Medical Utilization of Kiosks in the Delivery of Patient Education: A Systematic Review

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ABSTRACT

Background: The utilization of kiosks has previously been shown to be effective for collecting information, delivering educational modules, and providing access to health information. We discuss a review of current literature for the utilization of kiosks for the delivery of patient education.

Methods: The criteria for inclusion in this literature review were: (1) study discusses the utilization of kiosks for patient health education; (2) study discusses the use of touch screens for patient health information; (3) published in English. Our review includes searches via MEDLINE databases and Google Scholar for the years 1996-2014.

Results: Overall, 167 articles were screened for final eligibility, and after discarding duplicates and non-eligible studies with abstract. Full-text review of 28 articles was included in the final analysis.

Conclusion: The review of available literature demonstrates the effectiveness of touch screen kiosks to educate patients and to improve healthcare, both at a performance and cost advantage over other modes of patient education.

Introduction

Most providers of health information presume information will be understandable and beneficial to their audience in some way.[1,2] The trend to develop kiosks in accessible public locations in order to deliver information and services to the general public is ongoing. Numerous factors influence the use of kiosks, including belief in the accuracy of information content, convenience with regard to both location and time available, and ease of use.[1-3] These kiosks can deliver low-cost services at the point of need (e.g. money near a shopping center, tickets in a station).[4] Government and industry spending on digital consumer health information initiatives have recently increased.[1] Several studies have been published regarding kiosk and multimedia use in various clinical settings for patient education. We conducted an extensive literature search using the MEDLINE database and Google Scholar to gather articles for our review [MED-

LINE consists of a database of references and abstracts on life sciences and biomedical topics while Google Scholar lists all journal articles available on the World Wide Web (WWW)]. All pertinent articles that discussed the use of kiosks, computers, or other touch screen methods for the use of delivering health information, health education, or health data collection were included in the review.

Materials and Methods

For the review since we were concerned with the delivery of health information, the MEDLINE database and Google Scholar (1996-2014) were searched for articles containing "kiosk education" in the title or as a keyword. After our search criteria produced a limited number of relevant articles, the search was refined to include "touch screen", "computer assisted", or "kiosk" in the title. After compiling articles, they were narrowed down to a total of twenty-eight that discussed the utilization of kiosks or touch screens for patient health educational or informational purposes. We discarded peer-reviewed articles that did not discuss the delivery of patient education and/or information. Most discarded articles discussed patient information abstraction for the use of registering in an emergency department (ED) or physician's office visit or the technical/simulated training for healthcare providers. Ethical approval of this study was gained from the Research Ethics Committee.

Results
Medical Kiosks in Public and Healthcare Settings

In one shopping center, a single kiosk was installed for public use over seven months. The kiosk was used by over 20.8% of people exposed to it. The number of kiosks was subsequently expanded to eighteen in operation for one year. The kiosks were used a total of 57,064 times with an average use of 19.4/kiosk/day, thus showing a substantial capacity to engage people for oppor-

tunistic use in a community setting.[5] In a one year period, 120 kiosks in community settings registered over 306,302 pages viewed. The viewed pages most often addressed losing weight, itchy rashes, and adult chest pain; the most commonly viewed topic. The top use-per-day locations were in docks, hospitals, walk-in centers, and "Kwik Save" supermarkets. The lowest utilized kiosk locations were in community centers, youth centers, and Citizen Advice Bureaus.[6] These studies show that kiosks do not need to be deployed in a healthcare setting; high usage can be attained in common pedestrian areas. The studies, however, also indicate that viewer time constraint is an impediment to use in high pedestrian traffic areas, such as markets and docks resulting in frequent, but short use times.[6]

Nevertheless, kiosks are shown to be useful in the hospital setting. In a study conducted by Nicholas et al, kiosks that provided information on medical conditions, surgical options, health news, support groups, healthy living, and a health directory were installed in a hospital setting.[1] Seventy-nine percent of the viewers reported the information to be easy to use, 90% found the information easy to find, and 88% found the information easy to understand. Two-thirds of the users stated that the information they obtained successfully answered their question.[1] Similarly in an ambulatory cancer clinic, the use of computer touch screen technology was found to be an acceptable and efficient method for obtaining self-reported information on quality of life (QOL), cancer needs, and psychological distress. Despite half of the respondents not having previous computer experience, 99% found the touch screen kiosk easy to use.[7]

Majority of articles reviewed with "computer assisted" in the title discussed utilization of computer techniques in developing surgical skills, performing surgery, and medical provider education rather than patient education. For these reasons, they were excluded from our review as they did not meet our search criteria for the delivery of health

information to patients. Articles pertaining to patient education utilizing computers performed assessments or gathered patient information for assistance in delivery of care, such as family history and registration for healthcare visits.

Kiosks are Effective regardless of Gender, Age, or Education Level of the Users

Multiple studies have found that kiosks can be an effective public education tool irrespective of the gender, age, or education level of the target population. Use of kiosks in a hospital setting was not related to gender, neighborhood type, or length of time in the waiting room.[1] An overwhelming majority of female kiosk users in a prenatal clinic did not find the kiosk difficult to use and a greater proportion of women with limited education, compared to college educated women, favorably reported the use of the computer.[8] Woman with an age range of 36 to 81 years used the kiosk to receive information about urinary symptoms suggestive of the diagnosis of detrusor instability. No 'technophobic' reluctance by older women in the group to use the computerized system was evident. Older aged women were also able to successfully use an asthma kiosk in an ED setting.[9] In this study, kiosks did not disenfranchise any particular demographic group, irrespective of computer comfort level, previous Automated Teller Machines (ATM) use, education level, or racial group.[9]

Kiosks in Multi-Lingual Settings

The government encourages its citizens to take a greater role in their healthcare; however, the information required is not always easily accessible to the public. This is especially true for many ethnic-minority group members who do not read or speak English.[10] A study by Peters and Jackson demonstrates that multi-lingual kiosks can be an effective tool for delivering information on healthcare topics to African-American and minority groups.[10] In the study, healthcare topics were translated into five languages including Chinese, Bengali, Gujarati, Urdu, and Mirpuri Punjabi. Among 2456 users who accessed the kiosk for topics such as stress, diabetes, blood pressure, healthy eating, and exercise, 508 were given survey questionnaires. Feedback from most of the users indicated they found the kiosk easy to use.[10] In another study, a trilingual kiosk was used to provide information on malignant melanoma to viewers in Swedish, English, and German. Over 500 pages of information were provided in each language and nearly all of the 274 users found the kiosk easy to use with easy to understand information.[11] A third study reported that kiosks using Interactive MultiMedia (IMM), in coordination with classes taught by *abuela* (Hispanic grandmother) educators, enhanced the potential for delivering healthcare information about nutrition and behavior improvement and reinforcement. The effectiveness and cost benefit of bilingual (Spanish and English) IMM nutrition education used in conjunction with peer education classes on nutrition proved to be additionally beneficial.[11]

The Importance of Kiosk Design

The design of the kiosk is extremely important. The kiosk must be noticed by people passing by and its purpose must be clear.[4] Introductory material may be given and the system must appear simple and intuitive to use. It must also cater to those with limited skills or experience and with physical limitations and cognitive impairment.[4] Since users may also have time constraints, the system must be able to provide information or services quickly.[4] The system must be understandable at all stages of the interaction process and return automatically to an initial state if use is terminated.[4] There is an absolute necessity to protect the privacy of the user's medical records, especially in a healthcare setting.

Various touch screen vendors were detailed in the studies. No study reported problems with the touch screen itself. User perception of touch screen privacy was related to the size of the screen. Twelve inch screens were felt to be more private then 15 inch or 17 inch screens.[12] With privacy par-

titions, 12 inch and 15 inch screens were felt by most users to be private; however, 17 inch screens were not reported as feeling private by the users regardless of the presence of privacy partitions.[12]

Use of voice-recorded questions address the challenge of completion of a self-administered questionnaire by users with low verbal literacy.[8] Answering questions by touch screen eliminated the need for keyboard skills. Kiosks can easily be adapted to non-English speaking populations because the voice recording can be programmed in other languages. In a kiosk in an ED, the design was compared to an ATM and only 4% of users found the kiosk more difficult to use then an ATM.[9] Using an ATM as a measure of previous computer use found no differences in results between those experienced with computers and ATMs versus those without.[13] Ease of reading the information was important and users who found the kiosk difficult to read were twelve times less likely to have their question answered.[1] While some older users had problems reading the kiosk screen, they reported no problems in getting their questions answered.[7]

Important design considerations for a kiosk system in an ED setting include: 1) mobility of hardware, 2) modular approach to data entry, 3) visual simplicity, and 4) physical and cognitive ease of use. The design should also ensure: 1) data entry independent of keyboard use, 2) a multimedia approach to collection and dissemination of patient specific health information, 3) plain language, 4) semantic mapping of patient-level language to medical concepts, and 5) embedded editing and error-checking strategies to ensure maximal accuracy of patients' input.[9] Finally, it is necessary to ensure that the security of the kiosk is not compromised either locally or remotely.[14]

Kiosks and Traditional Paper Methods of Education

Effectiveness of the information and questionnaires delivered by kiosks versus paper showed kiosks to be as effective as or more effective than paper. A comparison of paper versus Personal Digital Assistant (PDA) versus tablet to administer the Pre-Admission Adult Anesthetic Questionnaires (PAAQ) instrument showed the kiosk to be most efficient with participants ranging from 18 to 92 years old and with two-thirds of the participants being female.[15] A study to evaluate the system by which women best learned and retained information on urinary symptoms concluded that both pamphlet and computer-delivered information were effective in increasing knowledge about urinary symptoms in women. Although both systems were liked by the participants, the computer system was slightly more effective than the pamphlet in increasing knowledge.[16]

A similar study utilizing the Quality of Life in Reflux and Dyspepsia (QOLRAD) questionnaire showed similar comparable reliability and validity of results when administered via paper versus kiosk.[13] Touch screen QOL questionnaires were shown to be well-accepted by cancer patients, with 52% versus 24% preferring the touch screen over paper use, (24% had no preference) with good data quality and reliability.[17] In a study on prenatal testing, the touch screen showed no added benefit over well-prepared leaflets. The touch screen however, did seem to reduce anxiety in nulliparous women.[18] Similarly, a kiosk delivering educational modules on Human Immunodeficiency Virus (HIV) increased patient knowledge regarding HIV testing, but did not result in an increase in testing rates.[19,20]

Costs Effectiveness of Kiosk Systems

A computer-based educational system is likely to have a significant cost advantage over other educational media. According to one study, the cost for implementing an education kiosk was relatively small. The cost for a computer with touch screen monitor was $700 and the monthly internet fee was twenty-five dollars.[21] A general computer information system costs less than half of the cost of providing full access to booklets, even if the booklets were purchased at a discounted, bulk rate.[22]

An evaluation by Gould and Anderson concentrated on the cost-effectiveness of kiosks in delivering nutrition education.[23] The kiosks were placed in several locations such as Head Start facilities, WIC clinics (Special Supplemental Nutrition Program for Women, Infants and Children), health centers serving immigrants and low-income persons, and in food pantries. These IMM modules were shown to be cost-effective through two sets of analyses.

The first analysis was cost comparison considering development, implementation, and evaluation. The second analysis was on cost comparison considering only delivery of nutrition information. Total direct costs for both *abuela* group education and IMM via kiosk delivery were determined. From these values, cost per participant per unit or per module of nutrition education was calculated. The cost per unit/module for the *abuela* group instruction was similar to that for one IMM system for 633 people. After 633 people (or 40 days of use), the IMM became more cost effective. At this rate, the IMM system was projected to educate 4000 users each year. The yearly cost savings through one computer kiosk system was enough to pay not only for itself, but also for three additional IMM systems. The study reported that the development time for the first module was eighteen months; however, the second module took less than three months for development. Greater experience in module development may not only lower costs and development time but may also lead to higher quality IMM modules.[11]

Effectiveness of Kiosks to Improve Public Knowledge and Behavior

The studies of these kiosks demonstrate they can improve the delivery of healthcare information. Kiosks have been shown to successfully instruct parents on child safety through tailored delivery of education on issues such as car seat safety, injury prevention, and ipecac use.[21] Headache disease management kiosk programs were successful in demonstrating decreased urgent care ED use, a decrease in lost workdays, and an overall improvement of headache symptoms with decreased headache frequency.[22] Parents of pediatric patients gained more knowledge on issues such as fever management, dental care, sleep position, nutrition, and car seats when the information was delivered via kiosk.[23] Asthma kiosks in an ED showed that patient self-reporting via kiosks was more valid than nursing documentation at triage on all medication details.[24] The asthma kiosk also successfully linked parents' data to guideline recommendations and identified data critical for health improvements in asthmatic children that would otherwise remain undocumented during ED based care.[25] The kiosks supported collaboration between parents and ED providers by providing patient–derived data in a structured form to the ED providers, including "actionable" content not currently captured through ED care.[9] The asthma kiosks however, failed to improve parents' satisfaction regarding the partnership with ED providers which may be due to providers' inattention to parents' concerns that were communicated via the kiosk.[9] Clinic users of education kiosks showed a 68% overall satisfaction rate with the kiosk. There was also a 24% increase in the number of patients receiving flu vaccinations compared to the previous year. These facts suggest that kiosks may increase patient compliance with clinical guidelines and instructions.[26]

In Michigan, fifty kiosks were installed specifically targeting areas of low-income and high pedestrian volume in shopping malls, department and grocery stores, health clinics, and libraries. The kiosks were able to deliver health messages tailored to individuals' needs and interests. In addition, the kiosks sparked discussion by community advocates about health issues and resource availability.[27] Sixty-six percent of kiosk users receiving education on malignant melanoma found the program information "worrying" and 29% (mainly young women) instantly declared that they were going to change their sun-exposure behaviors.[11]

When used for cancer risk assessments, touch screen family history questionnaires

enabled easy collection of family history information and risk assessments for a broad population. Awareness of familial risk and appropriate surveillance also increased. The combination of computer technology, knowledgeable genetic professionals, and tailored risk assessment communication showed to be effective in promoting desired modification of health behaviors.[14]

Discussion

The result of this review of information kiosks demonstrates the wide variety of uses of the kiosks. Kiosk placement in areas of high pedestrian traffic including shopping areas, clinic, and hospital settings demonstrated the ability to delivery healthcare information to a broad audience, independent of age, race, language, education, or gender with most users finding the kiosks very easy to use. Kiosks are also shown to be as effective as paper for delivery of information or administering questionnaires. In an emergent setting, kiosks proved to be more effective in gathering patient medication information than nurses or physicians, improved documentation and identification of risk factors in children with asthma, and increased patient compliance with clinical guidelines and instructions. The design of the kiosks showed the cost of the hardware relatively inexpensive with the system being more cost-effective than booklets, and was able to increase the number of users receiving nutritional education. Overall, we show that kiosks are capable resources in healthcare for both patient education and data collection. As the transition from traditional paper records to Electronic Medical Records (EMR) continues in healthcare, kiosks may provide a cost- effective way for users to not only receive healthcare information tailored to the content of their EMR, but also to update medical, family, and medication history for review by the treating physician. This is of interest in the emergent setting where family history of disease or current medication use would allow another criterion for patient triage and risk stratification.

This study did not directly review any of the kiosk software or hardware detailed in the studies. Although some details of the expenses of the hardware and development where addressed, we do not have full cost analysis of the design, development, deployment, and continuous maintenance of the kiosks.[9,11,28] Software upgrade testing cycles, software change management, software 'bug' fixes, hardware replacement costs, physical and software security need to be considered when deploying kiosks. Monitoring of the systems also needs to be considered to ensure that the kiosks are properly functioning at all times. If the systems are being used in an emergent setting, onsite 'spare' kiosks should be available and deployable in a timely fashion. This study focused on stand-alone kiosk systems and did not address WWW based information systems.

Future investigation should focus on connecting stand-alone kiosk and WWW to healthcare EMR systems and how this would affect patient care in outpatient, emergent, and inpatient hospital settings. Cost analysis of programming and software and hardware management need to be addressed. Security of the kiosks is critical to both the hardware and software of the systems and also to patient information. Moving from a stand-alone kiosk system to a WWW based system may further decrease costs by allowing central management of the software and content. With this model, the endpoint kiosks would be inexpensive WWW browsers with minimal hardware and software requirements. The model also allows patients remote access to portions of their EMR.

This review was undertaken with the specific purposes of examining medical utilization of kiosks in the delivery of patient education. While our review identifies important studies discussing this topic, there are several limitations. The search was performed using two databases; MEDLINE and Google Scholar. Future reviews should be expanded to include the educational database, Educational Resource Information Center (ERIC)

and the medical database Pubmed. The limited number of available literature on the delivery of health education to patients hinders the scope of this paper. Multiple studies would allow a complete meta-analysis on a larger sample size. Finally, the search for evidence was limited to peer-reviewed research publications available in English; as a result, the limitation of publication bias exists in the findings of this review.

Conclusion

Information kiosks are widely used and favorably accepted by the general public. Deployment of healthcare kiosks in both community and medical institution settings is an effective, efficient, and low-cost method of providing healthcare information and can improve healthcare outcomes of the target audience regardless of age, gender, race, language, literacy, demographics, and previous computer usage experience. Careful design of the kiosk, its user interface, and the information content is necessary to maximize the effectiveness of the kiosk and to allow for its use across a broad spectrum of users.

Competing interests

The authors declare that there is no conflict of interest.

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