Auto-Faxing Imaging Reports to Referring Physicians

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One of the major service issues within Medical Imaging is delivering reports quickly to referring physicians. As an effort to improve service, Mount Sinai Hospital's Department of Medical Imaging implemented Auto-Fax to distribute imaging reports to physicians instead of the postal service. When a report is transcribed and then verified by the dictating radiologist, the radiology information system will automatically fax the result report to the referring physicians if subscribed to the Auto-Fax service. If not, the report will be printed and mailed out manually. A transmission log is kept recording the requisition number, time, date, fax number, number of pages, and transmission status of all reports faxed. The system will try three times to fax the report. If unsuccessful at all attempts, the report will be printed and sent out by mail. Referring physicians are required to sign an agreement that the receiving parties are responsible to ensure transmitted reports are kept confidential. Over 150 referring physicians have signed on for the service. Initial problems with missing cover pages, missing report pages, and reports not being received by physicians have been resolved. A recent survey of physicians receiving reports by Auto-Fax indicate that the service is very popular and has increased the speed with which transcribed report are received. Suggestions for improvement included faxing reports in batches, at specific times of the day, and directly to personal computers. Challenges reported included photocopying thermal paper faxes and sorting reports (for those offices with shared fax machines).

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KEY WORDS: fax/facsimile, automatic fax, Auto-Fax, radiology information system/RIS, Mount Sinai Hospital, Toronto, medical imaging/radiology.

AFFILIATED WITH THE University of Toronto, Mount Sinai Hospital (MSH) is a fully accredited 550-bed teaching hospital, serving the local community and acting as a referral centre for the province of Ontario. The Department of Medical Imaging, with 15 radiologists and 55 technologists, offers all modalities of diagnostic and interventional imaging services, ranging from breast core biopsy to computed tomography (CT) angiography. In the 1995-96 fiscal year, 141,000 procedures were performed including: 75,000 x-rays, 25,500 ultrasounds, 17,700 nuclear medicine, 13,600 mammographies, 9,600 CTs, and 1,400 magnetic resonance imagings (shared facility).

RATIONALE BEHIND AUTO-FAX

The decision to pursue Auto-Fax had many objectives. Briefly, these included: (1) to reduce delivery delays due to postal service (which had been reducing the benefits of the private transcription agency's guaranteed 6-hour turnaround time); (2) to reduce printing and postage costs; (3) to reduce the resources required to manually prepare reports for mailing (dedicated clerk); and (4) to reduce the number of phone calls received in the Film Library requesting verbal reports.

SYSTEM ENVIRONMENT AND DESIGN

All modalities of medical imaging use IBAX's RIM application software, which runs on an IBM mainframe (Model 9672-R22). RIM provides basic radiology information system functions including patient demographics capture/storage, procedure documentation, result transcription and verification, and basic statistical reporting. Imaging modalities were implemented in phases beginning in 1992, replacing previous manual processes. Since the beginning of the RIM implementation, maintenance and extensive customization have been performed by a dedicated, internal programmer. There are currently four IBAX modules in operation: (1) RIM 1.0 (Radiology Information Management)—the main Medical Imaging system; (2) Orders 2.0—the order entry/result reporting application; (3) PM 3.0—stores patient demographics (including name, address, sex, date of birth, health card number) and visit history (including diagnoses, doctors, locations, admission data, discharge data, insurance data); and (4) ADS 3.0 (Application Development System)—development environment allowing screen generation, program coding, print formats, and database access/updates.

Each user has a unique ID and password which are required for entry into the application and

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0897-1889/97/1003-1037\$3.00/0*

restrict access to certain functions. User profiles are stored online in a physician database. Contained in the database are records for both authorized users as well as all physicians who receive result reports from the department. Although this database receives real-time updates from the main hospital information system, it is exclusive to RIM. Radiology users can update and add new physicians as required.

Radiologists dictate reports using Lanier's Voice-Writer 4800 digital dictation system. Off-site transcriptionists remotely access the dictation system for retrieving dictations and RIM for transcribing results. Electronic verification of result reports may only be performed by authorized radiologists. Once a radiologist verifies a result, RIM will execute the logic for printing the result report. It is at this point that RIM determines whether the report should be printed within medical imaging or faxed to the referring physician. This determination is accomplished by using two new fields in the physician database: a fax flag, indicating whether the physician has subscribed to the Auto-Fax service; and a fax number.

As reports are verified, RIM queries the physician database using the referring physician's ID, retrieves the profile data, and checks whether the fax flag is active and a fax number is available. If either the fax flag or number are missing, then RIM tags the report to be printed. If both exist, then RIM tags the report to be faxed. (RIM has also been configured to suppress the faxing of particular procedures' result reports, which reference dia-

grams inserted in the patient's film bag and not currently stored within RIM.)

Once a report has been marked for printing or faxing, it is sent to FormServer (and then Auto-Fax, if appropriate) for distribution. FormServer and Auto-Fax are local area network-based applications that were developed within MSH to provide more powerful document formatting and distributing features. Together, they provide key features of report generation, including: (1) priority printing control; (2) embedded digitized signature; (3) patient demographic attachment; (4) transparent Auto-Fax option; and, (5) monitoring components (i.e., sound alert, paging, fax transmission log).

Figure 1 diagrams the basic system configuration. Please see the Table 1 for more detailed technical specifications.

FormServer receives each report generated from RIM in ASCII text format, organized in two main sections: header and content. The header includes detailed information related to the patient and the report (including printing device name, number of pages, fax number if available, and physician ID). The content is the text of the verified report. FormServer formats and distributes each report according to its priority. Usually, "on demand" reports have a higher priority than normal, verified reports. As reports are received from RIM, FormServer automatically creates a report header with the MSH logo, a footer, and the digitized signature of the verifying radiologist. Patient demographics are printed on each page of the report for more

Fig 1. Auto-fax basic system configuration.

Table 1. Auto-Fax Components

Physician Offices	<ul style="list-style-type: none"> ● standard fax machines or fax modems
Mail Room	<ul style="list-style-type: none"> ● LAN laser printers (HP III or better)
System Users' Interface	<ul style="list-style-type: none"> ● terminals ● PCs with the following software: <ul style="list-style-type: none"> FlashPoint Irma for Windows Windows 3.1
Host	<ul style="list-style-type: none"> ● IBM 390 Mainframe ● RIM
LAN	<ul style="list-style-type: none"> ● SAA Gateway for NetWare <ul style="list-style-type: none"> NetWare Server 3.1× HostPrint for SAA ● FormServer ● FormClient <ul style="list-style-type: none"> WordPerfect for DOS v.6.0b ● Auto-Fax <ul style="list-style-type: none"> FaxServe DOS Client v5.0 ● FaxServer <ul style="list-style-type: none"> NetWare Server 3.1× Cheyenne FaxServe 5.0 MultiTech fax modems (with dedicated telephone lines) ● FormWatch <ul style="list-style-type: none"> data modem 16-bit sound card with speakers

convenient identification, especially when reviewing multiple-page reports.

Auto-Fax, as an additional component to the FormServer solution, distributes reports to remote sites or hospitals via fax. If a report has been flagged for faxing by RIM, FormServer will route the report to another MSH-developed product (Fax-Server) for transmission by one of the two fax modems currently in use. Reports are kept in a queue until one of the modems is free when they are sent out directly to the appropriate destination fax machine. If Auto-Fax is unable to successfully transmit to the destination fax machine, it will requeue the report for transmission. After 10 unsuccessful retries, Auto-Fax will send the report to a printer within Medical Imaging for distribution by mail.

From an information systems point-of-view, the issues of maintenance and troubleshooting are crucial. FormServer was integrated to provide an alert function such that if any one of FormServer's components fails, FormWatch will page the on-call person and sound an alarm in the MSH Data Centre, which is staffed 24 hours a day. In addition to real-time monitoring, Auto-Fax also generates a log for each fax transmission so that users can

verify the status of each transmission on demand. From start to finish, all of this processing is completely transparent to the user.

EXPERIENCES

Before Auto-Fax began, letters were sent to each physician stored in RIM as a referring physician, explaining the new service and inviting them to participate. Seventy physicians initially registered for Auto-Fax; that number has since more than doubled to over 150 physicians. The hospital's ethical and legal policies regarding faxing were also reviewed to ensure that Auto-Fax was compliant.

Between July 1996 and February 1997, over 13,000 reports were faxed to over 150 referring physicians at offices both inside and outside of the hospital. Initially, some problems were experienced with missing cover and/or report pages; in five instances, the entire report was not received. All of these issues have since been resolved.

It is projected that by June 1997, 40 percent of the annual 75,000 reports will be sent via Auto-Fax. Apart from the benefit of physicians receiving reports faster, annual cost savings of over \$26,000 are anticipated, as outlined: postage (\$0.45 each), \$13,500; envelopes and paper (\$0.025), \$750; printer service and ink cartridge, \$1,000; labor (0.40 FTE), \$11,300; Total savings \$26,550.

For the 2-week period of January 3 to January 17, 1997, a total of 3,283 reports were dictated and verified. During the same time period, the following Auto-Fax statistics were logged: transmissions attempted, 929; successful transmissions, 910 (98%); unsuccessful (unable to access physician's fax machine; reports were printed and sent out manually), 19 (2%); partial transmission (missing cover page or report page), 0 (0%); transmission with error (report not received at all), 0 (0%).

SURVEY: PROCESS AND FINDINGS

In October 1996, four months after Auto-Fax began, a user survey was distributed by fax to the 135 subscribing physicians. Sixty-two physicians responded, yielding a response rate of 46%. Of those who responded, 91% rated the service excellent or good. Seventy-two percent reported receiving reports on an average of two to three days earlier with Auto-Fax. Seventy-seven percent said they were calling less frequently for verbal reports.

Suggestions for improvement included faxing

reports in batches, at specific times of the day, and directly to personal computers. Some respondents reported challenges, including photocopying reports (for those using thermal paper fax machines) and sorting reports (particularly if the fax machine is shared by multiple users).

THE FUTURE

Critical to the on-going success of Auto-Fax and resulting cost savings is the incorporation of additional physicians. Following the Auto-Fax survey, another mailing was conducted to physicians still not participating, which resulted in increased enrollment. One option that would enable the department to realize more fully the potential savings of the Auto-Fax service is a policy change stipulating that all reports will be sent by fax. With plans for capturing and storing graphical reports within RIM, these, too, will be available for faxing in the future.

CONCLUSIONS

The experience of implementing the Auto-Fax service taught some valuable lessons. From a quality assurance perspective, a fax transmission log is vital for tracking transmissions and resolving problems. Initial testing and “debugging” of Auto-Fax required significant effort; any institutions considering a similar implementation should be sure to include sufficient time in a project plan for these tasks. Finally, hospital-wide policies regarding faxing confidential patient data should be in place before proceeding with a similar initiative. Auto-Fax cannot resolve all of the challenges related to the timely distribution of results, but it does address many of them.

ACKNOWLEDGMENT

We thank Chris McCabe for his participation in Auto-Fax design and RIM programming, and Huey Ly for the initial design and prototype of FormServer.