Using Personal Digital Assistants and Patient Care Algorithms to Improve Access to Cardiac Care Best Practices

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Abstract

In order to facilitate knowledge transfer between specialists and generalists and between experts and novices, and promote interdisciplinary communication, there is a need to provide methods and tools for doing so. This interdisciplinary research team developed and evaluated a decision support tool on a personal digital assistant for cardiac tele-triage/tele-consultation when the presenting problem was chest pain. The combined human factors methods of cognitive work analysis during the requirements-gathering phase and ecological interface design during the design phase were used to develop the DSS. A pilot clinical trial was conducted at a quaternary cardiac care hospital over a 3-month period. During this time, the DSS was used by the nine nursing coordinators who provide tele-triage/tele-consultation 24/7. This clinical trial validated the design and demonstrated its potential for use by nurses less experienced in cardiac care, and for its potential use in an interdisciplinary team environment.

Keywords

Clinical decision support, personal digital assistants, cardiac care best practices

Introduction

As the worklife of healthcare professionals becomes ever more complex, there is a need to provide them with decision support tools (DSSs) that enhance their practice. Providing the right information at the right time in the right format is a modern challenge that healthcare researchers, educators, and clinicians are currently struggling with. At present, even though there is a trend to increase the role of clinical nurse specialists in healthcare, there are a declining number of nurses with sufficient training to perform this role [1]. In addition, there continues to be very few computerized decision support tools for advanced nurses. [2] [3] Every indication, however, is that this is changing. Journal articles, best practice guidelines, drug guides and other forms of decision support tools for clinicians are readily available on the world wide web. Decision support can be thought of as any resource that provides guidance for making decisions regarding clinical care. The availability of decision support tools for downloading onto personal digital assistants (PDAs) has seen explosive growth in the last several years, and the rate of adoption has outpaced the evaluation of such tools [4]. Strayer, Reynolds and Ebell [5] provide a comprehensive overview of the various applications available for decision support on personal digital assistants. The majority of applications available, however, do not provide targeted summary information in order to provide information in an efficient manner. In addition to whatever evidence may be drawn upon in the literature, there is a window of opportunity to capture the clinical expertise of experienced clinicians before the first large wave of retiring healthcare practitioners leave practice. With the regionalization of healthcare services, there is also a need for innovative ways to support teamwork across professions and between hospital care and care in the community.

The intent of this project was to demonstrate the viability and value of implementing a cardiac decision support tool on personal digital assistants to deliver standardized care to cardiac patients using a human factors approach to the design. PDAs are particularly suited to tasks where there is an urgent need to access the decision support tool and the user is mobile.

The University of Ottawa Heart Institute nursing coordinators (NCs) receive approximately 2,000 calls a year from patients. Of these 2,000 calls, about 20% of them are from patients experiencing chest pain. Therefore, the application chosen to design and develop was the cardiac teleform, which was the previous paper-based documentation form that the nursing coordinators used to document calls from patients. This documentation record was used to capture patient demographic information, a description of why the patient was calling in, the pertinent clinical history, the nursing assessment, a description of the advice and recommendations that the NC gave the patient, and documentation as to whether or not the patient agreed with the advice and recommendations. The intent of the PDA-based teleform was to provide a vehicle for documenting the information exchange between the nursing coordinators and the caller, but also for embedding decision support.
Methods

Two human factors methods were used for this project. A cognitive work analysis (CWA) approach [6] was used for the requirements gathering/task analysis phase and the ecological interface design [7] approach was used for the design phase. Other than the cognitive work analysis (CWA) that has been done related to hemodynamic monitoring [8], there has yet to be a cognitive work analysis performed to model the work that nurses do to design computerized systems that would facilitate the nursing process.

Although a full CWA has five levels of analysis that include an analysis of complexities, an analysis of tasks, strategies analysis, social-organizational analysis, and worker competency analysis, not all five levels are appropriate to conduct for all projects. For this project, we concentrated on the strategies analysis which included in-depth interviews with all eight of the nursing coordinators (NCs) at the University of Ottawa Heart Institute. In addition to the interviews, the NCs were asked to generate examples of the types of calls that they received. Twenty-five hypothetical calls were generated.

The hospital provides patients with a number they can call 24 hours a day, 7 days a week to talk with one of the nursing coordinators. An analysis of the types of calls received was performed on the paper-based cardiac teleform documentation for a one-year period from November 17, 2002 until November 16, 2003. During this period of time, 550 calls were received from cardiology patients and 1520 calls were received from cardiac surgery patients. For the cardiology patients, chest pain calls ranked second in terms of the numbers of calls received and for cardiac surgery patients, chest pain or incision-related calls ranked second. The only calls that were more numerous in number were medication-related calls. In order to help with the medication-related calls, commercial software was downloaded onto the nursing coordinators' PDAs.

In order to embed more explicit decision support related to chest pain calls, we were interested in developing decision trees (algorithms). A brain-storming session was held with nine subject matter experts (SMEs), three of whom had previous experience developing chest pain algorithms for tele-homecare and interactive voice response systems. Three chest pain algorithms were developed: (1) Possible ischemic pain, (2) Cardiac surgery, incision not healing well and (3) Cardiac surgery, incision healing well. The algorithms were reviewed and approved by the cardiac surgeon and cardiologist on the team.

The decision support tool that was developed was a cardiac tele-triage/tele-consultation tool called the cardiac teleform residing on a personal digital assistant (Palm Tungsten T3) with companion desktop software for downloading patient files from the memory card. Feedback on the alpha version of the PDA software was received from the NCs as well as from participants of a family physicians conference and participants of a nurse practitioner conference.

Figure 1 provides an example of how visualization tools were incorporated into the cardiac teleform. OLDCAR is an acronym for onset, location, duration, characteristics, associated symptoms/aggravating factors and relieving factors. The ‘T’ for ‘treatment’ that is usually associated with the mnemonic OLDCART was not included as the application focused on the nursing functions of assessment, consultation and triage of patients.
The algorithm is meant to suggest questions that might be asked in order to help the clinician decide on a recommendation. The ‘car’ icon is an access point for OLDCAR data entry. The ‘D’ icon is an entry point to provide more information such as whether or not the patient had a aortic or mitral valve replacement, or a valve repair. The ‘i’ icon indicates points where more information can be obtained, such as a reminder of serious complications that can arise after cardiac surgery, the signs and symptoms of those complications, and any pertinent references.

As a variety of pieces of information are gathered during a phone call from a patient, we provided a summary page that could be accessed at any time during the call by clicking on the 'S' icon at the top of the screen. The top of the screen also has shortcut icons to facilitate switching algorithms if you need to, going to the OLDCAR assessment page directly, or accessing the bibliography. The bibliography includes references to pertinent texts and articles but also to current related cardiac consensus guidelines from the Canadian Cardiology Society, the American Heart Association, and the American College of Cardiology.

A 3-month pilot clinical trial was performed with the developed cardiac teleform. Outcome measures included evaluations of (a) appropriateness of the advice received as judged by the patient's physician, (b) satisfaction with how the call proceeded and the advice that was given as judged by the patient, and (c) satisfaction with using the tool as judged by the nursing coordinators. A log analysis of navigation and data entry strategies were performed and all NCs participated in in-depth interviews at the end of the clinical trial.

Results

Themes from the Interviews at the Start of the Project

Seven of the eight NCs were interviewed following a semi-structured format for between one and two hours at the beginning of the project. Although there were many areas of agreement among the NCs, the way in which the call proceeded and the types and number of questions that were asked differed. In terms of agreement, six of the 7 NCs thought that there were major differences in the way a call proceeded with a cardiology patient compared to a call from a cardiac surgery patient. Although initially the NC is assessing whether or not the patient is acutely ill (for instance, having ischemic cardiac pain, in which case the recommendation would be that they hang up the phone and call 911), the calls proceed differently if the patient recently had cardiac surgery or is being followed by cardiology. Many questions that are appropriate to surgery patients (for instance, questions related to the surgical incision) are not applicable to cardiology patients. Therefore, the first two check boxes on page 1 of the cardiac teleform has the NC choose whether the patient is a cardiac surgery patient or a cardiology patient. The following screens then have items related to that subpopulation.

An example of where the call might be managed differently depending on the NC, was illustrated by their answers to the following question: "For cardiac surgery patients, do you always (or almost always) assume that the complaints have to do with the recent surgery? Would you be as likely to consider other possibilities (e.g. a new condition on its own) at the same time?" Four of the 7 NCs said that they almost always assume that the complaint has to do with the recent surgery if the patient calling was a cardiac surgery patient. The other 3 NCs said that they considered not only the recent surgery but other types of problems that might also affect cardiology patients. For this reason, in terms of the design of the teleform, a drop-down menu at the top of the teleform allowed for quick access to any of the 12 pages in the teleform and the NCs did not have to go through the teleform sequentially. The algorithms were designed so that they could be entered or exited easily from any location in the teleform and the navigation within the algorithm was not constrained.

Feedback from Family Physicians and Nurse Practitioners

Although the feedback on the alpha version of the teleform received from the family physicians and the nurse practitioners at the two conferences did not help with any design modifications, it did help validate the approach to decision support that we were taking. One family physician commented that it would be particularly useful in his clinical setting where he was the team leader for a number of nurse practitioners in a rural setting.

Results of the Clinical Trial

The final version of the cardiac teleform was evaluated in a 3-month pilot clinical trial. The NCs were given the choice of using the teleform on the PDA or their paper-based teleform.
when they received chest pain calls from patients over the 3-month period. Of the 61 chest pain calls, 46 of them were documented with the PDA software. The outcome measures used to evaluate the effectiveness of the cardiac teleform were:

- Appropriateness of the advice received as judged by the patient's physician
- Satisfaction with how the call proceeded and the advice that was given as judged by the patient
- The nursing coordinators' satisfaction level when they used the PDA teleform software on chest pain calls

An analysis of the NCs' navigation and data entry strategies was performed from the teleform log file.

Of the 61 chest pain calls, 46 (75%) of them were documented with the PDA software. The advice received by the patient from the NC was considered appropriate by the patient's physician in 59 of the 61 calls (97%). Thirty-four of the 37 patients who could be reached for feedback were satisfied (92%) with how the call proceeded with the NC and with the advice that they received. Two of the patients contacted did not answer the question. For the one patient who stated that they were not satisfied, the advice given was different from the recommended advice in the cardiac surgery algorithms in the cardiac teleform.

The median satisfaction rating of the nursing coordinators with using the PDA teleform on chest pain calls where 1 was 'not at all satisfied' and 5 was 'very satisfied', was 4.00. The navigation strategies revealed that despite the fact that the power user features were built into the decision support tool to reflect the various strategies the NCs used during their calls with patients as revealed during the initial interviews, they mainly used the cardiac teleform in a serial manner, going from page 1 to page 12 in order.

Themes from the Interviews at the End of the Clinical Trial

Part way through the project, another NC was hired, leading to a total on 9 NCs to participate in the clinical trial. Each of the 9 NCs participated in an end-of-project semi-structured interview lasting approximately an hour. The features of the cardiac teleform that were considered the most useful and easiest to use were the pick lists, the drop down menus and the OLDCAR assessment pages.

The algorithms, which were developed with the help of the NCs and approved by them before the clinical trial, were generally more complete with the PDA teleform than it was with the paper-based teleform. We investigated the accuracy of the NCs' perception that documentation was generally more complete with the PDA-based teleform than it was with the paper-based teleform. We compared the documentation of the required data elements in the 46 PDA-based teleform records with a matched set of paper-based teleform records of comparable chest pain calls received immediately preceding the clinical trial. The documentation was more complete on the PDA-based record 68% of the time.

Seven of the 9 NCs thought that it was more time-consuming to use the PDA teleform than to use the paper-based teleform. There was also the fear that the information may get lost since the PDAs were stand-alone and not connected to a wireless network to be downloaded to the hospital LAN since the hospital does not currently have a fully functioning wireless network. The NCs also did not like the process of having to transfer the patient files from the memory card to the card reader and then onto the companion desktop software on the PC.

In terms of the design of the teleform and the algorithms, all of the NCs thought the DSS supported their usual workflow and did not interfere or change the development of their mental models regarding the patient's condition. They all thought that the decision support tool would be particularly useful for novice nursing coordinators with the caveat that they also be encouraged to think for themselves in case the problems the patient is calls in with do not fit into the algorithms.

Discussion

The use of the combined human factors methods of cognitive work analysis and ecological interface design resulted in a decision support tool that closely matched the nursing coordinators' cognitive strategies and mental models they develop during their tele-triage/tele-consultation sessions with patients. The use of PDAs for healthcare applications are still limited by (1) the speed and robustness of the device and (2) cumbersome data entry using graffiti or the keyboard.

Conclusion

The combination of decision support and personal digital assistants has seen explosive growth in the last several years [4] [5]. However, the majority of the applications available are generic in nature, providing information only or allowing for calculations of various sorts. The next generation of more
clinically comprehensive interactive decision support tools for PDAs are only starting to emerge [9] [10]. The decision support tool reported here is another example of a next generation PDA application. The cardiac teleform application design was the cumulative result of a cognitive work analysis and ecological interface design human factors methods. The cardiac teleform and embedded algorithms for decision support provide a flexible, interactive tool which results in documentation of the nursing coordinators’ tele-triage/tele-consultation session with the patient. Reference to the evidence, where it exists, to support the recommendations for questions to ask and suggested courses of action to take, are easily accessible in the tool. This type of application has the potential to be utilized in a multi-disciplinary team environment if it were to include scope of practice information for the professionals on the team. The approach taken here also provides a vehicle for capturing the expertise of specialists Since many aspects of clinical recommendations are the result of expert opinion, this tool also demonstrates how the expertise of specialists can be captured to share with other healthcare professionals in a variety of clinical settings.

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References


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