Accessing MEDLINE/PubMed with Handheld Devices: Developments and New Search Portals

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Abstract

We report on two new portals for searching MEDLINE/PubMed with handheld devices, PICO (Patient, Intervention, Comparison, Outcome) and a WAP (Wireless Application Protocol) browser interface. Early user evaluation and user feedback will be discussed. We also include an updated report of user evaluation of established search tools for handheld devices included in the first release.

Introduction

PubMed for Handhelds was announced to the general public in July 2003 in the National Library of Medicine (NLM) Technical Bulletin.[1] A new URL, http://pubmedhh.nlm.nih.gov, was obtained and subsequently publicized in March 2004[2] in response to written and verbal user feedback that the old URL was too difficult to write or type on a handheld device. A PICO feature was added to PubMed for Handhelds in May 2004.

PICO (Patient, Intervention, Comparison, Outcome) is a method of searching for evidence that encourages the formulation of a focused, structured question. Booth[3] found that this search strategy was associated with more precise searches, while Richardson *et al*[4] wrote that the practice of evidence-based medicine was facilitated by using the well-built clinical question. Although originally used as an aid for clinicians, especially medical students, it is now employed towards developing search skills.[5] The use of a structured question has been advocated in designing systematic reviews.[6] Medical librarians and evidence-based centers provide instructional Web pages and tutorials on using PICO.[7-11] A study on providing instructions on its use showed a positive impact, but whether it had an effect on patient outcome was not resolved.[12]

A continuing convergence of handheld devices is taking place through the integration of desirable features of mobile phones into PDAs and vice versa. As a result, mobile phones and PDAs are becoming more capable, many new mobile phones are now equipped with Web browsers and PDAs are getting more sophisticated in their wireless communication capability. Mobile phones are now being used for purposes originally intended for PDAs and even desktop browsers. We have had to adapt to changing user needs. For example, some users of the PubMed for Handhelds tool were having difficulty in accessing MEDLINE/PubMed on their Symbian operating system mobile phones with WAP browsers. One of the new interfaces reported here was designed to enable mobile phone users to access MEDLINE/PubMed. This required collaborative interaction with users because some of these handheld devices are not currently available in the US.

We will report on these changes and discuss early usability feedback on PICO. We will also discuss our experience with the features in PubMed for Handhelds in use for almost a year

now. Not enough data has been gathered to report on the WAP mobile phone portal.

Methods

An announcement to enlist the assistance of medical librarians in recruiting PICO testers was made in medical librarians' listservs in the Mid-Atlantic and Southeastern US regions. Many librarians in turn forwarded these to the their local e-mail system. Prospective participants of the evaluation were requested to contact the NLM directly. Interested parties were contacted by e-mail and given a brief introduction on PICO, links to PICO tutorials from medical libraries and instructions on how to access PICO and the feedback form. A link to the user feedback form was provided on the PICO Web page.

The form consisted of a set of questions in a checklist format based partly on a 5-point Leikert scale. Upon submission, it was converted to e-mail and sent to the NLM. A new e-mail account (pubmedhh@nlm.nih.gov) was created for the study. A follow-up e-mail was sent to non-responders after two weeks. The results of these forms were then tabulated.

The "Clinical Queries" feature in PubMed for Handhelds was modified based on new evidence from Haynes et al.[13] The new strategies have better performance than their predecessors. The modification matches current research methodology filters of PubMed.[14]

Results

PICO usability results

Fifty-seven people responded to the call for participation by sending an e-mail signifying their interest to participate in the usability study but only 14 completed the evaluation, a responses rate of 25%. Many of the forms were incomplete. The responders were equally represented at five each between those who used PDAs (3 Palm and 2 PocketPC) and desktop computers. One responder used a Nokia 6600 mobile phone. Six users connected to the Internet through wired networks, while three were on wireless networks.

Table 1 shows the responses to user interface questions. Ten users found the interface easy to

use. Only one thought that it was not easy to use because "not enough information" was given about the vocabulary to use. That participant thought that "the PICO trial assumed a great deal of knowledge about terms specific to PICO" and mentioned that it would be "hard to teach to students just learning about PICO." In response to the question whether this method of searching MEDLINE/PubMed was useful, ten participants said yes. The same responder as above said that it was not.

	Yes	No
Is the interface easy to use?	10	1
Is this method of searching MEDLINE/PubMed useful?	10	1

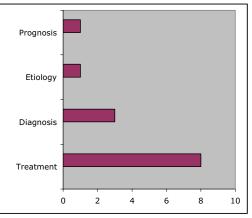**Table 1. User response to interface and search method questions.**

Figure 1. Clinical categories of searches by users of the PICO portal (n=13).

Figure 1 shows the distribution of the clinical categories of users of the PICO portal. The majority (n=8) used PICO to search for treatment options. Three searched for questions of diagnosis and one each for etiology and prognosis.

The overall quality of citations retrieved was judged "Excellent" by three, "Very Good" by two and "Good" by four participants. When asked whether they would use PICO in the future, 8 said yes and 3, said no. The question as to whether they would recommend PICO to a colleague was evenly divided (four each) among those who would and those who would not.

PubMed for Handhelds Feedback

The PubMed for Handhelds server log showed a total of 154,786 successful requests (average daily access=471) 10 months after its public announcement. The majority of server access (83.5%) originated from publicly available AvantGo proxy servers signifying that PDA users continue to dominate the use of this resource. However, the number of PDA users accessing the server through privately owned AvantGo proxy servers had dropped to less 1%. MEDLINE/PubMed searches were performed by 1.2% of users.

Only 39 users have completed an evaluation form. Fifteen of these users used a Palm PDA and 13 were PocketPC (PPC) users, although one responder said that they distributed 115 wireless enabled PPCs to their students. Only one reported using another handheld device, a Nokia mobile phone.

Figure 3 shows the route that users access PubMed for Handhelds. The majority of users continue to be PDA users who synchronize and access the Internet through their desktop computers using a USB connection.
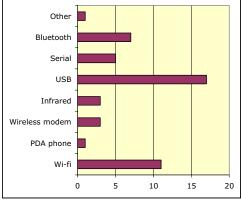

Figure 3. Method of access to PubMed for handheld devices (n=35).

The purpose of searching MEDLINE/PubMed is shown in Figure 4. Fifteen of responders said they used it for patient care, 14 for research, 12 to keep updated with the medical literature, and nine to discuss with colleagues. Two used it to teach clinicians and residents on its use and one used it to develop a database in Spanish. Twelve reported that they were attending physicians and two were residents. Nine said that they were medical librarians and one each reported being a

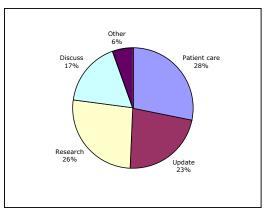researcher, dental surgeon, pharmacist, and veterinarian.

Figure 4. Motivation of responders who searched PubMed using the PDA interface (n=53).

Figure 5 shows how responders viewed the overall usefulness of PubMed for handhelds. Twenty thought that it was "Extremely Useful", two "Very Useful", and one each for "Useful" and "Somewhat Useful". One user thought that it was not useful. The reason given by the user for this rating was that it did not work with a Blackberry device.
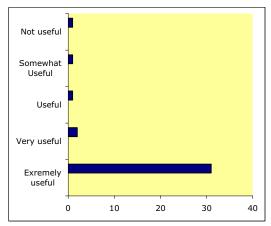

Figure 5. Overall usefulness of searching PubMed for handhelds (n=39).

WAP XHTML portal

We have successfully developed a portal for handheld devices that use XHTML capable browsers and WAP browsers in Symbian OS mobile phones.

Access to PubMed for Handhelds by users of WAP enabled handhelds devices has been low,

1-4 users per day. Only one user provided feedback in the form of e-mail communications while developing and testing the portal. Several mobile phone models were tested. Regular reviews of access logs indicate that most of the server access originated from the site created by the same user, and a few mobile phone service providers from the same locality

Discussion

PICO

Although many medical libraries feature PICO on their Web sites, a search of the medical literature yields only a few publications documenting its development and evaluation. It was not surprising then that several of the prospective study participants were unfamiliar with PICO. We therefore included links to medical library Web pages that talked about PICO in the introductory email.

The careful design and changes in formatting made after limited user feedback of the PICO interface was demonstrated by the nearly unanimous agreement that the interface was easy to use. Although there was again almost total agreement that this method of searching MEDLINE/PubMed was useful, we were surprised by the feedback on the overall quality of citations retrieved. We are unable to comment why those who rated the search interface as "Good" only, did so, since no comments were sent back.

Treatment requirements dominate the clinical category of PICO searches. Although not completely comparable, this seems to agree with the results (Figure 5) of earlier search tools where 'Patient Care' was the greatest motivator of their search.

PICO is designed to provide an interface for a focused and structured search. It is meant to answer a more specific clinical question and perhaps, more evidence based. It therefore requires a well-formulated question. For example, a search on 'P (patient): stroke' and 'I (intervention): statins' is likely to provide better results than 'P: stroke' and 'I: prevention'. It is also suited to comparing treatment interventions such as in these two examples: 'P: diabetes mellitus', 'I: insulin', 'C (comparison):oral agent' 'O (outcome): retinopathy', and 'I: H2 receptor antagonist', 'C: proton pump inhibitor '

'O: acid suppression'. It is also useful for comparing diagnostic tests such as, 'P: myocardial infarction', 'I: troponin' 'C; CK'. PICO is tolerant and "free-text" searching might be sufficient. Some familiarity with PICO is of course beneficial, so a brief instruction page for those who might have questions on its use is being considered.

Clinical Queries, Systematic Reviews and unfiltered search

The monthly access average of 15,400 for PubMed for Handhelds is comparable to the previous year's average.[15] Users of publicly available AvantGo proxy servers have all remained above 80% for the past 2 years. A large majority of PubMed for Handhelds users continues to be PDA devices going through AvantGo proxy servers available to the public. The decrease in access from private AvantGo proxy servers (maintained by universities and medical organizations) from around 30% to less than 1% is significant especially since approximately 30% of access to PubMed for Handhelds the previous year originated from private AvantGo servers.[15] Although access via private proxy servers is still observed, some have actually stopped. The variance may be due to the discontinuation of service of these servers, a change in access routes, or perhaps because of direct access to PubMed for Handhelds from handheld devices with newer Web browsers that don't require proxies. The increase in wireless networks in health care organizations may be a contributing factor since many of the new handheld devices are equipped with wireless capabilities.

User feedback showed that desktop synchronization via serial or USB port was the principal method of connecting the handheld device to the Internet and accessing PubMed for Handhelds. Wireless connections using Wi-Fi 802.11b was the second most popular method, a continuation of the trend encountered the previous year. The expectation was that there would have been a change because of the increasing deployment of Wi-Fi access points in health care facilities. However, this is not indicative of the actual state of connectivity since the number of responders is small.

Conclusion

The PICO interface was considered easy to use and useful as a portal for searching MEDLINE/PubMed. The quality of search results was found to be good to excellent. Many users were unfamiliar with PICO. Information about PICO and simple instructions on how to use it might need to be added to the interface. The average monthly access to the first search tool in PubMed for Handhelds has stayed the same all year long. Server log analysis showed a significant decrease among users going through organizations' private AvantGo proxy servers, but the total percentage of users originating from AvantGo proxy servers has been steady at around 85%. The development of a WAP XHTML portal is a response to the growing convergence of handheld devices towards combining desirable characteristics of mobile phones and PDAs. The overall goal of this project is the delivery of clinical decision support tools at the point of care. Wireless access to the Internet and local resources is essential. Development of innovative portals for searching MEDLINE/PubMed will continue in response to changing user needs and advances in handheld device technology.

References

[1] Stetson JS. PubMed® Available for Use on Handheld, Wireless Devices. NLM Tech Bull. 2003 Jul-Aug;(333):e5.

[2] PubMed for Handhelds Has New URL. http://www.nlm.nih.gov/pubs/techbull/ma04/ma04_technote.html#pda

[3] Booth A, O'Rourke A, Ford N. Structuring the pre-search reference interview: a useful technique for handling clinical questions Bull Med Libr Assoc. 2000 July; 88(3): 239246.

[4] Richardson WS, Wilson MC, Nishikawa J, Hayward RS. The well-built clinical question: a key to evidence based decisions. ACP J Club 1995;123(3):A12–3.

[5] Snowball R. Using the clinical question to teach search strategy: fostering transferable conceptual skills in user education by active learning. Health Libr Rev 1997 Sep;14(3): 167–72.

[6] Counsell C: Formulating questions and locating primary studies for inclusion in systematic reviews. *Ann Intern Med* 1997, 127:380-7.s

[7] Well-Built Clinical Questions using PICO, University of Washington HealthLinks http://healthlinks.washington.edu/ebp/pico.html

[8] University of Illinois, Library of Health Sciences Peoria, http://www.uic.edu/depts/lib/lhsp/resources/pico.shtml

[9] Health Sciences Library, UNC-Chapel Hill http://www.hsl.unc.edu/lm/ebm/Question.htm

[10] University of Alberta Health Sciences Library http://www.library.ualberta.ca/subject/healthsciences/catwalk/pico/index.cfm

[11] Formulating Answerable Clinical Questions Centre for Evidence-Based Practice, University of Toronto. http://www.cebm.utoronto.ca/practise/formulate/

[12] Villanueva EV, Burrows EA, Fennessy PA, Rajendran M, Anderson JN. Improving question formulation for use in evidence appraisal in a tertiary care setting: a randomised controlled trial [ISRCTN66375463]. BMC Med Inform Decis Mak. 2001;1(1):4. Epub 2001 Nov 08.

[13] Haynes RB, Wilczynski N. Optimal search strategies for retrieving scientifically strong studies of diagnosis from Medline: analytical survey. BMJ. 2004 May 1;328(7447):1040. Epub 2004 Apr 08.

[14] PubMed Clinical Queries Table http://www.ncbi.nlm.nih.gov:80/entrez/query/static/clinicaltable.html

[15] Fontelo, Paul, Ackerman, Michael, and Kim, George, "Development of Evidence-Based Medicine Resources: Bridging Clinical Research to Medical Practice," Proceedings of the Proceedings of the 37th Annual Hawaii International Conference on System Sciences (HICSS'04) - Track 6 - Volume 6. Page: 2004. ISBN:0-7695-2056-1 IEEE Computer Society, Washington, DC, USA.