An Academic Radiology Information System (RIS): A Review of the Commercial RIS Systems, and How an Individualized Academic RIS Can be Created and Utilized

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Current commercial radiology information systems (RIS) are designed for scheduling, billing, charge collection, and report dissemination. Academic institutions have additional requirements for their missions for teaching, research and clinical care. The newest versions of commercial RIS offer greater flexibility than prior systems. We sent questionnaires to Cerner Corporation, ADAC Health Care Information Systems, IDX Systems, Per-Se' Technologies, and Siemens Health Services regarding features of their products. All of the products we surveyed offer user customizable fields. However, most products did not allow the user to expand their product's data table. The search capabilities of the products varied. All of the products supported the Health Level 7 (HL-7) interface and the use of structured query language (SQL). All of the products were offered with an SQL editor for creating customized queries and custom reports. All products included capabilities for collecting data for quality assurance and included capabilities for tracking "interesting cases," though they varied in the functionality offered. No product offered dedicated functions for research. Alternatively, radiology departments can create their own client-server Windows-based database systems to supplement the capabilities of commercial systems. Such systems can be developed with "web-enabled" database products like Microsoft Access or Apple Filemaker Pro.

ACADEMIC RADIOLOGY departments undertake a variety of essential missions. These include research, teaching, and clinical services. Commercial radiology information systems (RIS) focus on the basic tasks of scheduling, billing, collecting charges, and disseminating reports and traditionally have been difficult to modify. However, the newest versions of commercial RIS offer improved functionality and greater flexibility, which can provide new support for the special needs of academic institutions.

The purpose of this report is to evaluate the current state of several commercial RIS with respect to the support that they provide for research, teaching, and quality assurance and the features that they provide for modification of their data structures to adapt to the changing needs of academic departments. We will also briefly discuss how personal computer applications can be used to help meet the needs of academic departments.

METHODS AND MATERIALS:

Questionnaires were sent to each of the following companies: Cerner Corp (Kansas City, MO), ADAC Health Care Information Systems (Houston, TX, now a component of Cerner Corp), Per-Se' Technologies, Inc (Atlanta, GA), IDX Systems Corporation (Burlington, VT), and Siemens Health Services (a division of Siemens Corp, Malvern, PA, formerly known as Shared Medical Systems Corporation). These questionnaires were completed by company representatives or their designates. When possible, after review of the completed questionnaires by the authors, company representatives were contacted for further clarification.

The questionnaires covered the following areas: customizability (the ability to modify data structures of the RIS), data accessibility (the ability to extract data from the RIS), query capabilities (the ability to search for, and report, specific data), internet capabilities, and specific functionality provided by the commercially available product for the purposes of research, teaching, and quality assurance.

RESULTS

Customizability, Query Capabilities, and Data Accessibility

Table 1 summarizes the results of the answers to the questionnaire regarding interfaces to the data in the respective RIS applications, customizability, and query capabilities.

The databases for each RIS supported structured query language (SQL) functionality. All applications supported Health Level 7 (HL-7) and SQL as interfaces to their data.

All vendors provided fields that could be customized by users. However, support for adding new fields to the database tables varied. IDX-Rad did not provide such functionality and we could not determine if ADAC's QuadRIS offered this capability. Per-Se' ProgRIS supported such func-

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Table 1. Features for Customizing Data Structures, Querying Databases, and Interfacing With Outside Applications for Commercial RIS Products

	Cerner	ADAC	Per-Se'	IDX	Siemens
Product Name	Millenium Radnet v7.8	QuadRIS, v6.1	ProgRIS v5.x	IDX-Rad, v10	Novius Radiology v25
Database language	Oracle	Oracle	Oracle	Microsoft SQL 7.0	Sybase
Interfaces to data	HL-7, SQL, application itself	HL-7, SQL, application itself	HL-7, SQL, application itself	HL-7, SQL, application itself	HL-7, SQL, application itself
Customizability					
User-defined data fields	Yes, multiple.	Yes, multiple.	Yes, 60 of fixed types.	Yes, 3-4 fields per module	Yes, limited # of modifiable fields.
User can expand data table (new fields)	In mammography app., not others.	Unknown.	Can add fields, but only accessible thru 3rd party apps	Cannot add to data table.	Cannot add to data table, but will be able to in v26
Customizable rapid data entry capabilities	Yes	Yes	Yes	Yes	Not currently, will be in v26
Can data be entered at time of readout?	Yes	Yes	Yes	Anywhere access to web browser	Yes.
Can SQL queries be utilized?	Yes	Yes	Yes	Yes	Yes
Queries					
Customized searches	Yes	Yes	Yes	Yes	Yes
Searches include customized fields	Yes	Yes	Yes	Yes	Yes
Capabilities for custom reports	SQL editor: Discern Explorer* or Crystal Reports	SQL editor: Oracle's SQL Report Writer, or Crystal Reports	SQL editor: Crystal Reports	SQL editor: Crystal Reports	SQL editor: SQL query system or Crystal Reports
Range of field functions	Full range of Discern Explorer*	Full range of Crystal Reports	Full range of Crystal Reports	Full range of Crystal Reports	Full range of Crystal Reports
Search capabilities	Study type. Subtype & text phrase searches available Q3 2001†	Study type, subtype, text phrases	Study type, subtype, text phrases	Study type, subtype, text phrases	Study type, subtype, text phrases (impression only)
Can query strategies be saved?	Yes	Yes	Yes	Yes	Yes

*Discern Explorer is a Cerner programming environment that includes applications with capabilities similar to Crystal Reports. Cerner reports that the full range of field functions supported by Crystal Reports are supported by Discern Explorer, and Crystal Reports can be utilized with their database.

†Text phrase searches are currently possible through SQL and will be available through RadNet internally in Q3 2001.

tionality, but these fields would only be accessible through applications outside of ProgRIS. Siemens indicated this functionality would be available in upcoming version 26. Cerner's RadNet had this capability only in the mammography module. Only IDX and Siemens indicated that relational links could be definitely created between their products and other databases.

All products offered such query capabilities as customized searches and reports (generally through use of an SQL editor). Searches could also be performed utilizing customized fields and with a variety of statistical and string functions primarily through use of an SQL editor. All companies indicated that their products could save query strategies either inside their own query applications or

by use of an SQL editor (though not necessarily both). Two products, Cerner RadNet and Siemens Novius Radiology, currently do not offer full-text phrase search capabilities of reports. Cerner indicated their product would support searches of text phrases of full radiology reports, and searches for study subtypes, in software version to be available the third quarter of 2001. Cerner reports that an SQL query could be created currently to search a report for a text phrase. Siemens currently can provide text phrase searches of only the "Impression" section of radiology reports.

None of the above companies provide programming services for creating a custom interface solution to a customer's pre-existing, non-RIS, database. While IDX and Siemens both provide data warehousing applications, the Siemens product reportedly is geared for primarily a hospital information system (HIS). All companies indicated that data could be exported via Crystal Reports (Seagate Software, Vancouver, Canada) or a proprietary SQL report writer, which could be adapted for the purposes of data warehousing.

Quality Assurance

All of the companies indicated that their products included user customizable functions for quality assurance data gathering. Several, including Cerner, Per-Se', and Siemens, indicated that radiologists would need to have access to capabilities normally assigned to technologists to use these functions. All indicated that a variety of reports could be generated particularly through the use of an SQL editor.

Research

None of the companies indicated specific product applications created for academic research purposes. However, all companies indicated that studies could be "marked," either through a pre-established "flag" field or through a user-defined field. All companies indicated that their products collected a variety of patient demographic data. The companies cited the previously described functionality for searching for data, creation of reports and customizing of RIS databases as means of creating database solutions for research projects.

Teaching Files/Interesting Case Catalogs

All of the products surveyed included functionality for "Interesting Case Files." Cerner, ADAC, and Siemens products had additional functionality to ease ACR case coding. IDX indicated that an older version, 9x, had such functionality but this functionality had not yet been implemented in the newest version. Per-Se' ProgRIS included a searchable field for storing an ACR code, and a searchable free text field for comments. All companies noted, that through using the previously described flexibility in database design, users could create their own system for tracking cases. None of the companies indicated that they had currently available a product to integrate radiographic images with studies or reports identified as "interesting" or of "teaching significance," though Cerner indicated they expected to have a product available in late 2001 and IDX indicated plans for such future functionality but did not indicate when it would be available. All companies indicated that they could currently integrate radiology reports with images either through a proprietary application or through integration with a customer's picture archiving and communication system (PACS).

Internet Accessibility

All of the companies surveyed indicated that that they provided web-based applications for accessing reports, and facilitating signing of reports. IDX indicated that "all functions from IDX-Rad are available through a web browser," which was probably the most extensive self-reported implementation of web-based technologies according to the returned questionnaires.

Personal Computer Solutions

An alternative to extensive alteration of a commercial RIS is in-house development, by an academic institution, of its own academic database solution. Personal computer database products, such as Microsoft's (Redmond, WA) Microsoft Access and Apple's (Cupertino, CA) FileMaker Pro, now include client-server architectures and Internet capabilities that would facilitate the creation of a department-wide database solution. Their easy-to-use interfaces allow for rapid database development and adaptability to changing department needs. Inexpensive personal computers, including legacy computers, can provide a hardware platform. Such a system can be set up to perform in a stand-alone fashion, as has been utilized in the Department of Radiology at Lyndon B. Johnson General Hospital of Houston, TX, since July 1999

using legacy personal computers (both Apple- and Microsoft Windows-based) and FileMaker Pro. This system acts as a repository for preliminary reports and data for research projects, facilitates gathering of quality assurance data at the time films are read, and allows for creation of teaching files that are linked with images and available over the internet through a built-in web server.

DISCUSSION

Current commercial RIS products offer greater flexibility than ever before. This has been primarily achieved through the use of SQL capable applications, which offer the possibility of integrating personal computer applications and other institution specific applications with commercial RIS products. Additionally, all of the commercial products surveyed offered quality-assurance capabilities and the capability to identify cases significant for teaching purposes. However, a limitation of our study was that the data were acquired through questionnaires directed to corporate personnel, and therefore ease of use of these RIS capabilities by end-users was not directly ascertained.

Personal computer database solutions allow for relatively inexpensive, flexible solutions. However, stand-alone applications require that data be reentered that had previously been entered into a facility's commercial RIS. Given the extensive implementation of SQL capabilities, a more efficient approach would probably involve the integration of a flexible personal computer-based system with a commercial RIS probably through SQL query capabilities or relational capabilities.