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HEALTH IT ADVISORY REPORT

Data Capture: Critical Step in Health IT

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Contents

From Database to Dataflow: New Directions in IT

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ABSTRACT

Data management technology is on the move, fueled by trends both in grassroots popular computing and in high-end research groups. Where we used to think of information technology (IT) systems centered around data *bases*, there is an increasing focus on data *flow*: the complex confluence of data from multiple sources – both stored and streaming – with real-time access for a global community of users. These trends have interesting implications for IT in general and health IT in particular.

DATA, NETWORKS, AND DISTRIBUTED QUERIES

For the last quarter century, institutional IT systems have revolved around databases — stable, reliable, centralized repositories of information. Patient records, billing systems, and online medical libraries are all examples of the centrality of databases in health IT.

Relational database technology was developed by researchers in the 1970s and commercialized in the 1980s. In about the same timeframe, a somewhat different population of researchers was connecting and loosely affiliating disparate computers across the globe; in a federation of systems we now call the Internet.

These two research communities represent very different computing cultures. Early database researchers focused on "transactional guarantees" and "strict relational semantics", with the goal of presenting a reliable, contractually valid model of computing over mission-critical data. By contrast, the Internet designers focused on "rough consensus and running code", with the goal of building a simple, decentralized system that worked pretty well and would be flexible enough to span the globe.

These two viewpoints began to merge in distributed database research in the 1980s and more dramatically in the recent popular rise of document retrieval in the World Wide Web. In both cases, *distributed query* software was proposed to make multiple distributed databases look like one database; in the relational space this is referred to as "data integration" or "content integration" [4, 10], and in web-style document retrieval this is typically called "metasearch" [2]. The vision of distributed query systems is simple: to present users with the illusion of a single unified database, while in fact integrating data on the fly from multiple databases across the globe. In these systems, each user query is translated into a family of queries on multiple databases, with the results consolidated and presented back to the user.

To date, efforts at distributed query systems have proven unsuccessful, at least in the commercial sphere. In both document retrieval and relational data, distributed query solutions have been overshadowed by massive centralization efforts: solutions that fetch *all* the data from multiple systems to one site and build an integrated copy of the databases there. In document retrieval on the web, this is achieved by web crawlers [5] and in relational databases by data warehousing tools [1]. It has seemed, to date, that the technical and political ability to centralize data into traditional IT architectures has outweighed the promise and capabilities of decentralized query solutions. One reason for this is that the distributed query tools have been relatively evolutionary: they attempt to solve the distributed query problem more *efficiently* than the standard centralized solution, but they do not provide significant new functionality to the end user. Since solutions for centralizing data have also evolved in the last decade, the distributed query solutions have not solved a burning problem for any customer.

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MEDICAL RECORDS INSTITUTE

Editor's Note

Kathleen M. Hunter, PhD, RN, BC

Capturing the data we need to make decisions is one of the most critical steps in managing data, information, and knowledge. A variety of techniques are available for this important endeavor, and each approach has its supporters and detractors. In this issue, we do not take a stand on any one technology or method for data capture. Our purpose is to present information for your decision-making.

Joe Hellerstein describes the increasing focus in data management technology on data flow: the complex confluence of data from multiple sources – both stored and streaming – with real-time access for a global community of users. These trends have interesting implications for IT in general and health IT in particular.

Transcription remains an effective and popular method for data capture about physician-client encounters. Some transcription solutions for healthcare enterprises are presented by V. "Juggy" Jagannathan, Scott Friedman, and Tad Davis. They examine current practices and processes and discuss ways in which the transcription process can be improved using emerging Internet-based software technologies.

Direct data entry by the physician is key to a successful electronic patient record. Charles Webster and John Copenhaver write on structured data entry as one technique for capturing physician interest and support. They describe the implementation of three different approaches to structured data entry in an electronic patient record: simple pick lists, default templates, and dynamic tree-based questionnaires.

Denise L. Colwell, Tammy E. Goemaat and their colleagues describe the electronic clinical notes application used at the Mayo Clinic. They provide a history of this application, the implementation experiences, and strategies for ongoing education of a very large user group.

The Association for Work Process Improvement (TAWPI) works to enhance the performance of organizations and strengthen the value of professionals who employ emerging technologies in mail, remittance, document, and forms processing. In this issue, we introduce you to TAWPI and some of their activities.

The Consensus Workgroup on Health Information Capture and Report Generation has released its report, *Healthcare Documentation: A Report on Information Capture and Report Generation*. We are pleased to provide you with an adaptation of its executive summary.

In the Standards Corner, Brenda Hurley updates us on the transcription-related standards work of ASTM's Committee E31.22. This subcommittee on Health Information Transcription and Documentation, established in 1995, has been steadily productive since its inception.

Thank you to those who have submitted articles. Unsolicited abstracts and manuscripts are welcome. As always, I invite your comments and suggestions.

Kathleen

Health IT Advisory Report is indexed in the Cumulative Index to Nursing and Allied Health Literature (CINAHL). Full text articles are available through CINAHL (www.cinahl.com).

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REVOLUTIONS IN THE MAKING

While this evolutionary work has been going on in traditional IT environments, a revolution has been percolating in the background in some very different contexts. This revolution is ongoing at the nexus of database and networking technologies. Here are presented two very different scenarios attracting attention today: one "streetwise", the other "ivory tower". Both point to a future of highly decentralized IT systems that merge the outlooks of the database and Internet cultures.

Peer-to-Peer Systems

If you know anyone under the age of twenty-one years, they can surely tell you about peer-to-peer (p2p) systems for sharing files with strangers on the Internet. These applications are phenomenally popular: according to a Reuters article [8], users swapped 1.81 billion media files in October of 2001.

Like the web, the concept and use of p2p file sharing is attractively simple. You run an application program (e.g. Kazaa, Gnutella, or Morpheus), which connects to the network; the application allows you to search by name for files you like. For example, you might search for files whose name contains a string like "Bach chorale". If you are in luck, somebody else on the Internet is running the same program and has a file they'd like to share called something like "Bach chorale"; this file will appear in your search results and be made available for you to download to your own hard disk. Meanwhile, you can place any files that you would like to share, in particular folders, on your hard disk, and their names will be searchable by others on the network. Most programs have default settings that share a lot of folders on the user's hard disk, which makes the availability of interesting content quite high.

The most famous (and infamous) file sharing application was Napster, which was originally written by teenager Shawn Fanning. Napster was a very simple database of file names with a traditional, centralized client-server architecture: you ran the Napster client program on your machine, and it published your shared filenames to a centralized Napster database server on the Internet; all searches from clients were directed to that database server. Napster was used by many people to share copyrighted files, which led to Napster's much-publicized legal difficulties. Napster's centralized database architecture made it prone to prosecution, since by running the centralized server, they also could be requested to enforce usage policies (e.g., checks for copyrighted material) in the database. In essence, Napster was done in by its traditional centralized, client-server architecture. Another centralized filesharing system, AudioGalaxy, recently underwent a similar fate.

By contrast, the still-available Gnutella file-sharing program is a truly *peer-to-peer* architecture, with no centralized database and no distinction between clients and a server. When you search for a file in Gnutella, your copy of the program finds neighboring machines running Gnutella on the Internet and asks them to search their local files and to pass the search along to their neighbors. This game continues for a few "degrees of separation" from the requestor and eventually peters out when it gets too far from the requestor. When you run a query, you do not necessarily get in touch with everybody in the world running Gnutella, but you often get a surprising breadth of coverage both in terms of geography and content. Since no centralized entity runs the Gnutella database, no individual or organization can reasonably be expected to monitor or enforce everyone's usage policies.

Both Napster and Gnutella represent amazingly popular yet technically simple software phenomena. Recent academic research on *content-based routing* [7, 9, 6, 3] proposes more technologically advanced schemes, which hope to allow p2p systems to be as fully decentralized as Gnutella and as comprehensive as Napster. This research is not targeted at swapping files, though certainly file sharing has been an interesting driver of p2p technology. Rather, content-based routing is intended as a step toward a higher-functionality Internet, in which networks are more than digital plumbing: networks should allow requestors and services to "rendezvous" without regard for shifting physical locations or links. Using this technology, the network itself routes the requests to the relevant services, and both routes and composes the pieces of the responses from each service to form a composite answer in flight. In this vision, the network is simultaneously responsible for data routing and request processing, and the distinction between these two tasks begins to blur. In the end, the network is processing requests over data and looks to the end user very much like a centralized database system. In essence, a p2p network serves as a distributed query engine, owned and operated by no one party and providing the combined functionality of all the participants. Such a vision is attractive in any scenario where any of the following holds:

A single point of failure is undesirable

Centralized storage of content is unacceptable

Centralized monitoring of queries is unacceptable

The first motivation is arguably "evolutionary", since many centralized services today are highly reliable – few applications require higher availability than is provided by today's web services, for example. The second two motivations, while more administrative, are in fact the drivers of the revolution: systems that require these features simply cannot be served by centralized solutions. To date, illegal file sharing is the best example of an "application" that has these requirements: every centralized file sharing scheme has been brought down by the centralized storage of file names and the ability (and negligence) of query monitoring.

Despite the attention placed on file sharing, it is important to note that a number of perfectly legitimate applications have similar requirements. For example, many data providers generate problem #2: they are unwilling to let their databases be copied into centralized databases. This is true for web-based phone book sites, for example, whose contents are not currently accessible to web crawlers or users of search engines. This is also routinely true in large corporations and other enterprises, where getting a "data dump" from a different department involves significant political wrangling and technical complexity (even within a single corporation!). It is certainly true across enterprises: imagine the benefits of data integration across insurers and multiple healthcare providers – this is unlikely to happen any time soon for administrative and political reasons.

Users of many systems impose problem #3: they do not want a single source to be able to monitor their behavior. There is more than one reason for this reluctance. A simple desire for privacy is one reason; another is a potential distaste for having the server change its answers based on who is asking – particularly in systems where the server may not have the interests of the end user in mind (e.g., comparison shopping systems underwritten by vendors).

Similar requirements would seemingly be widespread in health IT. It will likely take much longer for the peer-to-peer revolution to penetrate health IT than file sharing takes, because of the complexity of medical data, the serious political and ethical barriers to sharing information across enterprises in health care, and the enormous financial and technical barriers to replacing legacy health IT systems. Nonetheless, the motivations seem real, and the technology is moving to meet them. It is an issue worth watching.

Wireless Sensor Networks

In a quite different domain, a number of technologists are driving research into ad hoc collections of wireless, "smart" sensors. There is a variety of research on the design and manufacture of these smart sensor devices, which combine environmental sensing capabilities with low-power computers and wireless communication (e.g., radio). For example, the "Smart Dust" project at UC Berkeley plans to deliver devices one cubic millimeter in size, containing a sensor, power supply, analog circuitry, bi-directional communication, and a programmable microprocessor [11]. This class of devices has been proposed for use in monitoring biological systems, seismic activity, traffic, military scenarios, classrooms, and a variety of medical applications. Typically the sensors are made to be deployed in a "many/tiny" configuration, with lots of small, inexpensive sensors being combined to provide significant aggregate information. Note that "any/tiny" sensing is quite common in biological systems – for example, the taste buds on your tongue represent many tiny sensors, aggregated to form a generalized sensory response.

While this hardware is becoming a reality, software researchers are pursuing systems that put these devices to use. The first challenge is to get a tiny operating system running in the processors on these sensors and to get the devices to arrange themselves into a functioning wireless network; this is an active area of research. As this is accomplished, the next realization is that the usage scenario for a network of sensors is quite unlike the current Internet. You don't want to open a connection to sensor #1234567: indeed, that sensor may be out of power or out of communication range. Instead, you'd like to find out about properties of the environment being sensed, e.g., "what is the average temperature in a particular geographic region, and what are the hydration levels of individuals in that region?" In essence, the natural task for a sensor network is to run a query – *the network becomes a virtual database.*

However, a traditional centralized database solution is technically infeasible in wireless sensor networks – there simply is not enough battery power or network bandwidth to pump all the data out of the network and into a centralized computer, and this problem is unlikely to be solved by technology trends any time soon. As a result, there are nascent research efforts at places like UC Berkeley, Intel Research, UCLA, USC, and Cornell to invent power-efficient and communication-efficient algorithms to process queries at multiple nodes *within* the sensor network.

Another facet of sensor networks is the natural usage of a continuous, "live" data stream rather than a static historical database. Sensor network queries can ask about the current state of the stream or about trends in the stream over time. This is a somewhat different usage model from traditional database querying, requiring a new set of software techniques. The "live" nature of the data calls for queries that run directly in the network, precluding the approach of first centralizing the streams in a data warehouse. The topic of querying live data streams is the subject of research at a number of leading academic groups at places like UC Berkeley, Stanford, MIT, and Brown.

As wireless sensor network research matures, expect to see sensing – and biosensing – appearing more frequently in the popular press and in deployed applications.

Common Points

Both of these scenarios challenge the conventional wisdom of centralized IT infrastructure, which suggests bringing all the data into a single database. Peer-to-peer file sharing is decentralized largely because of administrative (one might say social or legal) constraints; sensor networks are decentralized because of the basic technological constraints of the devices. So even though decentralized query systems have yet to revolutionize corporate IT, there are clear proof points – and emerging technologies to back them up – that suggest a decentralized revolution in the works.

In both scenarios, the data exist in a large number of locations, and the queries are executed on the fly within the network, as data are passed from their sources to the origin of the query. The sensor network scenario adds the notion of streaming data sources to the mix. The result is a shift from a centralized database to a collection of data flowing from multiple sources in the network, including both "streaming" and "still" data sources. This *dataflow* revolution promises to knit together multiple databases and live streaming data sources at many scales and locations, creating a more global, integrated information utility.

A common technical challenge in these scenarios is to achieve high-function query processing within a large, unpredictable network fabric. In the case of true p2p systems like Gnutella, the set of nodes in the network is in constant flux as users sign on and off, and the links in the network range from slow modems to high-speed backbones. Wireless sensor networks are even more volatile, since they are subject to unpredictable radio interference and power failures, and the environment in which they exist – sensors for tracking wildlife, for example — often face a messy fate.

Adaptive dataflow is the core technology for managing this volatility for high-function queries. In essence, both the p2p query systems and sensor networks mentioned above are examples of adaptive dataflow technology. In addition, research projects like *Telegraph* at UC Berkeley and *Tukwila* at the University of Washington focus expressly on the question of adaptive dataflow queries. The ideas already have clear niches where they are required. As the technology matures, it will be interesting to see how it propagates and begins to complement, augment, and possibly overturn more traditional IT technologies.

POLICY IMPACT IN THE HEALTH IT COMMUNITY

If health IT is to take advantage of a dataflow technology revolution, a number of interesting policy questions must be faced in the management and use of these systems. To illustrate, consider a concrete scenario related to biosensors. This scenario is intentionally futuristic – biosensors of the sort envisioned here are not in use today. The goal is to highlight some issues that can arise, even if the devices mature in very different ways than what is envisioned here.

It is not terribly far-fetched to imagine tiny biosensors that are ingested or implanted to monitor a patient's blood content at various locations in the body. These can be used, for example, to communicate with implanted bioactuators to perform automated drug delivery; such automated systems have the potential to improve both the accuracy of and compliance with treatment plans. The same biosensors can also be used to communicate fine-grained information about a patient's status to points outside the body, e.g., for distress signaling or for less urgent monitoring.

Many Usage Questions Arise In This Scenario

Privacy and Roaming: A patient's biosensing data are likely to be considered private information, only to be communicated to their own healthcare provider. Yet efficiency dictates a "roaming" scheme much like that for cell phones, in which mobile patients beacon their data to whatever local network can listen; this network forwards their data on to their provider. It is unclear how patient privacy will be maintained in this context. The sensors themselves probably cannot do encryption: it is computationally very expensive and hence likely to drain power too quickly. One possible solution is for these patients to wear a larger outboard computer the size of a deck of cards, which could encrypt all their sensor data, bridging their body network to the external network. Yet even in this case, it is conceivable that other individuals could snoop on a person's body network simply by walking by, bypassing the encrypted signal from the outboard computer. It is not clear how to prevent such snooping or how to encourage the use of these devices given the privacy risks.

Bugs and Hackers: There are legitimate concerns about the reliability of implanted bio-computers, especially given current standards for software reliability. This becomes a particular issue with networked biosensors, which are susceptible not only to flaws in the software and hardware, but also to adversarial modification – i.e., "hacking". It is not clear how realistic such problems are, how well they can be prevented, and how the patient community would perceive such risks. But if embedded computing becomes a reality, there is a real risk of cyber-terrorism and bio-terrorism becoming the same problem.

Patient Aggregation: A potentially very interesting application of biosensors is to measure communities rather than individuals, aggregating readings across multiple people. This can be used, for example, in public health applications that would capture average sensor readings across populations for various health indicators. Interesting questions arise in this context in the tensions between personal privacy, freedom of information, and public health. It is conceivable that aggregated patient sensor information should be treated differently than individual patient information – much as aggregated census data are public even though individual data are private. There are significant gray areas as aggregates are broken down by gender, by ethnicity, by location, and so on. This leads to a thorny set of questions in statistics, computing, and policy.

Data Integration and Sensor Fusion: It is well known that sharing data across enterprises, e.g., between insurers and healthcare providers, is a tricky political and technical issue, often involving significant legal implications. These issues are likely to become very complex with biosensors or even with the (arguably more conservative) idea of universally integrated medical records via p2p technologies. One issue that arises with sensors but is often glossed over in IT is that sensors are *noisy*: they often produce incorrect or partial readings. *Sensor fusion* is the idea of merging results from multiple sensors to get richer, cleaner information. As sensors are deployed widely, sensor fusion should face many of the same policy issues currently faced in data integration.

By no means is this intended to be an exhaustive list of issues — just a hint of some potential complexities. Other issues may well prove more pressing than these as the technology evolves and begins to be deployed.

CONCLUSION

As with most technological developments, the rise of dataflow systems will be a complex mixture of technical insight, the identification of key applications, and the technology's impact on – and entanglement with – social, ethical, and legal issues. There is plenty of room for ideas here from computer science, medical science, healthcare policy, and the general populace. The technology is ripening, and the dialog is due to begin.

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ENDNOTES

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Transcription Solutions for the Healthcare Enterprise

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ABSTRACT

The dictation and transcription process continues to remain central in capturing clinical documentation. In this paper, we examine current transcription practices and processes and present ways in which these can be improved by using emerging Internet-based software technologies.

INTRODUCTION

The essence of the dictation and transcription process can be summarized very simply:

Physicians dictate clinical notes about their encounters with patients.

Transcriptionists listen to this dictation and transcribe the clinical notes into text.

The dictating physicians validate the accuracy of the transcription.

The written clinical notes are made available to whoever needs them and is authorized to see it.

The hospital enterprise perspective of the transcription process is depicted below. Figure one shows a diagram of the transcription process, the actors in it and the life cycle of a transcribed document.

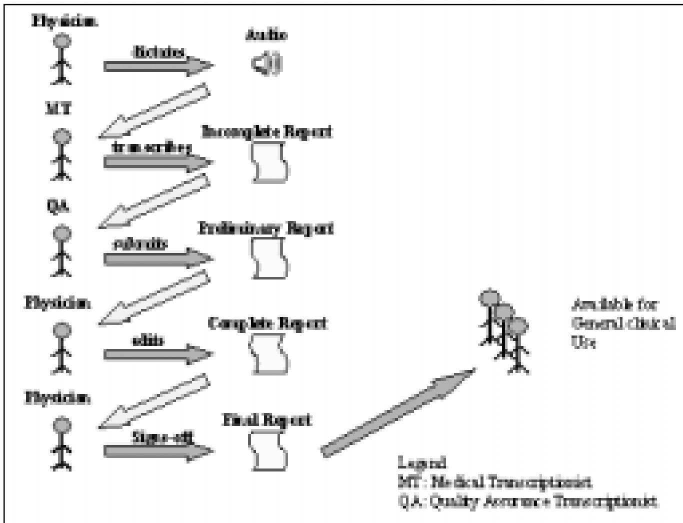

Figure 1: Typical life cycle of a transcription process

The dictation and transcription process has long been an accepted and established mechanism for generating clinical documentation in the United States. With the advent of electronic medical record (EMR) technologies, it was surmised that the dictation and transcription process would be supplanted by more structured techniques supported by current day EMR products. That has not happened. It also has been surmised that speech recognition technologies will eliminate the need for transcription. That has not happened either.

The transcription process continues to be a central process for the creation of clinical documentation. However, the transcription process has evolved, and it is now positioned to deliver structured documentation that can serve the needs of the clinical community in more important ways than ever before. A number of recent technological advancements have made this possible. Perhaps the most central are the advancements in Internet technologies. Internet technologies, such as the HTML/XML (hypertext markup languages/ extensible markup languages) technologies, along with distributed object technologies such as Java, CORBA and .NET, can provide unprecedented improvements in the dictation and transcription process. In this paper, we summarize the improvements these technologies have made possible and summarize their impact on healthcare organizations and transcription service providers. We conclude with an overview of CareFlow|Net solutions, which implements the ideas discussed in this report.

PROCESS SNIPPETS

In this section, we take various process snippets, explain typical current practice, and discuss how Internet-based solutions lead to significant improvements. The approaches presented here are based on our experience in fielding solutions that use various Internet technologies including Java, CORBA, DCOM, ActiveX, and HTML/XML. We focus on the savings that are possible by adopting various technological innovations and solutions. The cost of acquiring such solutions is balanced with the savings and improvements realized. The analysis presented here is for illustrative purposes only, to guide the reader in understanding the implications of adopting various technology solutions.

Printing and Routing

Current practice: Typical transcription departments and/or transcription service companies use a manual process to print transcribed documents. Typically, remote transcriptionists have to transfer the transcribed files to a central location (either manually or using a file transfer protocol [FTP]), and a clerical person is employed to retrieve and print these documents. MS Word and WordPerfect are the typical document formats used for this purpose. The physical routing is manual, using courier services.

Improvements Possible: Using client-server technology and the Internet's communication infrastructure, it is possible to submit and transfer documents from anywhere as soon as the document has been transcribed. Server-end software can be designed to recognize the availability of new documents and automatically print the documents at specified locations such as a particular ward, a printer at a hospital medical records department, or anywhere.

Savings: A typical transcriptionist, in an eight-hour period, may transcribe thirty documents. If a clerical employee were used to manage the printing, it would take an average of two to three minutes to open each document and print it. With automated printing, an hour of clerical help can be saved in a day. If there are eight transcriptionists in a group or service, the clerical worker position can be eliminated. If we assume that the average amount of time it takes to deliver a batch of documents is one hour and that in an eight-person transcription group there are at least eight locations to deliver reports, automated routing eliminates the clerical help involved in dispatching and delivering documents. In short, automating printing and routing can result in the elimination of two clerical positions, with potential savings of over $30,000 annually for a small group of transcriptionists. In addition, the customers are going to be more satisfied, as their documents are made available sooner than before.

Faxing

Current practice: Documents that need to be faxed to specific physicians or physician groups at various locations are identified manually. Most transcription groups store their local files electronically and, when called upon to fax a file it to a specific person, will tend to print it, stamp it as "Temporary" or "Preliminary" or with other such caveats, fill in the fax number and fax face sheet, and then fax it. If the fax fails to go through, someone will have to try to re-send it later. The above process can take as much as five to ten minutes per document.

Improvements Possible: With current software, the faxing process can be completely automated. In addition, with some intelligence built into the faxing process, support for specific practices can be provided. For instance, if a particular physician likes to receive faxes in the clinic in the morning and at the hospital in the afternoon, the software can be set up to fax documents to a user where the user is currently located.

Savings: Depending on the fax volume, the savings from this process can mirror or exceed the savings in printing.

Report Management

Current practice: In manual management of the transcribed files, most organizations adopt some form of a naming convention and a directory hierarchy structure. For instance, they might create a directory for each date and each transcriptionist. The reports may have patient names in them and additional information, such as report type. Hence, the process of saving a transcribed document involves going to a specific directory and naming the file based on the conventions the organization has adopted. On average, this process adds at least a half-hour a day to a transcriptionist's efforts. In addition, depending on the policies of the group, reports are constantly being added and disk space use must be monitored and managed on an ongoing basis by each and every transcriptionist.

Improvements Possible: Centralized management of the reports using current relational databases can significantly reduce management headaches.

Savings: Eliminating the report management headaches will allow the transcriptionists to be more productive and allow them to use the time freed more productively – to transcribe additional reports. If a transcriptionist is able to do two more additional reports each day, and if we assume that each report generates $3 of revenues, one transcriptionist can generate additional annual revenue of $1500 (250 work days x2 extra reports x3 dollars). For the sample eight-transcriptionist group discussed before, the additional revenues that can be realized will be $12,000 annually.

Handling Special Requests/Report Search

Current practice: When someone requests a particular report, finding the report requires a manual search using date and/or patient name as pointers. If the request for the report is not based on the elements used for the file-naming convention — for example, dictated by a particular physician — multiple reports will have to be manually examined before the correct report is identified. It is not unusual to get four to five requests daily in a service that uses about eight transcriptionists. This manual process may cost an hour of clerical time on a daily basis.

Improvements Possible: The centralized management of reports using traditional relational databases, coupled with proper indexing of the reports, can radically reduce the time to find the report from ten to fifteen minutes to a minute or less. Also, if the users of the transcription service have direct access through web browsers, and the appropriate privileges, they can directly search and retrieve the reports they need without any help from the transcription group.

Savings: The dollar savings for the transcription group could be a few thousand dollars annually, but more importantly, the customers (clinicians) are going to be happier, as they can directly access the reports they need, on demand. The quality of care provided to patient improves significantly – the impact of which is incalculable.

Transcribing the Dictation

Current practice: Typically, at the start of the dictation, the transcriptionist picks a template (which may have significant portions pre-filled with non-varying data, e.g., "normal chest"), listens to the dictation, and transcribes it. The physician typically provides patient identifying information. The transcribed report, in addition to patient identifying information, also needs one or more physicians identified — such as referring physician, attending physician, ordering physician etc. All of this information is manually entered. Also, if the spelling for the name of the patient is wrong, this error can make it difficult to retrieve the report later, particularly if the naming convention for storing the files relies on the name of the patient.

Improvements Possible: With integration with registration, ordering, and dictation systems, the patient demographics and physician demographics can be accessed over the intranet on demand and used to automate the pre-filling of documents with dictation-specific information. This not only relieves the transcriptionist of typing this information but also makes the information in the reports more accurate.

Savings: The time savings and improvement in quality of the reports can be equated to productivity gains for the transcriptionist. Even one additional report that can be transcribed every day due to such gains equates to additional revenues of $6000 annually for the sample transcription group. Also, inaccuracies in the transcribed report – such as the wrong medical record number or the wrong patient name can adversely impact patient care, which has a significant cost to the healthcare entity involved.

Management Reports

Current practice: Tracking the transcriptionists' work in terms of how many reports, how many lines, and for which physician are all essential parts of managing a transcription service. Typical practice here is for the transcriptionists to log their activity (for their own purposes as well as for management). Such logs typically contain, for each transcription, the identity of the person whose dictation they transcribed, patient identifier, date and time of transcription, work type, and other information that the service would like to track. These logs typically are handwritten in a notebook and later entered either in a spreadsheet or, in some instances, into consumer oriented databases, such as Microsoft Access. Reports are generated from the log data recorded in the spreadsheet or database. Others write various scripts to go through transcribed documents and generate needed numbers.

Improvements Possible: These kinds of logs and scripts can be completely eliminated by using the centralized report management software with indexes discussed before. In addition, use of appropriate word counting packages and standard report generation packages that work off of relational databases can provide all the reports the management needs, without any specific logging by the transcriptionists.

Savings: The transcriptionist with the process above can save as much as a half hour on a daily basis. This translates to additional revenues of about $12,000 annually for the transcription group in our example. In addition, some of management staff time is going to be saved as well.

Sign-off and Deficiency Tracking

Current practice: Typically, signing of the reports is a manual process. The stack of reports to be signed is presented to the clinician who eventually signs them. One of the big cost drivers in this process is that medical records departments spend significant energies tracking which reports have been signed and which have not been signed. Since signing is frequently tied to payment of the services rendered, the medical records departments are constantly and manually following up with clinicians to get the reports signed.

Improvements Possible: Client-server technologies enable transcriptionists to make the reports available to the clinicians electronically. Clinicians can be presented with an individualized work queue of reports that they need to sign. The software solution also needs to support various scenarios such as when a physician goes on vacation, when one physician can sign for another in a group practice, etc. Using public key/private key technologies and digital signatures, the above process can be made very reliable and secure — a HIPAA requirement. When reports are not signed in a timely fashion, automatic notifications can be sent to the appropriate clinicians.

Savings: With an automated system, deficiency reports are always available online – the system knows at all times which reports are signed and which are not. Notifications can be done automatically. This can result in substantial savings to the medical records department. If a physician dictates, say, five reports a day, and the medical records department spends five minutes to determine compliance with each report, this translates to thirty minutes a day per physician savings in time to the medical records department. If there are sixteen physicians supported by this group, the savings translate to eight hours per day, or the reduction by one clerical person from the medical records department. This may translate to savings of $15,000 annually for this sample scenario.

Access Control and Security

Current Practice: With the heightened emphasis now being placed on security and confidentiality, it is important to examine practices that can potentially compromise patient confidential information. Current practices are based on trust and contractual guarantees that the transcriptionists will not divulge information gathered during the transcription process. Hospital staff and medical records personnel have similar strictures. Physicians and other clinical providers have traditionally been accorded unfettered access to patient confidential information. This has worked in practice, as this ensures that those who do need access to that information do have the access necessary. In essence, the current practice of access control is based on trust. Abuses to trust do happen, and patient confidentiality can be compromised easily.

Improvements Possible: With the advent and use of Internet technologies in health care, the potential for harmful dissemination of patients' confidential information has indeed been raised. To counter that, a variety of security technologies are now practical. In fact, these technologies are routinely being used in e-commerce solutions. Intranets using virtual private networks, the use of smart cards for provider and personnel authentication, and the use of public key/ private key infrastructures are all possible now. In addition, through the specifications standardized by the Object Management Group (OMG) Healthcare Task force on Resource Access Decision (RAD) facility, there are now solutions for fine-grained access control for patient confidential information.

Savings: The savings here will have to be measured in terms of lawsuits avoided and possible reductions in insurance premiums afforded by using proper security technologies.

Integration

Current Practice: Typically, service-oriented companies do very little integration. Hospital transcription groups may have some messaging based integration – usually based on the HL7 standards – to the registration and ordering system. Transcribed reports are typically uploaded into EMR products.

Improvements Possible: Instead of using messaging to duplicate the registration information in a transcription system, on-demand access to patient demographics and registration information through, for instance, the PIDS standard from OMG Healthcare Task Force, will ensure current information on patient demographics. A similar approach is possible for accessing order information as well, though currently there are no standards for this. Also, avoiding the duplication of copying the reports into some other system, the transcription server software can provide on-demand access to the transcribed reports as part of its report management functionality.

Savings: Duplication of any information costs the organization. In a typical hospital, one can generate in one day over 1500 HL7 messages from the registration and ordering system. These messages can have updates to various demographics elements, patient location, order information, etc. There is a processing cost of all these messages. Though each message may be only 1K or 2K long, a significant amount of processing is needed to update databases based on these messages. This step is entirely eliminated if a PIDS solution is employed, and the server can be made more available to on-demand access. More importantly, every time the message sending system or the receiving side goes down and comes back up again, a system support person must ensure that all of the backend processing comes back up and is working in the appropriate fashion. When a merge happens in the registration system and if the information is duplicated elsewhere, the merge needs to be processed in the duplicated system. This is either automated or is manually done. Either way it costs in terms of system support or development support. Roughly 5% to 10% of a system support person is needed to ensure proper operation of every messaging interface. This means a savings of $10,000 in support costs for every interface that is eliminated. Eliminating the need for an interface engine to simply duplicate information in one system in another can save well over $100,000. The key is to provide standard interfaces for registration information, order information, and reports. The OMG Healthcare Task force is in the process of standardizing some of these interfaces.

Voice Recognition and Transcription

Current Practice: Though the use of automatic voice recognition is on the rise, the use of this technology is focused on niche markets and clinicians willing to take the time and effort to make the process work for them. The recognition rate varies from 80% to 95%, depending on a number of factors from availability of specialized vocabularies to training sample sets to the sophistication of the voice recognition engines. Regardless of the recognition rate, almost all automatically recognized text needs to be edited to assure the quality and correctness of the documentation.

Improvements possible: It is possible to improve the efficiency of the transcription process by incorporating voice recognition technology. If the automatically generated text is provided as a starting point to transcriptionists, they can basically serve as editors instead of transcribing from "scratch".

Savings: The primary savings is in time that the transcriptionists need to spend in transcribing. A 50% improvement in productivity would imply that the transcriptionists in the same eight-hour period could transcribe 50% additional reports. So, as in our example before, if the transcriptionist normally transcribes 30 reports, one can expect an additional 15 reports to be completed in the same time period. Using the same set of metrics, $3 in revenues for each report and 250 workdays in a year, this translates to additional annual revenue per transcriptionist of $11250 (250x15x3). If we assume the eight-person transcriptionist group, this translates to additional revenues of 8x11250 = $90,000 annually for the transcription group. If the productivity gain is only 25%, the additional revenues realized are $45,000 annually.

Data Mining

Current Practice: Transcribed reports, representing typically 90% to95% of all clinical records for a patient, are a rich source of information for clinicians, from treatment to research. However, the potential for using the information present in such documents is seldom realized, as the form in which this information is available currently is not conducive to automatic processing.

Improvements Possible: Incorporating any structure as part of the transcription process can enable data mining. Use of standardized templates during the transcription process and employment of data structuring representations, such as XML, are possible now. Using evolving standards for capturing document content, such as the HL7 Clinical Document Architecture (CDA), cannot only help in the short run to make information available in standardized representations, but it can also provide a long-term storage of information in a neutral format, facilitating longitudinal studies.

Savings: Having structured information available that can be processed automatically by programs instead of manually can provide innumerable benefits. It can be used to automatically notify appropriate persons on the availability of certain abnormal clinical findings – say to a practitioner's WAP-enabled cell phone! It can be used to filter patients used for clinical studies. It can be used to assess the efficacy of certain treatment paradigms. In fact, this has been the holy grail of the electronic medical records community. Depending on the amount of structure that is possible to encode as part of the transcription process, varying amounts of these benefits can be realized in practice.

CAREFLOW|NET SOLUTION

CareFlow|Net's enterprise transcription solution suite adopts a unique component-based, *n*-tier architecture that leverages Internet technologies and standard web infrastructures. A simple view of the dictation/transcription system diagram based on CareFlow|Net solutions is shown in Figure 2 (below).

The below figure tries to provide a sense for all the different modes in which the document created using the dictation/transcription process is made available for clinical and billing use. In the below figure, CTS stands for Careflow Transcription Suite – a fully functional, high productivity platform for transcriptionists working from anywhere (home, office, hospital); CCS stands for Careflow Clinical Suite – a web-based access and management system for transcribed documents for clinicians; and CDK stands for Careflow Development Kit – an Internet-based server module.

The component-based architecture has served us well in supporting a wide variety of customers' needs and has helped us realize the benefits identified in the sections above. In particular, the transcription solution has been deployed with the following types of customers:

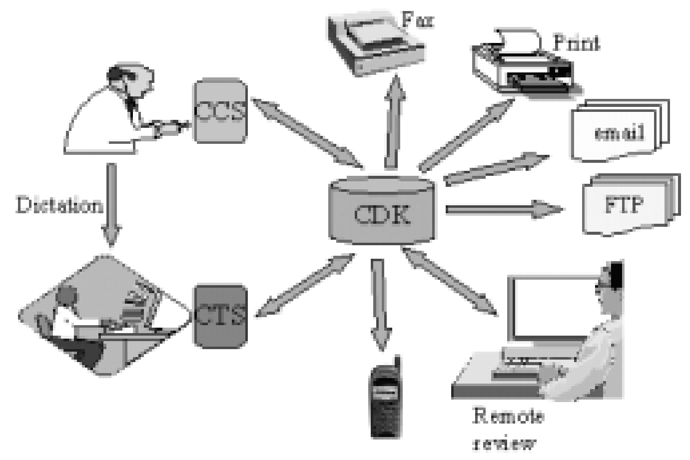

Figure 2: Simple view of the Dictation/Transcription System

Small hospitals with teams of transcriptionists working to produce a few hundred documents per day that get automatically emailed, printed, or electronically delivered to whoever needs to see it.

Transcription service providers who hire hundreds of transcriptionists who work from home and all over the US and other countries to produce documents for delivery all over the US

Application service providers (ASPs) who use the same software to serve the needs of multiple transcription services or hospital customers.

In short, the component-based *n*-tier architecture provides enough flexibility to deploy solutions for a diverse customer base and diverse business models without any change in the software deployed.

CONCLUSION

We have presented various process snippets as they relate to the dictation and transcription process automation. The ways in which such processes can be improved have also been presented along with the resulting savings possible. The approaches and solutions presented here are representative of the state of the art and practice in this industry. We also provided an overview of CareFlow|Net's solution that makes it possible to realize the benefits of transcription process automation.

ENDNOTES

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Structured Data Entry in a Workflow-enabled Electronic Patient Record[1]

Charles Webster, MD, MSIE, MSIS[2]

John Copenhaver, MD[3]

Direct data entry by the physician is key to a successful electronic patient record (EPR), as noted in a well-known Institute of Medicine study [1]. Approaches to direct data entry include typing, speech recognition, and structured data entry (SDE). Typing is not an efficient use of physician time since most physicians are not fast typists; speech recognition has not yet been perfected to the point that speakers do not have to proof their own work. Both generate free text that can be difficult to validate and analyze. In contrast, structured data entry is faster than typing and its structured output is easier to manipulate than free text.

Generating structured data requires the imposition of precise structure and meaning on collected data. Such data are easier to aggregate (important for clinical research such as outcome studies), easier to transport (in the sense of transferring specific data between applications), and more appropriate for driving the automated performance of patient-specific tasks such as alerts and protocols.

We implemented three different approaches to structured data entry in an electronic patient record: simple pick lists, default templates, and dynamic tree-based questionnaires. Pick lists are sufficient for recording routine encounter assessments and treatments; templates handle physical findings well; dynamic questionnaires deal with more complex data such as subjective historical information. All are user-customizable.

What makes our approach to structured data entry distinctive is its advantageous combination of workflow automation and touch screen data entry. Workflow automation (workflow) mitigates an important disadvantage of structured data entry: the need to navigate complex hierarchies of selectable items. And touch screen technology, in conjunction with large, colorful (read "easy to hit") buttons and icons, further increases the speed of data input.

The EncounterPRO application relies almost completely on structured data entry to capture information. The main exceptions are "escape route" text boxes that allow typing of free text or voice-to-text speech recognition (where a user has chosen to install speech recognition software—only a small minority typically chose to do this, and most of them eventually customize existing pick lists to contain frequently spoken phrases).

The described electronic patient record is currently in use by over a thousand users at almost a hundred sites.

STRUCTURED DATA ENTRY SCREEN TOUR

The following tour of screens illustrates and emphasizes a structured data entry approach applied in the context of workflow and touch screen technology. These are not the only screens, but they are either core to the application or are representative of particular data entry approaches. For completeness, three non-data entry screens are included because they perform important navigational and summary functions that, in a sense, glue the rest of the structured data entry screens together.

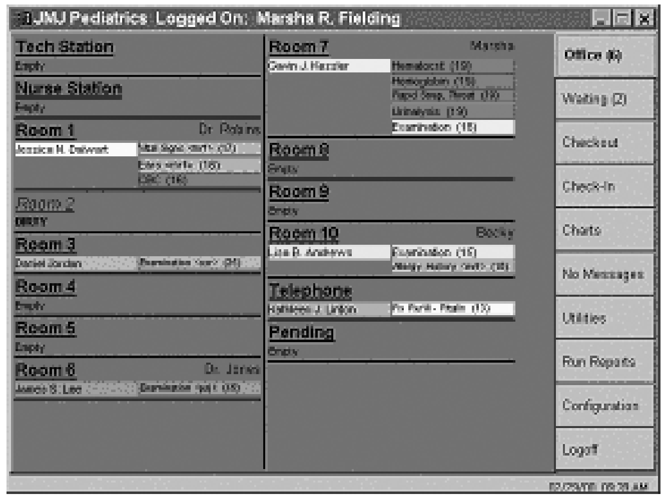

Figure 1. Office Screen: Summary-navigational function

While the office screen (Figure 1) is not an example of structured data entry per se (it performs summary and navigational functions), it does illustrate one of the very useful qualities of a workflow-enabled system: a bird's eye view of all activity. Displayed and constantly updated are the names and locations of patients, pending SDE screens for that patient (for example, examination, vital signs, specified tests, and immunizations), and how long the patient has been waiting (shown by the number of minutes in parentheses). The screen also shows—through color-coding—the person or role responsible for performing data entry.

The office screen is live: touching a task bar takes the user to that data entry screen. For example, touching a "vital signs" colored task bar takes the user to the vitals data entry screen.

EncounterPRO uses a workflow engine, which executes workflow rules, to determine the order of presentation of screens used for structured data entry. For example, if the nurse or technician enters his or her code while in the exam room with the patient, the vitals screen (Figure 2) automatically opens. This is an example of how workflow can perform some of the navigational work of finding the right SDE screen.

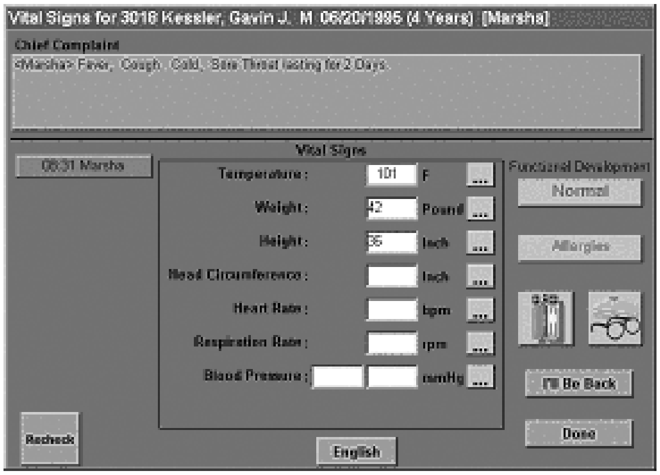

Figure 2. Vitals Screen. Structured data entry-navigational function

The vitals screen combines numerical data entry with navigational buttons that lead to other navigational and data entry screens. The vitals screen is configurable to the preferences of the practice. The chief complaint screen (Figure 3) is the first example of data entry based on pick lists. In this case the phrase "Complete Exam, Cough, No Chest Pain lasting for 7 days." is generated with six touches of the large buttons: 1. "Complete Exam";

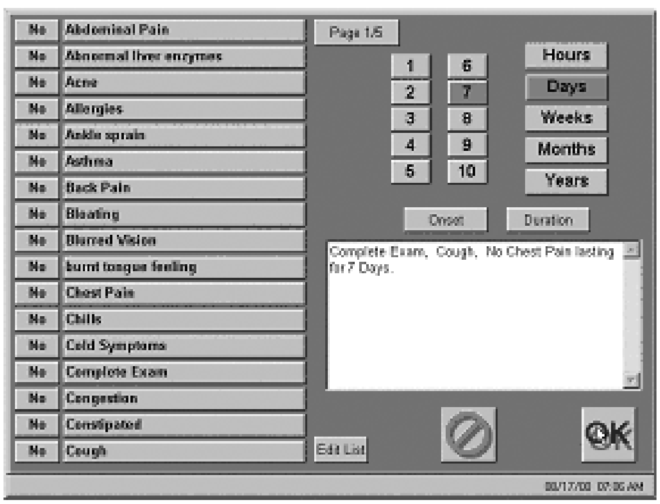

Figure 3. Chief Complaint Screen. Structured data entry function

2."Cough"; 3 "No" (next to "Chest Pain"; 4."7"; 5 "Days"; 6."Duration".

Further text may be entered using the keyboard or speech recognition. However, most users select the "Edit List" button to modify personal pick lists to include frequently typed or spoken phrases.

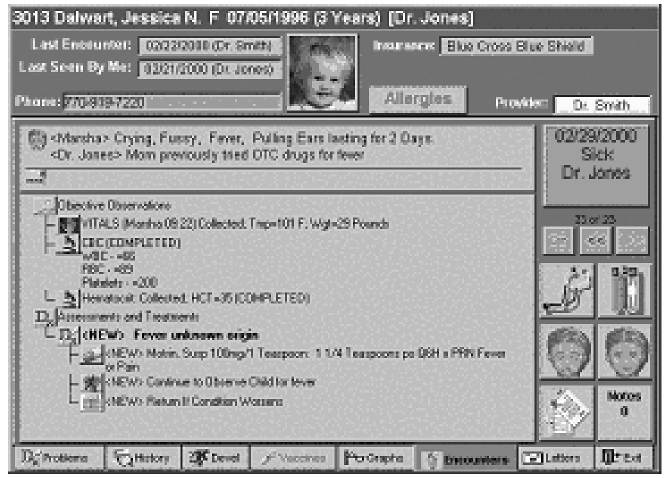

Figure 4. Encounter Screen: Summary-navigational function

The encounter screen (Figure 4) combines navigational and summary functions—the large gray area in the center is an outline of already-entered subjective, objective, assessment, and plan data (based on the SOAP model). These items are live. Touching them retrieves the SDE screens used to create them. Other areas, buttons, and tabs (along the bottom) take the user to other SDE screens.

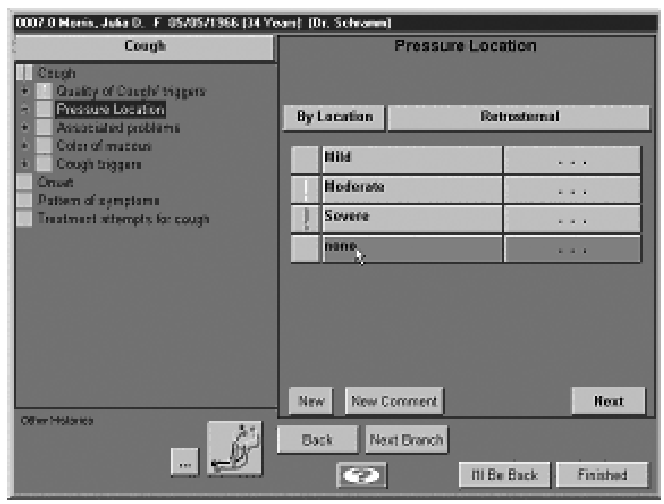

Figure 5. History Screen: Structured data entry function

The history screen (Figure 5) has the most flexible and user-customizable functionality of EncounterPRO's SDE screens. A user can create and edit a hierarchical set of "observations," each of which has an associated pick list of results, locations, and qualifiers. These dynamic questionnaires are analogous to a multiple-choice test in which more than one answer may be selected. If no correct answer is available, a new answer can be added (by selecting the "New" button), which will then be available in future uses of the questionnaire.

While a user enters data, pick lists are automatically presented for data entry. Answers to questions higher in the hierarchy can trigger (or skip) questions lower in the hierarchy, another example of workflow facilitating navigation through structured data entry elements. Questionnaires are created and edited by users in the context of patient encounters, allowing customization on the fly.

Our experience is consistent with that of van Ginneken and de Wilde [2], who make the important point that different styles of structured data entry can require different underlying data representations. In a *direct* model, there is a one-to-one relationship between onscreen elements and table attributes. The direct model does not allow the user to create new data entry screens (although they can still add new pick list items) because to do so would require modification of the underlying database model. Most of EncounterPRO's pick lists rely on a direct model approach.

In an indirect model, onscreen elements may have a many-to-one relationship to table attributes, because the data representation is a tree implemented in a relational database. An *indirect* model allows the user the freedom to create and edit new structured data entry questionnaires without modification to the underlying software or database. EncounterPRO's history screen and its user editable questionnaires rely on an indirect data model.

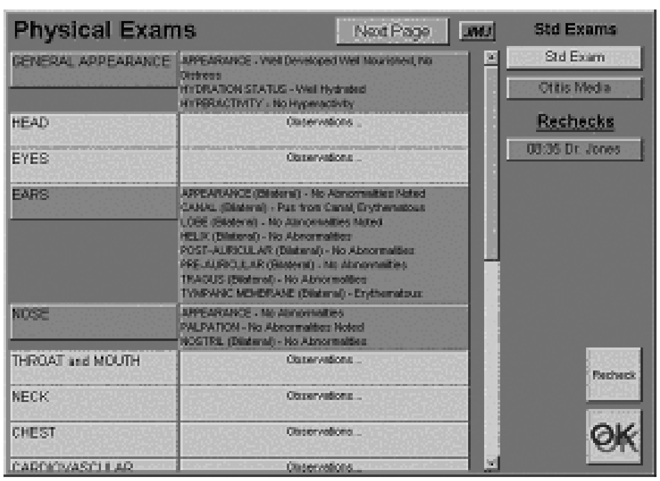

Figure 6. Physical Exam Screen: Structured data entry function

Physical exam findings are entered into the physical exam screen (Figure 6) using structured data entry in conjunction with the ability to assert combinations of normal—or abnormal—values, which can then be overridden, all of which are customizable by the user. For example, selecting the "Otitis Media" standard exam asserts a combination of normal findings (for example, "NOSE, APPEARANCE - No Abnormalities") and targeted abnormal findings (for example, "EARS, CANAL (Bilateral) – Pus from Canal, Erythematous").

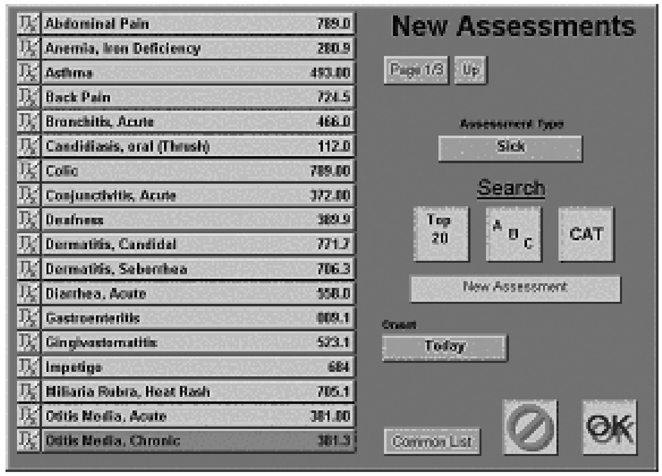

Figure 7. Assessment Screen: Structured data entry function

After entering vital signs, history, physical exam, and other data, and ordering laboratory tests and procedures (screens not shown), the user progresses from the encounter screen to the assessment screen (Figure 7). This, again, is an editable pick list. Each clinic has a standard Top 20 list (though more than 20 assessments can be herein contained), and each user can customize his or her personal list from a reservoir of ICD assessments.

For each selected assessment, a treatment screen containing relevant treatment pick list items is scheduled to appear in quick succession. Some of these treatment items, such as prescriptions, generate their own follow-on screens to allow a user to modify default dosage and other values. In this way, prior assessment and treatment selections drive the contents of subsequent treatment and other screens. At no time are multiple screens presented, as in the standard multiple document interface style. Instead, each screen appears at the right time with the right content, presented in an easy-to-hit, and therefore quick-to-hit, style.

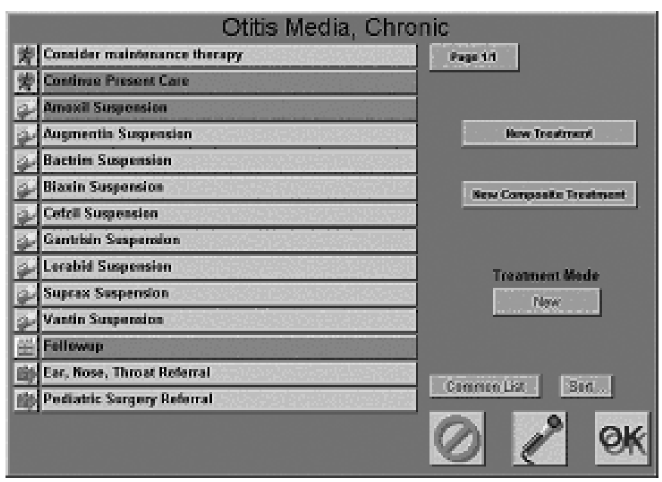

Figure 8. Treatment Screen: Structured data entry function

Each treatment screen (Figure 8) is pre-configured by each physician to present favorite treatments for each assessment. If the treatment that the physician prefers is not here, he or she may search the database by clicking the "New Treatment" button on the right or typing in an appropriate treatment on the keyboard. This new treatment can be added to the Top 20 personal list. Selecting the "Composite Treatment" item, the physician can order a set of treatments, such as a drug cocktail. These are also user-customizable popup pick lists.

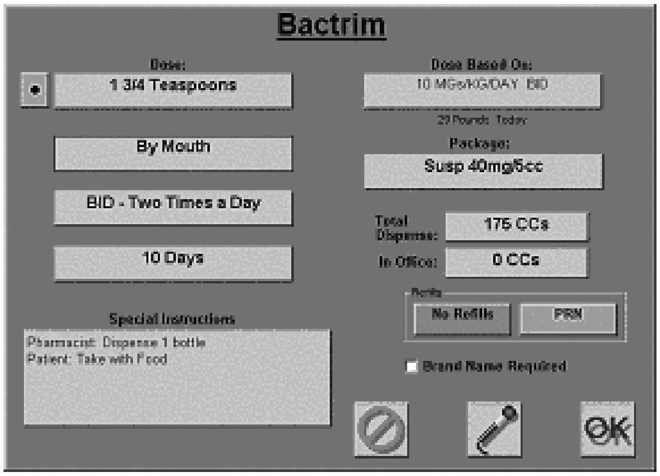

Figure 9. Prescription Screen: Structured data entry function

If the physician selects a drug as a treatment, EncounterPRO automatically brings up the prescription screen (Figure 9), calculating the dosage based upon the patient's current weight (in a pediatric context) and showing the physician's default settings for that particular drug. The physician can change the data shown on each gray bar by touching the bar and then touching a selection from the pick list that appears. Every prescription is reviewed again when the physician electronically signs for the encounter and the prescription.

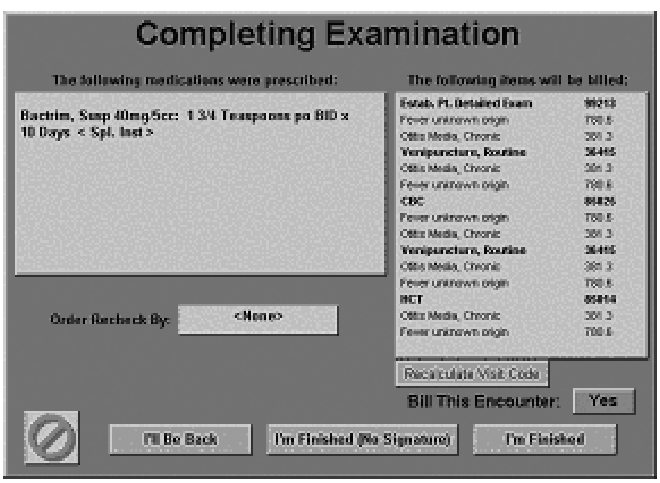

Figure 10. Billing Screen: Summary-navigational function

At the end of each encounter, the billing screen (Figure 10) summarizes prescriptions and the billing data generated by the treatments and procedures selected during the encounter. Touching these summary items takes the user back to the SDE screens to revise or add data. Touching the billing block brings up a screen that permits billing adjustments and the addition of billing notes, either from an editable pick list of phrases or by keyboard entry.

DISCUSSION

No current electronic medical record can achieve both maximum information utility *and* maximum system usability. Middleton aptly puts it, "As the degree of structured data capture goes up, the information utility rises, but the burden of the structured data gathering may eclipse the utility from the user's point of view." [3] While we understand and acknowledge that ultimately, patient data must serve research, policy, and management interests (for example, see [4])—in the short run, it must directly serve patient and clinician interests: after all, when issues of information utility and system usability collide, if users won't use the system, no information is generated to have a utility. Our bias, therefore, is toward system usability when implementing structured data entry in an electronic patient record.

The choice of touch screen technology and large icons deserves some comment. A major motivation for using a structured data entry approach is not just to obtain structured data but also to increase the speed of data entry. Fitts's Law [5] is a mathematical model of time to hit a target. It basically says that larger targets are easier, and faster, to hit. Fitts's Law seems obvious, but it is often ignored when designing electronic patient record screens because the larger the average icon, button, scrollbar, etc., the fewer such objects can be placed on a single screen. A natural inclination is to display as much information as possible; EPR screens are thus often crowded with hard-to-hit targets, slowing the user rates of data entry and increasing associated error rates.

Fitts's Law, in conjunction with constrained screen "real estate," suggests use of a few, large user-selectable targets. Displaying fewer rather than many selectable items tends to increase the number of navigational steps, unless some approach is used—such as a workflow system—that automatically and intelligently presents only the right structured data entry screens.

In our opinion, the combination of structured data entry, workflow automation, and screens designed for touch screen interaction optimally reduces inherent tradeoffs between information utility and system usability on one hand, and speed and accuracy of data entry on the other. Successful application of touch screen technology requires that only a few, but necessary, selectable items be presented to the user in each screen. Moreover, workflow, by reducing cognitive work of navigating a complex system, makes such structured data entry more usable.

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ENDNOTES

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Electronic Patient Notes for Clinical Documentation at Mayo Clinic[1]

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Jean M. Winslow[3]

BACKGROUND

The Mayo Foundation is a charitable, not-for-profit organization based in Rochester, Minnesota. Mayo's mission is to provide the best care to every patient every day through integrated clinical practice, education, and research. Mayo Clinic Rochester is comprised of a 1,500-physician group practice and an allied health staff of nearly 39,000**.** The electronic environment vision of Mayo Clinic is to significantly contribute to the success, practice, education, and research within Mayo Rochester and the Mayo Health System through excellence in information management, systems, processes, and technology.

Over a period of several years, the documentation process has evolved from handwritten and/or typed notes and reports to the electronic capture of information using Clinical Notes. Clinical Notes is an in-house developed client/server application written in Uniface to provide multi-platform support to end-users. The Clinical Notes application uses Sun Solaris server hardware, a UNIX operating system, and a Sybase database. Over 14.5 million notes, occupying 130 GB of space, are available on this server. The current version and all previous revisions of each document are stored on the server. The Clinical Notes application can be interfaced to separate departmental source systems. Currently, there is an interface from a diabetes management system. The data are entered directly into the Diabetes Electronic Management System (DEMS), and Clinical Notes is used to view and print these diabetic notes.

The Clinical Notes application at Mayo Clinic Rochester has been in production for over seven years. As more patient-related clinical documentation has become available on-line, care providers have continued to transition from a paper medical record to an electronic medical record as their primary source of information. The Clinical Notes application is used on the Rochester campus, as well as on several locally remote Mayo sites and on the Mayo Clinic Scottsdale campus. Mayo Clinic transcriptionists and providers use the Clinical Notes application to enter, edit, view, and print information collected during a patient encounter with a provider. The application also provides for electronic signature, automatic generation of correspondence, viewing of past document revisions, display of revision history after authentication, file recovery in the event of technical issues, automatic master sheet entry of longitudinal diagnoses, printing of draft copies, and the functionality to mark specific documents as confidential.

A separate application, the Documents Browser, may also be used for viewing Clinical Notes. Documents Browser has the added capability of allowing users to view, in an integrated manner, other electronic information such as complex reports, hospital summaries, correspondence created from the Clinical Notes application, electronic orders, patient-provided information, the master sheet, and instructions to listen to untranscribed dictations. Copies of the Clinical Notes also can be printed from the Documents Browser.

The Clinical Notes application is used to generate approximately 49,000 patient notes per week. Self-entry of Clinical Notes accounts for nearly 25% of total notes. There were over 8,500,000 Rochester patient notes stored in the database as of May 1, 2002. There are over 2,800 active providers and 2,100 active transcriptionists.

IMPLEMENTATION STRATEGY

The implementation strategy for Clinical Notes has been mostly voluntary, based on requests from the user areas. Clinical Notes has been implemented for provider outpatient notes, all hospital summaries, and several inpatient pilot areas. Numerous clinical reports and specialty documents that contain textual information have been implemented using the Clinical Notes application.

Current Workflow

1. The care provider interacts with the patient.
2. The care provider dictates a note via the digital dictation system using a dictation template or self-enters the note into the Clinical Notes application—instead of handwriting the note for the paper medical record.
3. The transcriptionist listens to the dictation and enters the information into the Clinical Notes application. A keyboard enhancement software product (Shorthand for Windows™) is often used to facilitate the note entry through the use of templates and keyboard text expanders.
4. The transcriptionist saves the note. A medical record copy of the note is printed to the appropriate clinical area through a link to our medical record location system.
5. The support staff retrieves the note from the printer and files it in the patient's paper medical record.
6. After the note is saved, it is available immediately for on-line viewing or draft printing (8.5" x 11") by anyone with the appropriate security access.
7. The author of the note reviews the document on-line and electronically signs the Clinical Note.
8. Automated crafting of correspondence to referring physicians, patients, and other recipients is frequently used.
9. Clinical Notes can currently be electronically viewed from any workstation that runs the Clinical Notes application.

Implementation Process

In most situations, individual departments contact the Clinical Notes implementation liaisons to request that Clinical Notes be implemented in their area. Before the first meeting, Clinical Notes liaisons ask the requesting departments to provide samples of documentation so an electronic version of the form can be presented at the meeting. Liaisons use a multi-page checklist to ensure that all the complex details of an implementation are successfully planned, completed, and documented.

Typically, the secretarial supervisor, patient care desk supervisor, physician proponent, department administrator, and the Clinical Notes liaison are present at the initial meeting. The objective of the first meeting is to gather information regarding the area's current documentation process from patient check-in to placement of the completed documentation in the medical record. This includes information regarding the different types of forms being used for handwritten documentation. Approximate volumes of anticipated notes to be generated per week by that department are documented. Transcription resources are discussed to ensure there are adequate personnel to support entry of electronic documentation. One or more of the following departmental scenarios typically exist:

Adequate transcription resources are departmentally available

Transcription resources will be secured, per department expense, to the central transcription pool

Providers will self-enter documentation

The liaisons and the physician proponent of the application offer a department-wide demonstration of Clinical Notes to the area. Availability of workstations is assessed, and a request for additional workstations is submitted if necessary. The number of providers and allied health professionals is documented for training purposes. Printer space requirements at the patient care desk are discussed for placement of the medical record copy printer. A mutual implementation date is tentatively planned based on departmental expectations and liaison resources. Approval of the electronic documentation samples is obtained from the departmental leadership. The standardized dictation template is discussed in detail. Clinical Notes training class objectives and time requirements are discussed. The liaisons request that the department provide them with a complete list of user names, pager numbers, and personnel numbers for electronic access purposes. Options for electronic correspondence using institutional or department-specific templates are discussed.

The purchase order for a medical record copy printer is submitted by the liaisons after the printer support personnel have conducted a site visit to the department. An introductory memo from the liaison team to the secretarial and patient care desk supervisors is sent a few days after the initial meeting. The memo reviews the entire implementation process, provides a printer supply list, outlines the back-up plan, and includes the step-by-step Clinical Notes handling procedure.

Subsequently, the initial meeting group reconvenes to discuss and gain departmental approval of: dictation templates, patient care desk processes for paper history printing and filing, customized letter formats, final placement of the medical record copy printer, and customized template needs for self-entry. The Clinical Notes User Group contact is identified. This person serves as a representative for the area, receives all Clinical Notes communications, and attends monthly user group meetings.

The liaisons order an appropriate number of tri-fold dictation templates for the providers. The delivery of the medical record copy printer is coordinated by the liaisons with the printer support staff and the patient care desk supervisor. Self-entry templates are developed, if desired. Reference data for the new implementation area are set up administratively (e.g., service name, report title, and medical record placement). The liaisons verify that the new Clinical Notes users are registered and set up with appropriate privileges.

Dictation template education is scheduled for the care providers at their convenience, often located on-site during non-patient care hours. Education specialists arrange self-entry classes for the care providers and transcriptionists. This instruction typically takes place in a hands-on classroom setting. The liaisons give specific details to the education specialists in order to customize the classes as much as possible. When the printer is installed, specific training is offered to the patient care desk staff regarding supplies and maintenance.

The final steps to the implementation process in a new area include choosing a date to begin using Clinical Notes, announcing the implementation at the Documents Oversight Group and the monthly Clinical Notes User Group meetings, and publishing an announcement in the institution-wide weekly newsletter.

EDUCATION

A variety of education strategies and approaches are employed to provide ongoing education to keep the large number of users who interact with the Clinical Notes application up to date. A central group of education specialists as well as the Clinical Notes liaisons and the assistant liaison provide these services.

Education Specialists

Hands-on training in a classroom setting or on-site training is provided by our education specialists. Proper use of the Clinical Notes application entry screen, creation of Clinical Notes correspondence, and template building tools for facilitated entry classes are offered. In addition to routine Clinical Notes classes, institution-wide refresher courses related to the Mayo Clinic's electronic applications (including the Clinical Notes application) are offered periodically. The education specialists have Intranet web pages, which include a quick reference guide about the Clinical Notes application and on-line class enrollment. A specific phone number is available 24 hours a day to answer technical questions. "How to" questions related to the software are answered during business hours. In the future, the education specialists plan to develop web-based tutorials for application training.

Clinical Notes Liaison Team

Monthly Clinical Notes User Group meetings are held by the liaisons to discuss modifications and enhancements made to the Clinical Notes application software, to give implementation announcement updates, and to provide helpful hints and reminders. Attendees are given the opportunity to ask questions, bring up issues, and request new functionality to make entry more efficient. These requests are documented, discussed after the meeting, and taken to the programmers, if appropriate, for application enhancement. The liaisons maintain Clinical Notes web pages for information related to the following: policies, procedures, recommended guidelines, contact names, access information, error correction, current and previous User Group handouts, year-to-date statistics on notes and letter counts, project specific information, training and quick reference guides, settings within the application, navigation tips, back-up plans, problem-solving hints, hardware and printing issues, and frequently asked questions. The liaison team also has an email account that is continually monitored for questions and issue resolution. Each liaison is available via pager for application support assistance.

IMPLEMENTATION TIPS

Our group of liaisons has found that, due to the complexity of tasks to be completed, a checklist outlining all the incremental steps is very beneficial. In addition, small department-specific implementations are offered one- or two-day on-site assistance. Large cross-departmental implementations have brought different training issues to the forefront. Our education specialists offer multiple well-publicized on-site classes. Project-specific pagers are used in conjunction with a calendar-like implementation schedule to rotate a team of liaisons who will be on-site.

One of the biggest hurdles in a large institution is keeping all personnel abreast of changes. We have found that a wide variety of communication vehicles is best. Published announcements through various internal information sources, email, web page updates, and presentations to numerous committees and groups work most effectively. Leadership support from an institutional level, including administrators and department chairs, is vital. Mayo Clinic has recently employed electronic application on-site support personnel that cover multiple areas. They provide assistance with technical issues related to the electronic environment and work closely with the liaisons associated with each application.

RESULTS/RECOMMENDATIONS

Benefits

Legibility: The Clinical Notes application provides legible patient documentation for healthcare providers and administrative staff who typically interact with the patient record.

Access: Capturing notes electronically, versus the paper medical record, allows multiple users to view a document simultaneously on any workstation. Major efficiencies have been gained because care providers can see a patient without waiting for the paper medical record to be transported from either the paper record archive ("record room") or the patient's prior appointment location to the patient's current appointment location. This improves patient care by reducing patient waiting time and enabling patients to have more appointments per day.

Keyboarding Efficiencies: The Clinical Notes application includes a number of keyboarding shortcuts:

Individual preferences with regard to customized service and pager information, recovery files, spell checker, printer location, and note save and/or print job verification messages can be preset.

When starting a new Clinical Note, some sections are automatically pre-filled with patient demographic information, provider name, services, pager, transcriptionist, date, and note revision number

There is functionality to "pull" a problem list of diagnoses started in the History of Present Illness section of the note to the Impression/Report/Plan section of the note. These can then be "pulled" into the Diagnoses section. Information saved in the Diagnoses section is automatically posted to the patient's central longitudinal diagnoses list called the Master Sheet, which is viewable in the Documents Browser.

"Pull from previous note" functionality is available in all sections. This enables the user to utilize the bulk of existing text, with updated modifications, from a previous visit to the same or a different provider.

The physical examination section has been divided into specific elements by examination components and offers some keystroke savings to the self-entry provider or transcriptionist. For example, by typing "abdo", the word, "Abdomen:" appears. The cursor is automatically placed immediately after the colon, ready for more information to be typed. The entry of "abdonx" produces the text "Abdomen: Not examined."

Patients complete Patient Provided Information forms at the time of check-in. These forms are electronically scanned and are viewable in the Documents Browser. Certain sections in the Clinical Notes application (e.g., Medications, Allergies, Social History, Family History, and Past Medical/Surgical History) have the capability to "pull" this scanned patient information directly into the Clinical Note.

Typical word-processing keystrokes of cut, copy, paste, select all, display paragraph markers, etc., are available.

Shorthand for Windows™ is a text and keystroke storage and playback utility designed to work concurrently with most Windows applications. It does interface with the Clinical Notes application. Mayo Clinic's acute illness department, the Urgent Care Center, utilizes 100% self-entry by the providers, using customized problem-specific templates, and has realized the benefit of needing six fewer full time employees.

Each field can be enlarged with a "zoom" feature.

Clinical Notes contains both personal and institutional spell checking dictionaries.

Print job status is accessible from the application to check on a note print request.

Web links are available directly from the application to pertinent web pages, including an email account for questions directed to the liaisons.

Automatic "news" alerts can be broadcasted to the user at the time of application log-in.

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Correspondence: A major benefit has been the decrease in secretarial effort required to generate correspondence. Referring physicians and patients prefer structured correspondence over other types of correspondence. The Clinical Notes correspondence feature allows users to construct correspondence with very few keystrokes from institutional or customized departmental templates that populate the cover letter with either the patient's Impression/Report/Plan or Diagnoses section of the note. Examples of institutional templates include letters to the referring physician, other care provider, patient, and "To Whom It May Concern". Final letter copies with the appropriate number of recipient draft copies, as well as envelopes or labels, are automatically printed. Other notes depicting the complete detail of the documentation may be included as attachments to the cover letter.

A marketing survey was sent to referring physicians and patients in May of 1997 to assess their satisfaction. Questions to the survey recipients included feedback regarding letter timeliness, whether their informational needs were met, and if the new letters were an improvement from past narrative letters. Results of the survey showed approximately 100% overall satisfaction to the above questions from the recipients. This method of correspondence generation also reduces transcription effort and improves physician productivity. Automatic correspondence from Clinical Notes has saved $2.6 million per year in time and personnel.

Printing Efficiencies: Home desk printing automates Clinical Notes printing to the location where the patient's medical record is currently stored. The medical record location is obtained through an interface from the Clinical Notes application to Mayo Clinic's internal chart location system. Clinical Notes printing at the home desk has resulted in savings of eight full time employees and $200,000 per year. Prior to home desk printing, Clinical Notes were printed at the location where the note was transcribed. The patient's paper medical record was requested and transported to the location of the note for inclusion in the chart. Miscellaneous (non-face-to-face encounters generated from prescription refills and phone calls) note printing to permanent file has resulted in cost savings of approximately $1,000,000 per year. By printing miscellaneous notes directly in permanent file, patient medical records do not need to be called to the areas generating the notes for insertion into the medical record.

Deployment Limitations

Additional workstations have been deployed for viewing of electronic Clinical Notes.

Transcription resources continue to be recruited.

Training of application use and process changes is an on-going effort.

FUTURE GOALS

Eliminate printing, with the exception of an archival copy of all pertinent Clinical Notes at the end of an episode of care—for an estimated institution-wide saving of approximately $1.3 million per year.

Increased self-entry of clinical documentation by care providers through the use of templated text and/or keyboard enhancement tools

Further expansion of Clinical Notes into the hospital (inpatient) setting

A pilot study to better understand remaining issues and the processes of moving the current paper-based practice to a chartless and filmless practice across the institution

Creation of a new clinical system integrating all phases of a patient visit to form a complete electronic medical record (appointment scheduling, patient check-in, test ordering, patient documentation, correspondence, and service recognition). The new Clinical Notes application will have the enhanced functional capabilities of images, tables, and graphics.

ENDNOTES

[1] This article is adapted and updated from material presented at the 2001 Annual HIMSS (Healthcare and Information Management Systems Society) Conference and Exhibition, February 4-8, 2001: "Clinical Documentation of Electronic Patient Notes at Mayo Clinic"

[2] Ms. Colwell, Ms. Goematt, Ms. Jacobson, and Ms. Krahn are Clinical Notes Liaisons at the Mayo Foundation, Rochester, Minnesota

[3] Ms. Winslow is Assistant Clinical Notes Liaison at the Mayo Foundation, Rochester, Minnesota

The Impact of HIPAA on Information Capture Operations[1]

The Association for Work Process Improvement

The mission of The Association for Work Process Improvement (TAWPI) is to enhance the performance of organizations and strengthen the value of professionals that employ emerging technologies in mail, remittance, document, and forms processing.

The Healthcare Insurance Portability and Accountability Act of 1996 (HIPAA) is legislation that could significantly impact operations centers that capture and/or otherwise process certain healthcare-related information. HIPAA applies to organizations that are categorized as "covered entities", whether they are health plans (insurers, HMOs, etc.), healthcare providers (hospitals, physicians, etc.), or healthcare clearinghouses (organizations that process healthcare-related information into or out of standard transactions). The Act also defines "business associates", which basically are organizations (such as TAWPI members) that process healthcare-related information on behalf of a covered entity. These are very simplified definitions – if you think your organization falls into one of these categories, you (or your organization's attorneys) should be delving more deeply into the HIPAA regulation to determine your need to comply and your potential liability if you don't.

Of particular interest to information capture professionals is the April 2001 final Privacy Rule. One of the objectives of this rule is to keep data that identify individuals and healthcare-related data (called protected health information or PHI) confidential. Do TAWPI members process PHI? Most probably, yes! PHI can be in the form of health claims that are processed by service bureaus, payment and remittance information processed by lockbox providers, or any other scenario where the confidentiality of PHI could be jeopardized.

TAWPI HIPAA TASK FORCE FORMED

At the request of our members, TAWPI has formed a HIPAA Task Force, whose purpose is to:

> Establish minimum requirements for privacy and security within an operations environment that processes healthcare-related information, including lockbox and remittance operations, service companies, and organizations directly related to the health insurance industry
>
> Provide a forum for information capture professionals to discuss best practices related to productivity and throughput that could be impacted by compliance with the privacy and security aspects of HIPAA

To accomplish these objectives, members of the Task Force have begun identifying work processes that could result in an organization falling into the category of "business associate" or "healthcare clearinghouse" as defined by HIPAA. The next task is to determine what steps an organization needs to take in order to be in compliance with the Privacy Rule, depending on the category into which it falls. (The date for compliance is April 2003.) Finally, the group will look at best practices that will help an organization measure its productivity standards that could be impacted by HIPAA compliance measures.

In conjunction with the work of the Task Force, TAWPI will develop educational programs and other methods of distributing information to TAWPI members to ensure that organizations are kept informed of their requirements under HIPAA. TAWPI will also ensure that the components of HIPAA that directly impact information capture are integrated into the information capture professional (ICP) certification program.

ENDNOTES

[1] For more information, contact Linda O'Hara or Melissa Comeau at (617) 426-1167 or visit TAWPI's web site: www.tawpi.org

Healthcare Documentation: A Report on Information Capture and Report Generation Executive Summary[1]

Consensus Workgroup on Health Information Capture and Report Generation[2]

Accurate, accessible, and shareable health information is a well-accepted prerequisite of good health care. Yet, the healthcare system in the United States continues to accept illegible handwriting and other documentation practices that diminish the quality of healthcare documentation through reduced accuracy, accessibility, and shareability. This reduced quality influences five major areas in the healthcare system.

Patient safety is affected by inadequate information, illegible entries, misinterpretations, and insufficient interoperability.

Public safety, a major component of public health, is diminished by the inability to collect information in a coordinated, timely manner at the provider level in response to epidemics and the threat of terrorism.

Continuity of patient care is adversely affected by the lack of shareable information among patient care providers.

Healthcare economics are adversely affected, with information capture and report generation costs currently estimated to be well over $50 billion annually.

Clinical research and outcomes analysis are adversely affected by a lack of uniform information capture that is needed to facilitate the derivation of data from routine patient care documentation.

Healthcare documentation has two parts: information capture and report generation. *Information capture* is the process of recording representations of human thought, perceptions, or actions in documenting patient care, as well as device-generated information that is gathered and/or computed about a patient as part of health care. Typical means for information capture are handwriting, speaking, typing, touching a screen, or pointing and clicking on words, phrases, etc. Other means include videotaping, audio recording, and image generation through x-rays, etc. *Report generation*, i.e., the construction of a healthcare document (paper or digital), consists of the formatting and/or structuring of captured information. It is the process of analyzing, organizing, and presenting recorded patient information for authentication and inclusion in the patient's healthcare record.

This Report focuses on six documentation methods, i.e., handwriting, speech, direct computer input, document imaging, device capture, and clinical imaging, as well as their hybrids. The evolution from handwriting to electronic healthcare documentation is concurrent with a transition from free (i.e., unstructured and typically unsearchable) text to structured and interactive text. To better understand this transition, this Report addresses the characteristics of unstructured, structured, and interactive data capture styles.

The challenge of attempting to standardize information capture, given today's varied, proprietary, vendor-related, and often innovative approaches, is an almost overwhelming task. Although it merits continued attention and work, the more fruitful, near-term, pragmatic goal should be the standardization of report generation, thus facilitating the exchange of information.

The need for sharing health information among authorized health practitioners is hindered by inadequate documentation methods. Handwriting is often illegible, and varying terminologies represent different meanings to different practitioners. Lack of a universal structure of patient information makes it difficult to find relevant information in a record created with free text or from another organization. Also of note are legal and professional barriers related to non-standardization, data integrity, signatures, etc.

Many steps must be taken to create systems and policies that make healthcare documentation more effective for quality health care. The Workgroup has developed a set of "Essential Principles of Healthcare Documentation"[3] and has assessed how they are met by the healthcare documentation methods addressed in this Report. The key principles are that:

Unique patient identification must be assured within and across healthcare documentation systems.

Healthcare documentation must be:

- Accurate and consistent
- Complete
- Timely
- Interoperable across types of documentation systems
- Accessible at any time and at any place where patient care is needed
- Auditable

Confidential and secure authentication and accountability must be provided.

The practitioner who effectively interacts with electronic resources for patient care, rather than relying on memory, gains more complete and timely access to information. Rapid access to databases such as formularies, drug references, and other decision-making support tools, improves the quality of care. When this is accompanied by practices that support the "Essential Principles of Healthcare Documentation" noted above, quality of care is further enhanced.

In the interest of improving the quality of healthcare documentation, this Report makes the following recommendations to the healthcare community.

RECOMMENDATIONS

Recommendation #1:
Fund, create, and promote a practical implementation guide for the dissemination, teaching, and adoption of the "Essential Principles of Healthcare Documentation" by practitioners, providers, vendors, and healthcare organizations, as well as regulatory bodies and medical schools. (Chapter 1)

Recommendation #2:
Develop and fund a national rapid response system at the practitioner/provider level for data collection and shareable reports to deal with incidents of epidemic outbreaks and bioterrorism. (Chapter 2)

Recommendation #3:
Create, mandate, and fund a standardized discharge care plan for ambulatory and inpatient care, providing a uniform summary of care given to a patient in a specific provider setting and a recommended care plan that can be easily accessed when the patient is seen by a new provider.[4] (Chapter 2)

Recommendation #4:
Develop and fund a model study of the costs and benefits of uniform healthcare documentation using the "Essential Principles of Healthcare Documentation" and the discharge care plan. (Chapter 2)

Recommendation #5:
Develop a coordinated five to ten year national plan to minimize the use of both unsearchable free text and handwriting in healthcare documentation. (Chapter 3)

Recommendation #6:
Develop and adopt standardized templates to enhance data integrity at the point of care. (Chapter 3)

Recommendation #7:
Provide more information to practitioners and providers related to the impact of handwriting on a healthcare system's effectiveness and efficiency in handling information. (Chapter 4)

Recommendation #8:
Develop standards and guidelines for the editorial process related to report generation, with emphasis on standardized, exchangeable reports. (Chapter 4)

Recommendation #9:
Create a cost-benefit model of uniform healthcare documentation methods with emphasis on standard reports. (Chapter 4)

Recommendation #10:
Conduct a risk assessment of authentication in order to provide guidelines for electronic and digital signature types. (Chapter 5)

Recommendation #11:
Develop guidelines for security, including nonrepudiation, data integrity, and auditing of healthcare documentation. (Chapter 5)

Recommendation #12:
Create and fund an institute for healthcare documentation to (1) conduct further research and create practical implementation guides for uniform adoption of the "Essential Principles of Healthcare Documentation," (2) advance the recommendations of this Report, and (3) develop and administer education and certification programs in (a) healthcare documentation based on the "Essential Principles of Healthcare Documentation" and (b) security and authentication of healthcare documentation. (Chapter 6)

ENDNOTES

[1] Copyright C. Peter Waegemann, Claudia Tessier, et al., Newton, MA, 2002. The copyright holders have granted permission for inclusion of the executive summary in this publication. It has been edited for format.

[2] The Consensus Workgroup on Health Information Capture and Report Generation studied these issues extensively and seeks input and responses to its findings. Contact the co-chairs and primary authors, Peter Waegemann at peterw@medrecinst.com and Claudia Tessier at ctessi@attglobal.net. A full list of authors and participants is available in the complete document or upon request.

[3] See Chapter 1 of the full report for more details regarding the "Essential Principles of Healthcare Documentation."

[4] Standards organization ASTM E31 Committee on Health Informatics is currently working on a national standard "Discharge Care Plan."

ASTM Standards in the Medical Transcription Industry

Brenda J. Hurley [1]

ASTM International (formerly called ASTM) was organized in 1898. It is one of the largest voluntary standards developers in the world with more than 30,000 members in 100 nations. Today, there are over 11,000 published standards in materials, products, systems, and services. In 1970, the E31 Healthcare Informatics committee was formed to develop standards for health information and systems. There are several subcommittees within E31 that focus on a range of topics from health information security, XML document type definitions, healthcare document formats, laboratory information systems, bioinformatics, and others.

In 1995, the subcommittee E31.22 Health Information Transcription and Documentation was formed with the scope to develop standards for the systems, processes, and management of medical transcription and its integration with other modalities of report generation. As the current chair of E31.22, I am proud of our accomplishments, as we have developed some excellent standards for our industry. Here is a short summary of each standard.

The first approved standard came in 1997 with *E1902-97: Standard Guide for Management of Confidentiality and Security of Dictation, Transcription, and Transcribed Health Records.* This document has been updated with new language and processes consistent with HIPAA, and has recently been balloted and approved. This newly published *E1902-02: Standard Specification for Management of Confidentiality and Security of Dictation, Transcription, and Transcribed Health Records* will be available soon through ASTM International.

The next approved standard came in 1998 *with E1969-98: Standard Guide for Requests for Proposals Regarding Medical Transcription Services for Healthcare Institutions.* This document provides reasonable expectations for each party in the request for proposal (RFP) and defines terminology used in the RFP process.

In the year 2000, we celebrated another approved standard with *E2117-00: Standard Guide for Identification and Establishment of a Quality Assurance Program for Medical Transcription.* This document provides essential components of a quality assurance program and delineates the responsibilities and processes involved.

Our most recently approved new standard is *E2195-01: Standard Specification for Transferring Digital Voice Data Between Independent Digital Dictation Systems and Workstations.* This is a highly technical standard that provides a mechanism for interoperability of digital voice files and their identifying data elements between disparate systems, regardless of the manufacturer. The lack of compatibility of digital dictation systems has long been a problem, so a method for obtaining vital data elements with the accompanying voice file is welcomed by many within this industry. This new standard will be available soon through ASTM International.

Within E31.22, we have two activities still in progress. The first one is a *Standard Guide for Speech Recognition Products in Health Care.* This document identifies features and benefits important to include in speech recognition products. It also provides scenarios where speech recognition systems are used in healthcare settings and clarifies some common misconceptions regarding the use of speech recognition systems.

The other ongoing activity is a *Standard Guide for Data Capture through the Dictation Process* (guidelines for dictation). This will be a useful document for those transitioning to dictation and for those currently using dictation as their primary choice for data capture. Helpful hints for dictating, environmental issues, and equipment training are some of the topics that will be included within this new standard guide.

At the last E31.22 meeting, in May of this year, another new activity was proposed for the development of a standard for medical transcription workstations. This standard would include appropriate tools, references, equipment, and environmental issues such as ergonomics and security.

As you can see, the work done within E31.22 is making a difference in the medical transcription industry. For information about ASTM E31.22 activities and other meeting dates, e-mail me at bhurley@medware-inc.com.

You can purchase any of the ASTM standards referenced in this article through ASTM (www.astm.org) or the American Association for Medical Transcription (AAMT) (www.aamt.org).

[1] Brenda J. Hurley, CMT, is Director of MT Development, MedWare, Inc., in Maitland, Florida, and Chair of ASTM E31.22 Subcommittee on Health Information Transcription and Documentation.

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