This method comprises problem identification, data collection and evaluation, planned intervention and a new data collection and evaluation. The quality improvement system, which was already in place, included a method of identifying and reporting deviations in standard quality. These reports were systematically collected by the quality coordinator, who together with the department management, developed a system to categorize various types of error. errors were prioritized according to the seriousness of their nature and for necessary root cause analyses were carried out. As a consequence the various strategies have been put in place to reduce the risk of these errors occurring again.

To evaluate the effectiveness of these strategies **random sampling** was carried out as well as monitoring of deviation reports.

Conferences have also been arranged with the Orthopedic Department, which is in the Department requisitioning the majority of radiological investigations, in an attempt to reduce the number of errors occurring in examination requisitions.

The total number of errors is not great in comparison with the number of investigations carried out each year, (about 75,000 investigations), but since these errors can lead to serious consequences for patient treatment we believe it is necessary to monitor them closely and to try to eradicate as many as possible.

In 2001 the incorrect annotation of a radiograph of the hand lead to an adverse incident involving wrong side surgery and this has sharpened our awareness of the need for vigilance.

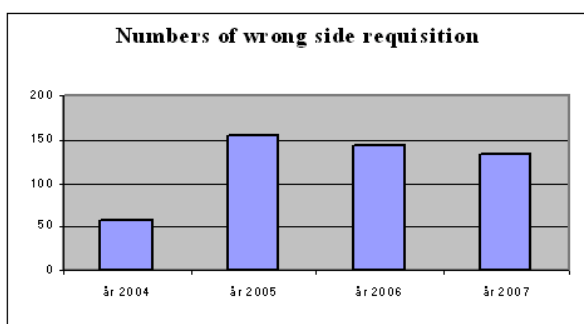
## Results

### 4 Types of Error

1) The most common errors are “wrong side” requisitions. This is where the electronic requisition form contains inaccurate information about which side of the patient is to be radiographed. Although this is a simple error it is not easy to eradicate as the actual causes may be quite complicated and involve workflow problems in other departments.

The actual number of errors may, in fact, be stable but due to the increased complexity of digital procedures the consequences are unpredictable.

**Figure 1**



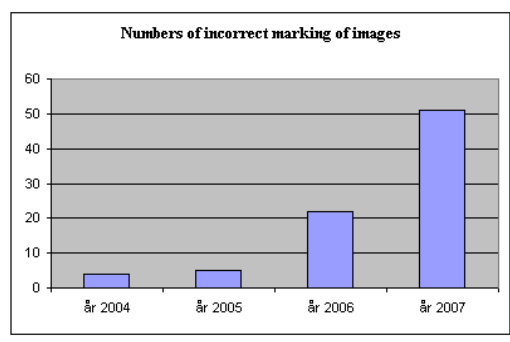
### How do we deal with these errors?

The only effective way we have found of dealing with these errors is to cancel the requisition and ask that a new requisition be forwarded to the X-ray department via RIS (Radiological Information System). This may seem unnecessarily bureaucratic, but our experience has taught us that this is the only

way to guarantee correct information throughout the integrated RIS/PACS/WEB distribution system.

2) The next most common error concerned radiographers' incorrect marking of images. Side annotations (left/right) are often performed as post-processing, after the examination has been completed and sometimes by another radiographer. The annotations are contained in the DICOM image header (which is not a part of the image data) and not embedded in the image data and can therefore be changed during further processing.

**Figure 2**

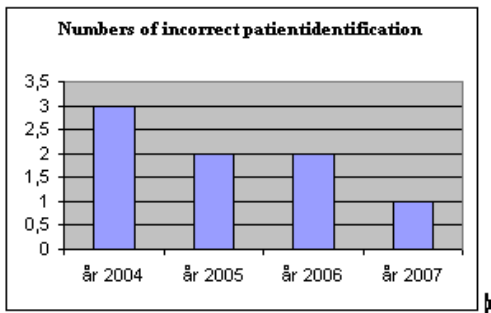


### How do we deal with these errors?

In our department we have established guidelines, which require annotation by lead marker. This means that the radiographer places the lead marker physically on or near the patient, where the likelihood of incorrect positioning of the annotation is minimized. The lead marker is also “burned” into the image data, making it almost impossible to remove or change.

3) The third most frequent error noted by us concerns incorrect patient identification. This is seldom but serious. Because of the paperless environment patient identification becomes more hazardous for the health care staff. Radiographic staff do not have paper forms or labels with which to identify patients in the waiting room and patient identification numbers can be difficult to remember.

**Figure.3**



### **Solution**

We have resolved this problem by installing electronic patient identification screens in each examination room, so the radiographer can see the patient's name and identification number at the same time the patient identifies himself.

4) The fourth error we have identified concerns the manipulation of images after post-processing either by the radiographic staff involved or by other health workers in the X-ray department, which can lead to diagnostic uncertainty. Some of these errors include inadvertent image inversion without a corresponding reversal of side annotation. In contrast to earlier analogue systems, these images can be very difficult to decipher and often result in the patient being re-called for a repeat examination. This is not only a waste of resources for the patient and the department; it also involves an increased and unnecessary radiation dose to the patient.

### **Solution**

In cases of doubt, only the system manager in collaboration with the radiographer directly involved in the examination procedure should be allowed to alter the images.

Our experience leads us to believe that the more complex the IT system is the more prone it will be to these types of errors. The system in our department consists of four integrated and interdependent IT systems and we have become aware that the interface between these systems can be the focus for

some serious quality problems. An example of this can be seen in our type 1 error, where the initial requisition contains inaccurate information about which side of the patient is to be x-rayed. The radiographer in the examination room can in fact alter this information to the correct annotation, but our experience tells us that as the image progresses through various other systems for example PACS and RIS these systems may in fact switch the annotation back to the original incorrect information. The radiographer may not be aware of this, and when the radiologist dictates the examination and a medical secretary later on writes the radiological report they may not be aware that the side annotation is still incorrect.

### **Conclusion**

Our work with quality improvement and radiological IT systems has led us to the following conclusions:

Radiological and digital IT systems can lead to considerable increases in productivity in x-ray departments. They can also greatly improve working conditions for department staff, however it is wise to be aware that the procedures employed in analogue technology need to be redesigned in the digital environment. In particular work-flow needs to be looked at and procedures changed where necessary. When implementing digital technology close monitoring of its effects is imperative.

Staff need to be trained to understand the complexity of new systems and should be encouraged to partake in planning of new procedures. It is only through increased staff competence and understanding that the challenges of digital imaging can be successfully met.

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