Automatic Generation of Teaching Files During Routine Clinical Dictation

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THE GENERATION of teaching files within a large university setting is time consuming and disruptive to the workflow of radiology. Yet interesting cases are often encountered during routine reading that are valuable for the teaching environment. A system is presented to allow for the automatic generation of teaching files by using key phrases that identify the case as a teaching file case. No manual intervention is necessary. Each of the teaching files are made available via a web interface immediately after the report dictation is completed.

ENVIRONMENT

The system is a web-based application with the software operating on a Linux server platform. Access to the information is available from Windows 95, Windows 98, or Windows NT (Microsoft, Redmond, WA) web browsers. The acquisition modality transmits Digital Imaging and Communications in Medicine (DICOM) images to the server. Report data are obtained from the radiology information system (RIS) via a picture archiving and communication system (PACS) broker (Mitra) immediately after report dictation and sign-off. Upon receipt of the diagnostic report, the contents of the report are automatically scanned for a configurable key phrase to determine if the study was identified as a teaching file case. If the key phrase is found, the patient information is immediately altered to a designated generic teaching category. Copies of the images and report text are made available via a web interface for review by radiologists and radiology residents. In addition, the key images and report text are available for the radiologists to copy to their local computer for use in applications such as PowerPoint.

KEY ISSUES AND BARRIERS TO IMPLEMENTATION

There are several barriers to implementing this type of system. The minimum requirements are:

- A computer network with modality scanners, the web server and web clients connected to it (local area network [LAN]/wide area network [WAN] or full internet)
- Imaging devices that are capable of sending DICOM 3.0 images.
- A method of entering report data on the web server or transferring it from a RIS
- A method to ensure that the patient images are matched to the correct diagnostic report

The latter is a critical and nontrivial issue in a non-RIS environment where most equipment does not support DICOM modality worklist. Within an integrated RIS environment, DICOM Modality Worklist provides the most robust mechanism for matching image studies with diagnostic report data.

Beyond these basic workflow requirements, each individual user must specify the configurable key phrase to use during dictation to denote a teaching file.

Once all of the functional requirements are met, the system is configured to generate teaching files automatically based on key phrase spoken by the radiologist during normal dictation. This phrase will be automatically identified within the transcribed diagnostic report by the AutoMark feature during a result-processing step. When the key phrase is found that matches the radiologist assigned phrase, the study is marked and sorted as a teaching study.

When a study is identified as a teaching study its contents are copied to a new study and all uniquely identifying demographic information is replaced with generic categories. This includes the patient's name, patient ID, and study accession number. Patient information that is left intact is the patient sex, date of birth, and any other physical attributes that have been captured in the DICOM header supplied by the acquisition modality. One source of concern is the generic use of the study comments field with DICOM. Often, the study com-

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0897-1889/01/1402-1025\$35.00/0

doi:10.1053/jdim.2001.23829

ments field is used arbitrarily by technologists to convey information about the state of the patient during the examination or other relevant clinical information. In some cases, specific patient demographics that could be used to identify the patient are put into the study comment field for routing or matching purposes. The system deployed in this case erased the study comment field. It is possible to leave the study comment field intact. However, that would increase the risk of identifying specific patients by these comment fields.

In addition to simply marking the study for the teaching files, the ability to control the presentation of the images to the audience is important. The radiologist may select images that are particularly relevant to the diagnosis by marking them as "key" images during the dictation by identifying the images in the diagnostic report as well. The same feature that identifies teaching cases can also be configured to identify these key images in the dataset. For example, a radiologist may dictate, "The lesion is best demonstrated in series 2, images 1 through 5." This dictation can be identified by the system and automatically mark the specified images as key images. These images will appear in the teaching file as key to the diagnosis. The text within the report is highlighted to indicate the source of the key image selection.

In addition to specifying which images are important to the diagnosis, it is also possible to automatically apply window/level values to all the

images or select images within the study. This is useful if the teaching file is to be used with presentation software that only supports standard file formats such as JPEG or GIF.

Finally, the study needs to be accessible through some reasonable hierarchy. For the purposes of this study, all teaching files were organized by the imaging modality. So all computed tomography studies were accessible as one set. Additionally users with the proper permissions are able to see all teaching files with a list. It is possible to organize the teaching files in a more fine-grained manner by body part or report coding. However, this approach was not done at this time.

CONCLUSIONS

It is possible to implement a system that facilitates the automatic generation of teaching files through routine clinical dictation. While some training is required, user-specific options make the transition to this system relatively easy. Once the training and system is in place, control of the images and display of the images are done through the same dictation mechanism. Additionally, patient demographic data can be safely removed from the study information. Since the studies are readily available on the web immediately after the dictated report for the study is transcribed there is no additional time required for the radiologist to manage teaching file creation.