Experience with an Electronic Health Record for a Homeless Population

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ABSTRACT

A computerized electronic medical record (EMR) system using client-server architecture was designed and implemented by the Laboratory of Computer Science for use by the Boston Health Care for the Homeless Program (BHCHP) to meet the unique medical record needs of the homeless. For the past three years, this EMR has been used to assist providers in the delivery of health care to the homeless population of Boston. As the BHCHP has grown and technology improved, it is important to review what features of the EMR work, and to investigate what improvements can be made for the better delivery of care to the homeless, especially as we approach the next century.

BACKGROUND

The health care needs of homeless population are unique. People who are homeless are less likely to seek ambulatory medical care with their multiple medical problems until their conditions have worsened [1]. There is a high prevalence of mental-health illnesses and substance abuse among this population [1]. Certain medical conditions like diseases and disorders of the skin (especially Cellulitis), human immunodeficiency virus infection, tuberculosis and gynecologic problems are more prevalent in the homeless [2,3,4]. Homeless people die younger and have a higher mortality rate [5]. Homeless individuals with kidney disease, liver disease, arrhythmia and seizures have a markedly increased risk of death [5,6]. Homeless children have a higher incidence of injuries related to trauma and chronic diseases. Obesity is the major nutritional problem in homeless children due to the high content of carbohydrates and fat in their food sources [7].

The Boston Health Care for the Homeless Program (BHCHP) was established in 1985. Its mission is to provide access to quality health care services to homeless adults and families in the greater Boston area. At over 92 sites that include shelters, motels, racetracks, soup kitchens, hospital clinics and the Boston street, BHCHP physicians, physician assistants, nurse practitioners, nurses and case managers provide patient care to over 13,000 patients. BHCHP patients' admissions to Boston hospitals are monitored and two respite units with 93 beds total are available for recuperative care. In addition, BHCHP also provides dental care, substance abuse treatment, ante-partum care and mental health treatment.

An Electronic Medical Record (EMR) System was designed by the Laboratory of Computer Science at Massachusetts General Hospital to try to meet the particular needs of the BHCHP [8]. A central server running Windows NT and Shiva remote access technology (NetModem™ and LanRover™) are located at a BHCHP respite. Using portable computers and workstations and regular telephone lines, providers dial via modems into to this server from the various remote sites in the Boston area, where medical care is being delivered.

IMPLEMENTATION

The system was implemented in a client-server, distributed database architecture. Microsoft Windows for WorkGroups (3.1.1) was the operating system running on the client machines. ASYMETRIX™ Toolbook 3.01 was used to create the graphical user interface that simulates a chart metaphor with a selectable tab for each section of the medical record. Relational databases were used for data storage - ORACLE™ 7.2 for the central database on the server and Watcom™ SQL 4.0 for the local database residing on the client's machine. By using the distributed database design, the client's local database stores a local copy of the controlled vocabularies and is used as a temporary repository for a record retrieved from the central server. Using ORACLE Glue, Structured Query Language (SQL) is used to request/send information to/from the server.

The EMR currently includes the following sections: Demographic, Summary, Medical History, Physical Exam and Procedures, Labs, Guidelines, Case Management and Visit Notes. The fields included in these sections are the usual fields expected in a medical record (problem and medication lists, etc.) with the additional fields vital for providing care for a homeless population. These include: alias,

benefits, substance abuse, previous address, homeless status, case management and guidelines for the 20 health maintenance concepts that are monitored. There is a "Sticky Note" for providers to leave reminder notes. Current and previous Visit Notes are viewable and printable. Even though this was designed as a paperless system, some sites (like hospital-based sites) do require a hard copy of Notes.

Controlled vocabularies are used to validate data entry where ever possible. Standard vocabularies like Computer-Stored Ambulatory Records (COSTAR) diagnoses and Diagnostic and Statistical Manual of Mental Disorders: 3rd ed. rev. (DSMIIIR) terms were obtained from the Unified Medical Language System® (UMLS) to create the problem list vocabulary. Terms that are specific to the homeless population, like "dirty skin" or "multiple gun shot wound," were not part of any available standard vocabulary. Terms may be added to any of the vocabularies using special tools developed for the database manager. Any additions, deletions and edits to the vocabulary terms are first committed to the ORACLE server database. Each time a provider logs into the BHCHP EMR, a comparison is quickly made between the client and server vocabularies, and then any updates are downloaded to the local database. Term look-up and validation queries for data entry use the local database to minimize data transfer, and also to achieve faster response rates, since the problem and medication vocabularies contain over 11,000 terms.

Access to data entered in the system for analysis is provided via an ODBC connection from Microsoft Access to the ORACLE database. Special views of the ORACLE tables have been created to simplify the schema of the system for the data managers. Queries are run on the database to scan for duplicate records, misclassification of encounter types and other possible data entry errors. Retrospective analysis studies can also be conducted using the EMR for assessing quality assurance and outcome.

RESULTS

The system has been used by over two hundred providers from various health care specialties (Table 1). There are, on average, twenty providers logged into the system at any given time. Over 150 portables and workstations are available for use by the providers. Each provider

has a password to access the EMR and this serves as the "signature" for each encounter. Each access of a patient record is logged in the database. The log data includes the time the record was accessed, the provider who accessed the record and the time the record was exited. Reporting tools exist for the data manager to review these logs to insure patient confidentiality and no inappropriate perusing of records has occurred. In the last 36 months since the EMR's inception, there have been over 167,000 record retrievals and 87,000 encounters recorded in the database. The different types of encounter are listed in Table 2. The number of encounters has grown steadily over the past three years, increasing by approximately 10,000 encounters a year (Table 3). The 92 sites for encounters include a racetrack, shelters and respite units, and clinics at Massachusetts General Hospital and the Boston Medical Center. Care for the homeless is a multidisciplinary effort, and various types of providers are involved in the care of each patient. A single record has been retrieved by as many as 50 unique providers, the average being 4.4. Up to 37 unique providers have contributed information to a single record with the average being 3.0.

Table 1

Provider Types	%
MD/Med Stud/PA	31%
NP/RN/LPN/Aide	31%
Dentist/DA	3%
CM/LICSW	19%
Mental Health	5%
PsD	3%
Financial	8%

Table 2

Encounters	%
Clinic Visit	47%
Respite Visit	3%
Dental Visit	5%
SS/Family Team/Home Visit	15%
Mental Health Visit	5%
Inpatient Rounds	7%
Registration/Chart Review	18%

Table 3
Number of encounters per year

1st year of use	17914
2nd year of use	30497
3rd year of use	39337

Over 13,000 patients have been registered into the system (Table 4) representing a

heterogeneous population as has been seen in other assessments [2,9]. To register a patient, four key identifiers must be entered: last name, first name, date of birth and gender. Alias information can also be recorded and 375 patient records include Alias information. When a patient record is being selected, the user must enter at least the first three characters of the last name. Other information is optional (first name, gender and date of birth). Matches are sought not only in the last name field but also in the Alias field, in order to minimize duplication of records, as well as to make the best effort possible to see if the patient's medical information is contained in the system. Social Security numbers are available for 8,246 patients (63%). The system checks each Social Security Number that is entered against previous entries in the database to identify duplications in the system, and flag possible use of a Social Security number by another patient. The accuracy of this data is essential for obtaining benefits.

Table 4

Patients	N = 13256	
Gender	Age Distribution	
Male	64%	<18	18%
Female	36%	>=18 and <35	26%
		>=35 and <45	45%
		>=55	11%
Ethnicity		
Asian		1%
Black		25%
Hispanic		15%
Native American Indian		1%
Other		2%
White, not Hispanic		31%
Unknown		25%

The primary diagnoses recorded for this homeless population reflects diagnostic patterns found by others providing medical care to homeless populations [2,3] (Table 5). Over 1750 primary diagnoses have been recorded with mental health/substance abuse, dental problems, hypertension, respiratory problems, diabetes, dermatologic problems, pregnancy-related care and AIDS being the most prevalent. Since being of male gender, Caucasian and having a history of substance abuse along with either renal disease, liver disease, arrhythmia and seizures, have been identified as high risk factors for death in Homeless adults [4,6], it is essential that the database be reviewed for patients' records that meet these criteria so that there can be aggressive intervention.

Table 5

Primary Diagnoses	%
Mental Health/Substance Abuse	13%
Dental	7%
Hypertension	6%
Respiratory	6%
Diabetes	4%
Dermatologic	3%
Health Maintenance	3%
Pregnancy-related	3%
AIDS	2%
Other	53%

DISCUSSION

Periodic review of an ongoing EMR system is vital to assess its various successes and failures. That the BHCHP system is constantly in use is a good indication of its acceptance. Demand for greater access has prompted an increase in the number of computers from 20 to 150, and in the number of access phone lines from 16 to 32. Providers indicate that it takes longer to enter patient data into the EMR than to hand-write a note, but the immediate access to current information on a patient, no matter where the patient has been seen, is cited as the major benefit of an EMR [10,11] Providers are increasingly computer literate and increasingly comfortable using the EMR, as computers become more prevalent in everyday life.

The EMR has also been an essential tool for tracking quality improvement and outcomes. The database has been queried to determine the level of charting that is being done for preventive care. It has also been used to track patient visits and identify patients that are lost to follow-up. A retrospective study has been conducted using the EMR for evaluating AIDS and antiretroviral use [11]. Patient Summary reports can easily be printed for referrals to other medical institutions. Also the EMR data has been evaluated to make sure BHCHP is being reimbursed for all billable encounters.

An advisory board with representatives from each provider type has been formed and meets biweekly to discuss issues regarding the EMR. Providers are very enthusiastic about being part of this board and have offered encouraging feedback and suggestions for making the EMR a better tool. Priorities are set for each request. This collaboration between the advisory board and the developers of the system has proven most productive and all are pleased with the

"team" effort. The providers have identified additional data items that they would like to include in the EMR. These include: additional data fields for the collection of case manager information, a checklist to insure all medical and social service provisions are being made for the patient, add specific fields to meet the Department of Housing and Development (HUD) grant reporting needs, more demographic fields (as many homeless patients now have e-mail addresses and phone numbers to use for job searches), and add fields to record, hospital identification numbers for the various hospitals that patients are know to frequent. Also, since mental health problems are so prevalent among the homeless[1], the providers feel that a separate section of the medical record is needed to document psychiatric information. Currently patient billing information is not part of the system and is handled by an outside service. Steps are being taken to match all primary diagnoses to International Classifications of Disease (ICD) 9/10 codes to start the initiative to use the EMR for financial reimbursements efforts.

However the system is not without its challenges. The current application is connection-based and a valid communication line must be maintained at all times. Loss of connection due to noise on the line has been a cause of frustration for providers. Under Windows for Workgroups 3.1.1, it was impossible to re-establish a connection and resume use of the application. To solve this problem, all computers were upgraded to WINDOWS 95, and code was added to the application so that the user could reconnect and establish the necessary ORACLE database connection. Also, to upgrade and distribute a new version of the application, each client machine needs to be upgraded. Although this "versioning" could be done over phone lines, the magnitude of changes were weighed against the problems resulting from a loss of connection and each client machine was instead hand-versioned. Given the many sites using this application, hand versioning was not the ideal solution.

The complexity of the application necessitated multiple screens for data entry, and users have reported this confusing, or cumbersome. One example is on the Social Service Intake form: efforts were initially made to mimic the paper form and all data fields thought necessary at the time, resulting in twelve separate screens. On a

486 portable computer with minimal memory over a phone line with a 28.8K baud modem, navigation through all these pages was slow. In addition, as the paper Social Services Intake Form went through revisions, the data entry screens no longer reflected the changes. The Social Service section is being evaluated in an attempt to reduce the number of data elements and streamline the data entry.

More quality assurance of care features need to be implemented. Often data is reviewed retrospectively, and it would be more helpful to have immediate feedback on a regular basis regarding charting variability or lack of charting[11]. Since statistical reporting is essential for many avenues of financial support, it is important to insure that key data items are being collected.

The providers have expressed a need for access to knowledge sources, especially for the health maintenance and guideline sections of the chart. Patients are often seen at unconventional medical sites, like a racetrack or soup kitchen, where there is no access for the provider to medical colleagues, diagnostic and medication reference books or computer programs. Because health maintenance is so important for this population, it would be helpful to provide access to the many resources now available.

E-mail could give providers another way to connect with these patients, improving adherence to treatment plans and increasing access to care[12]. Since providers are often at various remote sites, e-mail provides another way to confer and communicate with one another.

Each advance in computer technology since the inception of this system provides an additional opportunity to consider alternative implementations. More and more people have access to portable computers and are increasingly familiar with the Internet and Web applications. Migration to Web-based technology to extend this medical record application could provide solutions to many of the current system's deficiencies. The simplicity of Web-based networking can be used to enhance reliability and performance. Web-enabled technologies provides rapid application dissemination since the software is server-based. Web-based applications have been used to collect and present patient data common to one institution's intranet [13], or across multiple institutions [14].

Preliminary work to migrate this system to a Web-based EMR application has been successful [15,16] and work is underway to create a full-featured Web-based EMR for BHCHP.

CONCLUSION

The electronic medical record has become an accepted asset in providing care for this homeless population. Further work to improve and refine the existing application is ongoing.

ACKNOWLEDGMENTS

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