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FEATURE ARTICLE

Taking It to the Streets

Recording Medical Outreach Data on Personal Digital Assistants

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Carrying hundreds of patient files in a suitcase makes medical street outreach to the homeless clumsy and difficult. Healthcare for the Homeless—Houston (HHH) began a case study under the assumption that tracking patient information with a personal digital assistant (PDA) would greatly simplify the process. Equipping clinicians with custom-designed software loaded onto Palm V Handheld Computers (palmOne, Inc, Milpitas, CA), Healthcare for the Homeless—Houston assessed how this type of technology augmented medical care during street outreach to the homeless in a major metropolitan area. Preliminary evidence suggests that personal digital assistants free clinicians to focus on building relationships instead of recreating documentation during patient encounters. However, the limits of the PDA for storing and retrieving data made it impractical long-term. This outcome precipitated a new study to test the feasibility of tablet personal computers loaded with a custom-designed software application specific to the needs of homeless street patients.

KEY WORDS

Healthcare • Homeless • PDAs • Personal digital assistants • Tablet PCs • Street outreach

Gathering appropriate clinical information "on the streets" has proved elusive for healthcare providers to the homeless. Although complex systems are in place to collect health data and medical reference information in hospitals and outpatient systems, acceptance of these systems has been mixed because they have not been user friendly. This article will discuss a model program designed to collect and deliver clinical information from the street homeless in a variety of settings. The lessons learned from this project have implications for distributed care, as provided by a team of clinicians rather than a single one, and may help improve the care models delivered in more traditional care settings, such as outpatient centers and hospitals. In this pilot program, Healthcare for the Homeless—Houston (HHH), an organization devoted to addressing the needs of the local homeless population, developed a personal digital assistant (PDA) model to share and organize information between clinicians attempting to deliver quality healthcare to the street homeless in a large metropolitan center. The clinical team identified issues that were technical, social, and cultural in nature. It learned that ignoring any of these issues could doom a system to failure.

BACKGROUND

The delivery of quality healthcare to a street homeless population is a difficult task under the best of situations. Of the street homeless patients HHH clinicians encounter, fewer than 50% will have a second visit with a team member.[1] This ratio holds true in other settings

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Preliminary findings were presented as poster presentations at the 30th Annual Meeting of the North American Primary Care Research Group in New Orleans, LA, November 17–20, 2002, and the 31st Annual Meeting of the North American Primary Care Research Group in Banff, Alberta, Canada, October 25–28, 2003.

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such as Operation Safety Net (OSN) in Pittsburgh and Carein' Connections Unlimited in Chicago, leading us to believe the low return rate is not unique to our site. Of the patients who do return, each will be seen an average of three times before being lost to follow-up. Since the street homeless, by definition, have no fixed address in a shelter, halfway house, or other location, it is common for outreach team members to see patients at a variety of sites rather than in the same place. This circumstance generates a need for a highly portable, highly coordinated information delivery system, perhaps more so than what would be needed in a more traditional delivery setting. The system needs to be

- easy to use as extensive training for clinicians is not an option,
- lightweight and manageable, so that a heterogeneous clinician mix operating in a variety of locations can use it,
- robust enough to be used on the street without on-site support resources and yet must meet the needs of the clinicians, and
- inexpensive since there was no budget for information technology (IT) and everything was developed as a pro bono project.

First, we will examine the problems inherent in providing healthcare to the homeless and the social-technical concerns described by Coiera[2] as they relate to medical street outreach. In his discussion of the social-technical framework, he examines how systems are developed and interact with the context in which clinicians deliver healthcare. Next, we will address the underlying technologies that HHH used (Palm V Handheld Computer, palmOne, Inc, Milpitas, CA, and iPAQ H3765 Pocket PC, Hewlett Packard Company, Palo Alto, CA) and the rationale for the selection of each one. It should be understood that every technology produces a set of compromises and the technologies HHH adopted may not be appropriate for other settings and solutions.

SOCIAL DOMAIN

There are two obvious aspects to the social domain in this study. The first is the patient/client population and the second is the clinical/staff population. The authors will briefly describe how aspects of each affect the development and utilization of IT.

Street Homeless

The street homeless actually reflect a minority of the total homeless population in most urban centers, comprising approximately 10%.[3] They differ from other homeless groups regularly accessing shelters and halfway houses because they do not have any kind of stable residence. The transient nature of this population makes it very difficult to assess, evaluate, and track, a problem further exacerbated by its lack of strong affiliations with any organization or location. At a macrolevel, there are two major issues complicating the provision of care. The migration patterns of individual patients around the city are not well modeled, making it difficult to locate individuals for follow-up care. In addition, the lack of an integrated care system between health institutions is problematic. Hence, there is a need for health information to be available to clinicians at the time of contact and "better communication between medical institutions throughout the community."[4(p1)]

Street outreach programs have become a common feature of many community health service programs out of necessity.[5–9] In such programs, clinicians encounter homeless people in diverse settings (soup kitchens, on the streets, under bridges and overpasses, and in shelters) "for the purpose of improving their health, social functioning, or utilization of human services and resources."[10(p261)] HHH assembled a clinical team in 1999 that worked in collaboration with local case managers of the homeless to bring healthcare to individuals living on the street.

Bringing technology to a clinical practice is not a self-evident good. Coiera[2] has noted on multiple occasions that adoption of technology radically changes the work environment. These changes often have intended and unintended consequences. For example, clinicians have seen the use of bedside charting decrease nurse-to-nurse consultation, clearly an unintended consequence. Similarly, it is not clear a priori how the homeless will respond to the introduction of IT in healthcare encounters. The vulnerable nature of this population warrants attention to how the technology will affect social patterns and whether those changes will result in improved healthcare or new challenges to the delivery of care.

During the first few months of the HHH street outreach program, clinicians began amassing copious amounts of patient files they carried from encounter to encounter. During this same period, the organization received a donation from a Houston-based healthcare information systems consulting firm, in the form of initial programming services and ongoing support for PDA programming. In response, HHH began a case study of a clinical intervention lasting from June 2000 through May 2002 in which PDAs were given to care providers to track patients on the street for routine clinical care.[1,11] Because the intention of the study was to improve how medical information was gathered and thereby to ultimately improve service accessibility for the homeless, this project was granted exempt status from the Baylor College of Medicine Institutional Review Board.

Clinical Staff

There is great variability in the medical training and composition of clinical staff working with street homeless around the country. Some programs, such as OSN in Pittsburgh, have many part-time volunteers and funded providers who work solely with the street homeless. HHH has two family nurse practitioners (FNPs) who spend part of their time doing street outreach; there is also a part-time physician as well as other staff employed on a part-time or volunteer basis who participate in the outreach program. The high turnover and staffing variations in these types of programs can lead to a lack of continuity of care between the street homeless and the clinicians. It also means informal information is often not shared among the clinicians. Therefore, the existing electronic medical record (EMR) system is an excellent tool with which clinicians can communicate about patient care.

Limited research has been done on interactions between the street homeless and healthcare providers. Because these patient/provider interactions are inconsistent and brief, the objective is to be more focused than traditional healthcare encounters taking place in office or clinic settings. Indeed, one of the main goals is to help the street homeless become more engaged with the healthcare system.[5] Without knowing exactly how these interactions function, it is not clear what the impact of the technology would be. Moreover, there is limited evidence in the literature about other homeless healthcare programs adopting mobile technology for homeless healthcare. We are aware of only two other homeless healthcare programs using PDAs for street outreach. At Boston's Health Care for the Homeless Program, Palm devices are used to collect biomedical data in a mini-chart format. And, at OSN in Pittsburgh, iPAQ Pocket PCs with Internet connectivity were pilot tested for linkage to the EMR system at both sites. A number of articles discuss the convenience of custom-designed drop-down menus and screens for accessing physical examination results and medications on PDAs,[12–14] while Levine[14] talks about a specially developed software application for data entry of patient information. Despite the fact that these programs are similar in scope and nature to what HHH is using, they were implemented in diverse traditional clinical settings and not for medical outreach with the hard-to-reach homeless population.

TECHNICAL DOMAIN

Over the past 30 years, computers have evolved from huge mainframes occupying entire rooms to desktops sitting in a room to handheld versions small enough to fit in a pocket. The medical and technology literature is filled with articles extolling the virtues of handheld computers in medical practice, detailing their rapid diffusion among physicians and healthcare professionals over the last 10 years.[15–17] Since physicians are among the most mobile professionals, their interest in, and adoption of, wireless technology is not surprising.[18] PDAs offer greater mobility and flexibility and potentially improve the efficiency and accuracy of clinical tasks.[15] They also provide the ability to record details of patient interviews, fill in session charts, and transcribe notes.[13] Two-way synchronization allows creation, updating, and deletion of patient records from any location.[19] Limitations of PDAs include inadequate memory, slow processing power, small display size, and cumbersome input mechanisms.[15,20,21]

The field of handheld or pocket-based computing is becoming more baffling with the rapid evolution of technology. The recently announced Sony VAIO U750P Notebook combines an MS Windows XP machine in a $6.6'' \times 4.3'' \times 1''$ package weighing less than 1 lb (http://www.sony.com). There are also tablet PCs on the market weighing less than 3 lbs from Motion Computing, Inc (http://motioncomputing.com), and Fujitsu Limited (http://www.computers.us.fujitsu.com/www/productbridge_st5000.shtml). This new category of computers will challenge some of the limitations of the PDA in terms of processing power, storage, flexibility, and interconnectivity capabilities. This rapidly changing hardware environment requires an understanding of how hardware allows people to work in a variety of environments. Homeless healthcare, with its unique set of environmental problems, is therefore a perfect setting to test some of the new and more mobile technology.

SYSTEM DESCRIPTION

The developer created a program using Pendragon Forms (Pendragon Software Corporation, Libertyville, IL) for the pilot study with the Palm PDA. The Pocket PC application used in the next phase of street outreach with handhelds was created using Microsoft eMbedded Visual Tools 3.0 and Microsoft SQL Server 2000 (Microsoft Corp, Redmond, WA). The application uses SQL Server CE 2.0 to store data on the Pocket PC. SQL Server replication synchronizes data on the Pocket PC and the centralized SQL Server database. Synchronization is possible through either a cradle attached to a personal computer running ActiveSync 3.6 or via Wi-Fi access points.

The initial goal of the application was to make the technology an integral part of the workflow for clinicians during medical street outreach. Another key requirement was flexibility in data entry methods. It was

important that use of the hardware and program would not interfere with the clinician-patient encounter but would actually facilitate the delivery of patient care. While this project was undertaken to implement a more functional and efficient method for data collection during medical street outreach, the main goal was to test a handheld computer program to capture demographic information, patient histories, and clinical data. Another goal was to track patient outcomes so that the information could be used in future research projects.

Most data fields support free-text entry. In instances of standard data, a drop-down list was used. The choice of "other" was always available to allow for text entry, too. Medical histories, diagnoses, and treatment information for homeless patients could now be acquired and entered into a single client server-based database. Multiple providers could access the electronic records using a secure password system.

RESULTS

Once data collection was completed, patient records were transferred into a Microsoft Access 2000 database. All summary statistics were calculated using SAS Version 8.2. Of the original sample of 1108 patients, 71 files were excluded because they were duplicates. An additional 97 files were not included because the PDA record was considered to be incomplete (missing full name, a Social Security number, a diagnosis, or any set goals). The patient population was predominantly male (89.0%); 50.0% were African American, 35.6% were non-Hispanic white, 13.0% were Hispanic, and 1.4% were either Asian or other. Although the number of female patients receiving services at HHH during this time was relatively small overall (8%), the majority of those were non-Hispanic white (50.6%).

Informal interviews with the clinicians who pilot-tested the PDA platform revealed they were generally satisfied with it as a method for collecting patient information. They felt that using PDAs facilitated more efficient history taking and provided direction about goal setting. However, they thought some areas needed improvement. For instance, data entry became time consuming as the number of patient files in the database increased, eventually becoming a barrier during the clinician-patient encounter. The Palm-based PDAs crashed because of insufficient memory for the large patient database. A new version of the application using more robust iPAQ Pocket PCs was then implemented (in 2003) and remains in use by the current outreach team. Although the free-text entry capability was replaced with drop-down menus to standardize the patient records as much as possible, there are still design issues that may never be resolved: the small screen limits the amount of clinical information that can be viewed in a short encounter and the storage capacity of the iPAQ devices is still restrictive.

We started with an assumption that this population would be technophobic and feel either intimidated by the technology, or worse, might view it as a personal threat or threat to their lifestyle. For example, there was concern that a paranoid schizophrenic patient might think the provider was trying to contact the FBI about him. This did not prove to be the case. It was encouraging to find that the patients seemed comfortable with the use of technology. In fact, many were flattered that such "high-tech" methods or state-of-the-art technology was used with homeless patients.

DISCUSSION

HHH is beginning to see evidence of success with the use of PDAs for medical street outreach. Although much of the feedback is anecdotal, there are definite indications that Houston's homeless have benefited from the advanced technology. Clinicians report that the quality of care is improving as they are able to access appropriate records and spend their time with homeless patients, focusing on building relationships instead of spending time charting. They are also able to coordinate care with colleagues seeing the same patient at other sites. This improves care in two ways: first, providers feel more confident that all of the health information about a particular patient is contained within a single file rather than fragmented across multiple records. Second, providers are able to spend more time addressing patient healthcare needs.

The major obstacle encountered was the limited memory available on the Palm PDA. As more and more patient encounters were recorded, sorting data and moving between screens took more time. Building the application took longer than expected and ultimately, there were unresolved problems. Although there was extensive interaction with the programmer, there was also a clash of subcultures: clinicians felt they could tell the programmer what they wanted and he would make it happen while the programmer thought the clinicians would understand the technology enough to implement the program "as is" without difficulty. There were also unrealistic expectations by clinicians and the management team about what could be accomplished in terms of the amount of time data entry would take, the complexity of what information could be captured, and the overall efficiency of the platform. Finally, data analysis revealed the need for more consistent, uniform data entry methods to avoid the variability inevitable with free-text entry.

As clinicians adapted to the use of PDAs and learned more about their capabilities, they not only began to

demand more of them but also evaluated them in a more critical light. Although moving from the Palm PDA to the iPAQ Pocket PC improved the reliability of the system, the clinicians found that the application impeded the workflow rather than supporting it. The original software program was designed to progress in a logical, linear manner from the beginning of an encounter to the end of the encounter, a condition that did not allow for multiple "paths" through the encounter process. A paradox to these constraints of the software was the clinicians' increased comfort level using the PDAs along with the clients' recognition and acceptance of the value of the technology. This is consistent with Coiera's[2] understanding of the social technical model in which there is a constant interaction between the user, the technology, and the task. What is acceptable at an early stage of adoption may no longer be acceptable at a more advanced stage of adoption.

The sociotechnical barrier was also impacted by financial limitation. All of the programming, and indeed the PDAs themselves, were donated. Although there was a need to revise the software to meet the demands of more advanced users, there were no financial resources available to do so. The complexity of the interactive relationship between the task, the device, and the people is one that is obvious in hindsight but had not been part of the planning process. This also reflects a maturation on the part of HHH as an organization as well. Organizations and individuals need to understand the entrance of technology into everyday practice will have a much larger impact on the culture of the organization.

Because of the limitations of PDAs, our strategy changed in 2004 to developing a tablet PC platform. The advantages of tablet PCs over other PDAs are that data can be recorded with a digital pen, voice, keyboard, or mouse[22]; chart notes can be written or dictated; and there is increased screen space, clarity, and resolution.[23] Recently, Main et al[24] conducted a study of patient receptivity to completing a survey with tablet PCs. Since the study findings indicate patients were willing to use the technology, it seems logical they would also be willing to interact with a provider who used the technology in their presence. Further, although intuitively it seems obvious that tablet PCs rather than PDAs will prove to be the better instrument for collecting clinical information on patients, there is a need to demonstrate whether this is really the case. The relevant questions are as follows: (1) Which technology performs best in field situations? (2) Do providers collect patient data differently depending on the technology? (3) What impact do these differences have on the clinical outcomes? Evaluating the strengths and weaknesses of each technology will help ascertain whether certain limitations outweigh the overall performance and cost benefit of one technology versus the other. For example, tablet PCs may have broader performance capabilities but providers may prefer PDAs because they are smaller and lighter.

With minimal funding and no permanent IT staff, HHH has been able to do what many large corporate organizations have not accomplished: create an EMR system containing all encounter information for homeless patients across multiple care settings. Efforts with PDA implementation taught valuable lessons about the enormity of the challenge communities face serving the homeless population whose medical histories are complex, ability to communicate is often hampered by the same mental health and medical issues placing them on the street, and contact with healthcare professionals is sporadic.

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