Investigation of Misfiled Cases in the PACS Environment and a Solution to Prevent Filing Errors for Chest Radiographs[1]

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Rationale and Objective. The aim of the study was to survey misfiled cases in a picture archiving and communication system environment at two hospitals and to demonstrate the potential usefulness of an automated patient recognition method for posteroanterior chest radiographs based on a template-matching technique designed to prevent filing errors.

Materials and Methods. We surveyed misfiled cases obtained from different modalities in one hospital for 25 months, and misfiled cases of chest radiographs in another hospital for 17 months. For investigating the usefulness of an automated patient recognition and identification method for chest radiographs, a prospective study has been completed in clinical settings at the latter hospital.

Results. The total numbers of misfiled cases for different modalities in one hospital and for chest radiographs in another hospital were 327 and 22, respectively. The misfiled cases in the two hospitals were mainly the result of human errors (eg, incorrect manual entries of patient information, incorrect usage of identification cards in which an identification card for the previous patient was used for the next patient's image acquisition). The prospective study indicated the usefulness of the computerized method for discovering misfiled cases with a high performance (ie, an 86.4% correct warning rate for different patients and 1.5% incorrect warning rate for the same patients).

Conclusion. We confirmed the occurrence of misfiled cases in the two hospitals. The automated patient recognition and identification method for chest radiographs would be useful in preventing wrong images from being stored in the picture archiving and communication system environment.

Key Words. Picture archiving and communication system; medical accidents; patient recognition; digital image.

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The picture archiving and communication system (PACS) has become an increasingly important system for the large number of digital images acquired in hospitals. All of the images in the PACS environment should be stored in the correct locations, such as the proper patient's folder, in the PACS server. However, if the patient's information associated with an image is entered incorrectly or an incorrect image acquisition for the wrong patient occurs, the images will be assigned to a different patient and will not be stored in the proper folder. We call this a misfiled case. Adoption of HL7 and digital imaging and communications in medicine (DICOM) modality worklist (1–6) in PACS environment could be useful to reduce the frequency of misfiled cases resulting from incorrect entries of the patient's information, such as patient identification (ID) number or patient's name. However, these technologies could not eliminate all human errors. Misfiled cases

have been reported in the literature (7); however, details of the causes and frequency of misfiled cases in clinical situations have not been well analyzed. If misfiled cases occur in the PACS environment, failure to retrieve a specific patient's image from the PACS server is likely. Moreover, if radiologists do not recognize misfiled cases in their interpretation of a specific patient's image, they may interpret incorrect images for the wrong patient. Although such serious accidents do not occur frequently in clinical situations, misfiled cases are mainly caused by human error (7,8). Thus misfiled cases in the PACS environment may create serious medical accidents in hospitals. It is, therefore, desirable to discover a misfiled case as soon as an acquired image is transferred to the PACS server and to develop an automated warning system for radiology personnel to prevent subsequent medical errors.

We have been developing automated patient recognition and identification methods for posteroanterior (PA) chest radiographs based on a template-matching technique in which we compare the correlation value between a current PA chest radiograph with a previous one (9–11). The correlation value between a current and a previous image was used for determining the similarity between the two images. Preliminary results obtained with our methods, by use of a database that was obtained from a lung cancer screening program in Iwate prefecture, Japan, were promising for discovering filing errors for chest radiographs (9–12).

In this study, we surveyed misfiled cases in various modalities at the Osaka University Hospital, Osaka, Japan, and those of chest radiographs at the University of Occupational and Environmental Health (UOEH) Hospital, Fukuoka, Japan. In addition, we demonstrated the usefulness of the automated patient recognition and identification method for PA chest radiographs at the UOEH Hospital.

MATERIALS AND METHODS

Survey of Misfiled Cases in Image Modalities in a Hospital

Misfiled cases in various modalities such as radiography, computed tomography (CT), magnetic resonance imaging (MRI), fluoroscopy, angiography, ultrasound, scintigraphy, and radiography in operating rooms and in emergency rooms were surveyed at Osaka University Hospital. This hospital has digital image acquisition devices in most modalities except for mammography; these

were connected with each other by intrahospital networks interfacing with the radiology information system (RIS; PC-RIS (version 1.0), Teijin System Technology Co. Ltd., Tokyo, Japan) of the hospital information system (HIS; PC-ORDERING'97 [R1.7] and MegaOak NEMR [R4.1.12.2], NEC Co. Ltd., Tokyo, Japan). All of the acquired digital images including a computed radiographic (CR) system (Fuji Photo Film, Tokyo, Japan) were available as hard copy on films. Digitally acquired images in the hospital with the DICOM header were stored in each patient's folder in one of the PACS (MegaOak Media Navigator version 3.0, NEC Co. Ltd., Tokyo, Japan) servers based on patient information belonging to an image. When an acquired image was transferred to the PACS server, a potential mismatch between the patient information associated with an image and patient information list in the RIS was automatically examined. If mismatch was found, the mismatch list was recorded for each modality. In addition, there were a few cases in which radiologic technologists or radiology personnel noticed misfiled cases just after image acquisition. Moreover, they compared examination orders with the patient's information of images stored in the PACS server at the end of the day. If they recognized misfiled cases, they reported the errors to an administrator of the PACS server on a daily basis. We accumulated these reports for misfiled cases for 25 months, between March 2000 and March 2002, and counted the number of misfiled cases in each modality. In addition, we investigated reasons for misfiled cases based on reports from staff in the hospital.

A Prospective Study for an Automated Patient Recognition and Identification Method for Chest Radiographs Based on Template-Matching Techniques

Misfiled cases for chest radiographs at the UOEH hospital were surveyed in a prospective study that was designed for evaluating the usefulness of an automated patient recognition and identification method for chest radiographs. The survey was performed between June 2001 and October 2002 for the cases used in the prospective study, but not surveyed for all chest radiographs taken in this hospital. All chest radiographs in the hospital were acquired with the CR system. ID cards, a plastic card that contains a magnetic strip carried by the patient or person accompanying the patient, were used for entering patient information into the CR system before each examination, but the information was entered manually if an ID card was not available. All images were automatically trans-