Improving on-line skills and knowledge

A randomized trial of teaching rural physicians to use on-line medical information

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ABSTRACT

OBJECTIVE To assess the change in frequency and methods with which a pilot group of rural physicians consulted on-line medical resources before and after an educational intervention.

DESIGN Physicians were randomly assigned to an educational intervention or control group. Self-administered questionnaires were completed before and 3 months after the intervention.

SETTING Rural practices in southwestern Ontario.

PARTICIPANTS Eighty rural (defined as a population of 15 000 or less) physicians in southwestern Ontario, with a computer with Internet access.

INTERVENTIONS Individualized 3-hour training session on using the World Wide Web to research patient-related questions.

MAIN OUTCOME MEASURES Frequency of access and comfort with on-line medical information were compared after intervention with baseline data using the Wilcoxon two-sample test.

RESULTS At follow up, the intervention group showed a significant improvement over the control group in their frequency of accessing the World Wide Web to address patient-related questions ($P = .009$), in their comfort level in using on-line databases ($P = .032$), and in their frequency of accessing on-line databases ($P = .044$).

CONCLUSION Rural physicians' comfort and competence in using computers to address patient problems can be improved by an individualized 3-hour training session.

RÉSUMÉ

OBJECTIF Déterminer l'effet d'une séance de formation sur la fréquence et les méthodes d'accès aux ressources médicales en ligne chez un groupe pilote de médecins pratiquant en milieu rural.

MÉTHODOLOGIE Les participants ont été répartis de façon aléatoire entre un groupe recevant la formation et un groupe témoin. Ils ont rempli un questionnaire auto-administré avant cette intervention et trois mois après.

CONTEXTE Cabinets médicaux d'un milieu rural du sud-ouest de l'Ontario.

PARTICIPANTS Quatre-vingt médecins exerçant en milieu rural (population ne dépassant pas 15 000 habitants) dans le sud-ouest de l'Ontario et possédant un ordinateur relié à l'Internet.

INTERVENTIONS Une séance de formation individualisée de trois heures sur la façon consulter le Web pour repérer de l'information sur des problèmes rencontrés en pratique.

PRINCIPAUX PARAMÈTRES MESURÉS Le test à deux échantillons de Wilcoxon a été utilisé pour comparer la fréquence d'accès au Web et le degré de confort des participants dans l'utilisation de la documentation médicale en ligne avant et après la séance de formation.

RÉSULTATS L'évaluation post-intervention a révélé que par rapport au groupe témoin, les médecins qui avaient reçu la formation utilisaient plus souvent le Web pour repérer des renseignements sur des problèmes cliniques ($P = 0,009$), étaient plus à l'aise dans l'utilisation des bases de données en ligne ($P = 0,032$) et consultaient plus fréquemment ces bases de données ($P = 0,044$).

CONCLUSION Une séance de formation individualisée de trois heures est un moyen efficace d'améliorer la compétence et le niveau de confort de médecins de milieux ruraux dans l'utilisation de l'ordinateur à des fins cliniques.

C omfort and competence in using computers and on-line information in medical practice is becoming increasingly important.[1] This is especially true for rural physicians because they are often remote from colleagues and sometimes have limited access to medical libraries and specialists.[2,3]

A survey of family practice educators at McMaster University in Hamilton, Ont, found that computers were used mainly for word processing, billing, e-mail, and making appointments, but respondents were interested in learning how to use Internet resources, such as MEDLINE.[4] A 1999 survey of rural physicians in Ontario showed that 96% owned a computer and most identified educational software, e-mail, and the Internet as important areas for further training.[5] Dorsch[6] reviewed the literature on the information needs of rural health professionals and concluded that they encounter pronounced barriers to accessing information including lack of time, isolation, inadequate library access, lack of equipment, lack of skills, high costs, and inadequate Internet infrastructure.

McGowan and Richwine[7] found provision of and training in use of information tools positively affected rural physician decision making. Allen et al[8] reported from Nova Scotia that holding workshops in basic computer skills for physicians increased their use of computers. Although both studies reported increased use of computers as a result of training, they were not randomized studies, and had limited or no statistical analysis.

We conducted a pilot randomized controlled trial to assess whether individualized tutoring from specially trained community hospital librarians in physicians' homes or offices would increase rural physicians' use of on-line medical resources to address patient-related problems. The study objective was to assess changes in the frequency and methods with which a group of rural physicians consulted on-line medical resources before and after the educational intervention. The intervention taught them how to search for

and retrieve reliable, peer-reviewed, evidence-based information from bibliographic databases, such as PubMed and the Cochrane Library, and how to find additional resources in the University of Western Ontario (UWO) libraries' on-line collections.

METHODS

Before intervention
In spring 2000, a survey was mailed to the 489 rural physicians on the Ontario Medical Association's Rural and Isolated Physician mailing list for postal codes in southwestern Ontario. The questionnaire asked for demographic information, the type and Internet capability of the office computer, and physicians' use and comfort with e-mail, World Wide Web, and on-line medical databases using a 5-point Likert scale. Respondents were also asked to list the most difficult information management issue they encounter on a day-to-day basis and to identify a clinical question or issue in their practices. These data provided the framework for the subsequent instructional session.

Criteria for selection of subjects
Physicians were eligible to participate in the study if they practised in a rural community (defined as a population of 15 000 or less) in southwestern Ontario, had a computer with Internet access, completed the initial questionnaire, and agreed to participate in the study. For eligible physicians in group practices, one of the group was randomly selected for study participation. Eligible physicians were then randomly allocated to either the educational intervention or the control group. All physicians in the study received preintervention and postintervention questionnaires. Approval from the UWO Ethics Review Board was not required.

Intervention
A 2-day workshop for four rural southwestern Ontario community hospital librarians covering Chatham, Sarnia, Owen Sound, and Huron-Perth was given at UWO. Workshop content was based on a 58-item needs assessment completed by the four librarians and on extensive input from a rural family physician who has published articles on computer use in practice. It focused on a range of electronic, evidence-based medicine resources and guidelines, reviewed search strategies for PubMed and the Cochrane Library, and examined how to structure and deliver training for adult learners.

The librarians then visited intervention-group physicians at their practice sites and gave an individualized

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3-hour training session on evidence-based information retrieval including the Cochrane Library, PubMed, MD Consult, Harrison's Online, and the Canadian Medical Association's practice guidelines database. Cases and examples were individualized and based on the clinical question identified on the doctors' preintervention questionnaires.

Intervention physicians received an extensive reference binder, 6 months of on-line access to current medical databases, borrowing privileges at the UWO library, a university e-mail account, and a service delivering journal articles and other documents to their offices. The UWO library mounted a special website for their use with evidence-based links and practice guidelines. Immediately after the training, intervention group physicians completed an end-of-training feedback form to measure the effectiveness of the instructional session. The librarians also filled out a physician contact report for each visit. Control physicians received neither training nor access to the UWO library system.

After the intervention

Three months after the educational intervention, questionnaires were sent to all control and intervention physicians to measure changes in comfort level and frequency with which they consulted electronic medical resources to address patient-related problems.

Statistical considerations

Assuming a standard deviation of 1.5 on a 5-point Likert scale, 36 subjects per group are required to detect a difference of 1.0 with 80% power at the 5% level of significance. Allowing for a 10% loss of subjects to follow up, 40 subjects per group were required. A Likert scale was chosen because it is widely accepted and recognized by practitioners. Comparisons of demographic characteristics and preintervention responses were made in order to evaluate the effectiveness of the randomization process. Frequency of access and comfort were compared after the intervention using the Wilcoxon two-sample test on changes from baseline.

RESULTS

The 241 questionnaires returned indicated that 99 physicians met the eligibility criteria and were willing to participate in the study. A group of 81 were randomly selected, 41 for the intervention and 40 for the control group. Thirty-three (82.5%) of the

intervention group and 37 (92.5%) of the control group were family physicians.

Demographics

Table 1 gives demographic characteristics and importance of computer training at the time of enrolment. There were no major differences between the two groups including their rating of the importance of training. The control group saw more barriers; there were more specialists in the intervention group.

Table 1. Demographics and importance of training at baseline

RATING OF TRAINING AND DEMOGRAPHIC VARIABLES	CONTROL (N = 40)	INTERVENTION (N = 41)
IMPORTANCE OF TRAINING*		
E-mail: mean (SD)	2.79 (1.19)	2.97 (1.18)
World Wide Web: mean (SD)	3.30 (1.04)	3.50 (1.08)
Databases: mean (SD)	3.68 (0.97)	3.80 (0.91)
DEMOGRAPHIC VARIABLES		
Barriers to using on-line resources: f (%)	32 (82.1)	28 (68.3)
Family physician: f (%)	37 (92.5)	33 (82.5)
Year starting first practice: mean (SD)	1980.1 (8.9)	1983.8 (10.7)
Male: f (%)	30 (75.0)	31 (75.6)
Solo practice: f (%)	22 (55.0)	16 (40.0)
Size of community less than 5000:n (%)	22 (56.4)	17 (42.5)

f—frequency, n—size of subsample, SD—standard deviation.
*1—not important, 5—extremely important.

Effect of the intervention

Table 2 compares the two groups at baseline and at 3-month follow up. Eleven of the intervention physicians did not complete the study because they were unable to schedule the librarians' visit. For all outcomes except e-mail access, the improvement was greater in the intervention group. At follow up the intervention group showed a significant increase over the control group in frequency of accessing the World Wide Web to address their patient-related questions (P = .009), in their comfort with using on-line databases (P = .032), and in frequency of accessing on-line databases (P = .044).

Eleven of the 41 physicians in the intervention group could not schedule a visit by a librarian. As well as a statistically significant difference for year of starting practice (P = .03), other factors could be important (**Table 3**). Those not visited were more frequently specialists, male, and in larger communities.

Table 2. Comparison at baseline and at follow up

PHYSICIAN VARIABLES	CONTROL GROUP (N=40)		INTERVENTION GROUP (N=30)		P VALUE*
	PREINTERVENTION	POSTINTERVENTION	PREINTERVENTION	POSTINTERVENTION	
How often do you access e-mail to answer patient-related questions: mean (SD)†	2.03 (1.64)	1.70 (1.51)	2.13 (1.70)	1.70 (1.47)	.924
How often do you access the World Wide Web to answer patient-related questions: mean (SD)†	2.81 (1.60)	2.60 (1.55)	2.10 (1.35)	3.00 (1.31)	.009
How often do you access on-line databases to answer patient-related questions: mean (SD)†	2.05 (1.37)	2.23 (1.58)	1.90 (1.47)	2.63 (1.33)	.044
Comfort in using e-mail: mean (SD)‡	3.18 (1.32)	3.37 (1.30)	3.19 (1.44)	3.59 (1.27)	.237
Comfort in using World Wide Web: mean (SD)‡	2.95 (1.34)	3.05 (1.25)	3.00 (1.30)	3.34 (0.94)	.241
Comfort in using on-line databases: mean (SD)‡	2.10 (1.22)	2.58 (1.45)	2.00 (1.12)	3.00 (0.87)	.032
Opinion on value of Internet for answering patient-related questions: mean (SD)§	3.13 (0.91)	3.00 (0.86)	3.00 (0.77)	3.21 (0.74)	.285
Access full-text medical journals on-line: f (%)	2 (5.3)	6 (15.8)	5 (16.7)	7 (25.0)	.352

f—frequency; SD—standard deviation.
*With the exception of Access full-text medical journals on-line, P values presented here are for the Wilcoxon two-sample test on changes from baseline. For Access full-text medical journals on-line, the P value is for a χ^2 test at 3 months.
†1—never, 5—daily.
‡1—not comfortable, 5—extremely comfortable.
§1—not valuable, 5—extremely valuable.

Physicians' comments

Twenty-one of the 30 physicians who received the intervention returned the end-of-training feedback form. All rated the content of the instruction very highly (4 to 5 on a 5-point scale) in all aspects, including relevance to patient care and increase in knowledge. All respondents rated the librarians as very well prepared, responsive, and enthusiastic. Twenty of the 21 would recommend similar training to peers, and 19 considered this time away from practice worthwhile. Improved skill in use of PubMed and the Internet was listed as the most useful outcome.

Librarians' comments

The librarians' physician-contact reports outlined material covered during intervention visits, level of physicians' computer knowledge, technical problems encountered, and any follow-up contacts after the intervention. They noted improved communication, more frequent contacts with these physicians after their visits, and a higher-than-average number of requests for document delivery.

DISCUSSION

As other reports have suggested,[6-8] this study demonstrates a clear and substantial benefit of an educational intervention. Comfort with and frequency of using on-line medical resources and frequency of accessing the World Wide Web to answer patient-related questions by rural physicians were significantly increased after individualized training by librarians. The data also suggested improvement in comfort with e-mail, the World Wide Web, and the Internet, although these findings were not statistically significant (**Table 2**). Although participants increased their use of the Internet, it is possible that they do not yet see its value in patient-related decision making.

Our results demonstrated improvement using a powerful research design, a randomized controlled trial. A search of the MEDLINE (PubMed) literature from 1995 onward identified only one randomized controlled trial on teaching rural practising physicians to use on-line resources.[9] One additional randomized controlled trial of an individual tutorial session on MEDLINE use was identified,[10] but this study involved residents in an urban program. In spite of the difficulties of conducting a randomized controlled trial with a geographically dispersed group of busy physicians, we were able to show statistically significant results where these other studies have not done so.

Table 3. Comparison of members of intervention group receiving visits with members not receiving visits

PHYSICIAN VARIABLES	VISITED (N = 30)	NOT VISITED (N = 11)	P VALUE*
IMPORTANCE OF TRAINING			
E-mail: mean (SD)†	3.00 (1.14)	2.91 (1.30)	>.999
World Wide Web: mean (SD)†	3.48 (1.16)	3.55 (0.93)	.898
Databases: mean (SD)†	3.76 (1.02)	3.91 (0.54)	.797
PHYSICIAN CHARACTERISTICS			
Barriers to using on-line resources: f (%)	22 (73.3)	6 (54.6)	.28
Family physician: f (%)	26 (89.7)	7 (63.4)	.076
Year starting first practice: mean (SD)	1985.9 (10.2)	1978.4 (10.4)	.03
Male: f (%)	21 (70.0)	10 (90.9)	.239
Solo practice: f (%)	13 (44.8)	3 (27.3)	.473
Size of community less than 5000: n (%)	15 (51.7)	2 (18.2)	.079

f—frequency, n—size of subsample, SD—standard deviation.

*For continuous measures, P values presented are for the Wilcoxon two-sample test. For categorical measures, P values presented are for Fisher's exact two-tailed test.
†1—not important, 5—extremely important.

Allen et al[8] discussed the need for continued support to provide maximum benefits for participants. The rural librarians in our study also reported continued contacts with participants who had follow-up questions and support requests demonstrating the importance of this element for positive outcomes.

While there were definite benefits from the educational intervention, there were also some limitations. It is likely the increased use and comfort among the intervention group was a direct effect of the librarians' teaching, yet one or a combination of the other benefits (UWO library access, document delivery) provided to the physicians could have affected the group's improvement. The librarians reported difficulties scheduling visits to accommodate physicians' needs and burdensome time commitments for travel. Without specific research funding for the project, it is unlikely any of the regional hospitals could have afforded the costs of training in physicians' offices.

Although none of the physicians commented on computer problems, unanticipated technical difficulties with physicians' computer configurations and Internet access were often encountered during the visits. Only technical support offered by the UWO library's Systems Department could solve many of the problems. This suggests that widespread application of similar interventions would require considerable technical expertise with associated costs. More uniform means of Internet access could minimize this potential problem. These unexpected difficulties point to the importance of having technical expertise available during delivery of informatics training.

The individualized teaching sessions contributed to the strengths as well as to the weaknesses of our study. Because librarians responded to individual needs, the content of the teaching sessions varied widely. Principles of adult learning suggest that this is a valuable teaching strategy, and it likely contributed to the apparent benefit in use of on-line resources, but the heterogeneity makes it difficult to measure clinical significance. The study was not designed to determine whether physicians' increased use of and comfort with on-line resources actually affected clinical decision making. It is clear, however, that this needs-based individualized training is resource intensive and would be very costly to implement on a large scale.

Ideally, we would like to demonstrate that increased use of on-line resources improves patient outcomes or reduces costs. So far, as detailed in Hersh and Hickam's[11] suggested framework for investigating physicians' use of electronic information retrieval systems, it has been extremely difficult to design a randomized controlled trial to do this. Our results are encouraging and point the way to future studies, perhaps with simpler interventions. Further, taking advantage of established computer communications links could alleviate some of the problems we encountered. It is also possible that the strengths of our study (the train-the-trainer model and individualized instruction) could be transposed to a telemedicine format, with librarians conducting sessions for remote physicians.

CONCLUSION

Rural physicians' comfort and competence in use of computers to address patient problems can be improved by an individualized 3-hour training session. These data suggest that physicians distant from medical libraries can have excellent access to evidence-based resources; as connection to the Internet becomes faster, more uniform, and reliable across communities, the training will become easier to deliver. ❦

Contributors
Dr Kronick *and* **Ms Blake** *conceived of and designed the study, analyzed data, and drafted the manuscript.* **Ms Munoz, Ms Heilbrunn,** *and* **Ms Dunikowski** *contributed to study design and reviewed the literature.* **Dr Milne** *contributed to study design and discussion.*

Competing interests
None declared

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References
1. Cameron S. Toward a national curriculum in informatics. *Can Fam Physician* 1998;44:2044-6 (Eng), 2053-56 (Fr).
2. McClaran J, Snell L, Duarte-Franco E. Continuing educational needs in computers and informatics. McGill survey of family physicians. *Can Fam Physician* 2000;46: 839-47.
3. Iglesias S. Advanced skills by Canada's rural family physicians. *Can J Rural Med* 1999;4(4):227-31.
4. Kaczorowski J, Walsh A, Chan DH, Trim K. Short report: medical informatics. How do family medicine educators at McMaster University use it and teach it? *Can Fam Physician* 2000;46:1310-2.
5. Milne K. *Rural and isolated physicians in Ontario and computers*. Presentation at the 4th WONCA World Rural Health Conference; 2000; Calgary, Alta.
6. Dorsch JL. Information needs of rural health professionals: a review of the literature. *Bull Med Libr Assoc* 2000;88(4):346-54.
7. McGowan JJ, Richwine MS. Electronic information access in support of clinical decision making: a comparative study of the impact on rural health care outcome. In: *Converging information, technology, and health care. Proceedings of the AMIA Symposium;* 2000 Nov 4-8; Los Angeles, Calif; 2000. p. 565-9.
8. Allen MJM, Kaufman DM, Barrett A, Paterson G, Sargeant J, McLeod R. Self-reported effects of computer workshops on physicians' computer use. *J Cont Educ Health Profes* 2000;20:20-6.
9. Chan DH. Problem-based small-group learning via the Internet among community family physicians: a randomized controlled trial. *MD Comput* 1999;16:54-8.
10. Erickson S, Warner ER. The impact of an individual tutorial session on MEDLINE use among obstetrics and gynaecology residents in an academic training programme: a randomized trial. *Med Educ* 1998;32:269-73.
11. Hersh WR, Hickam DH. How well do physicians use electronic information retrieval systems? A framework for investigation and systematic review. *JAMA* 1998;280:1347-52.

Editor's key points
- This randomized controlled trial showed that a 3-hour educational intervention among rural physicians in southwestern Ontario increased their frequency of and comfort with accessing Internet medical information.
- The educational session was carried out by specially trained community hospital librarians at rural physicians' offices. Content was individualized to physicians' learning needs.
- Training sessions were highly valued by physicians, but the labour required from the librarians suggests that future interventions might be more economically performed electronically.

Points de repère du rédacteur
- Cer essai randomisé a montré qu'à la suite d'une séance en formation de trois heures, des médecins de milieux ruraux du sud-ouest de l'Ontario consultaient plus fréquemment l'information médicale en ligne et étaient plus à l'aise pour le faire.
- Les séances de formation ont été données au cabinet de ces médecins par des bibliothécaires d'hôpitaux communautaires qui avaient subi une formation spéciale. Le contenu des séances était individualisé selon les besoins des médecins.
- Les médecins participants ont beaucoup apprécié les séances de formation; toutefois, ces interventions exigent beaucoup de travail de la part des bibliothécaires et cela donne à croire qu'elles pourraient être effectuées plus économiquement à l'avenir en utilisant l'électronique.