Integrated Radiology Information System, Picture Archiving and Communications System, and Teleradiology—Workflow-Driven and Future-Proof

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The proliferation of integrated radiology information system/picture archiving and communication system (RIS/PACS) and teleradiology has been slow because of two concerns: usability and economic return. A major dissatisfaction on the usability issue is that contemporary systems are not intelligent enough to support the logical workflow of radiologists. We propose to better understand the algorithms underlying the radiologists' reading process, and then embed this intelligence into the software program so that radiologists can interact with the system with less conscious effort. Regarding economic return issues, people are looking for insurance against obsolescence in order to protect their investments. We propose to future-proof a system by sticking to the following principles: compliance to industry standards, commercial off-the-shelf (COTS) components, and modularity. An integrated RIS/PACS and teleradiology system designed to be workflow-driven and future-proof is being developed at Texas Tech University Health Sciences Center. Copyright © 1999 by W.B. Saunders Company

THE PARADIGM SHIFT from film-based imaging to digital-data-based imaging requires a reevaluation of radiology operations. Contemporary radiology information systems (RIS) picture archiving and communications systems (PACS)-based radiology systems¹⁻⁵ have evolved considerably from the original systems developed in early 1980s, but image interpretation using PACS is still not generally accepted as the norm due to concerns regarding usability and affordability.

On the usability issue, contemporary systems do not yet live up to the expectations of radiologists by presenting images and/or clinical data effectively. Common problems include the following: (1) Contextual information pertaining to the current episode such as patient's symptoms, complaints, and reason for doing an x-ray procedure is lacking or incomplete. (2) Delays in bringing up a new case, especially when the total number of images in the case is large. (3) The field-of-view provided by the monitor is different from that of traditional view-box station. This makes the comparison between different series awkward and difficult. (4) The previous examination is made available in its original form for the radiologist to review. The radiologist has to spend the same amount of time

reviewing the whole series images in an examination over again to refresh his impression of any previous examination.

Regarding the economics issue, commercial RIS/PACS systems are very expensive. With technologies advancing at an ever increasing pace, a methodology to future-proof the investment is needed.

To address the usability issue, the following approach has been utilized: (1) Contextual information will be retrieved automatically from RIS, and be displayed on the screen when a case is opened, so that the radiologist will have access to all data in the medical record. (2) The display of images can be arranged to consist of two windows: the left window consisting of multiple panes, each of which shows the first frame of the series, and right window displaying frames belonging to the active series. Due to the small number of frames to be loaded initially, the lengthy waiting incurred in opening a new case can be eliminated. If the right window cannot accommodate the whole series, the rolling wheel of the mouse can be rolled back and forth to determine which section of the series shall be displayed. By the same token, the rolling wheel can be used to select the active series in the left window. (3) Provision of flexibility in comparison formats. For instance, a sagittal view series cannot be paired with an axial view series. Consequently, a repertoire of possible pairing series can be prepared before the case is opened. The radiologist can scroll through this repertoire quickly by either invoking an entry or skipping it. The preparation of this pairing repertoire can be refined further by using the specific pairing rule laid out by the radiologist who is currently logged in. Whenever a particular pair comparison is invoked, adjustment is done automatically to compensate for the slice spacing

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difference so that they will remain synchronized in physical space. (4) Provision of a utility to enable the radiologist to tag or even add annotation to frames of significance. At the next viewing, the radiologist can refresh his impression in a fraction of time.

To address the issue of economic return, an open-architecture is proposed to provide a unifying platform, thus enabling the incorporation of industry-standard-compliant, commercially off-the-shelf (COTS) products as modules. The essential ingredients of this approach are: compliance to industry standards, COTS components, and modularity. The usage of COTS components reduces the cost to affordable levels. Compliance to industry

standards avoids the possibility of being locked into the proprietary products of any particular vendor. This not only reduces the risk of losing support from failing companies, but assures a rich supply of alternative solutions from different companies. Modularity enables progressive enhancement of the system by replacing outmoded modules, without affecting other modules in the system. This prolongs the effective usable life-span of any business investment.

At Texas Tech University Health Sciences Center, an integrated RIS/PACS and teleradiology system based on the methodologies described here is being developed. The actual extent of implementation is shown in this demonstration.

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