Continuing educational needs in computers and informatics

McGill survey of family physicians

Jacqueline McClaran, MD   Linda Snell, MD   Eliane Duarte-Franco, MD, MPH

abstract

OBJECTIVE **To describe family physicians' perceived educational needs in computers and informatics.**

DESIGN **Mailed survey.**

SETTING **General or family practices in Canada.**

PARTICIPANTS **Physicians (489 responded to a mailing sent to 2 500 physicians) who might attend sessions at the McGill Centre for CME. Two duplicate questionnaires were excluded from the analysis.**

METHOD **Four domains were addressed: practice profile, clinical CME needs, professional CME needs, and preferred learning formats. Data were entered on dBASE IV; analyses were performed on SPSS.**

MAIN FINDINGS **In the 487 questionnaires retained for analysis, "informatics and computers" was mentioned more than any other clinical diagnostic area, any other professional area, and all but three patient groups and service areas as a topic where improvement in knowledge and skills was needed in the coming year. Most physicians had no access to computer support for practice (62.6%); physicians caring for neonates, toddlers, or hospital inpatients were more likely to report some type of computer support.**

CONCLUSIONS **Family physicians selected knowledge and skills for computers and informatics as an area for improvement in the coming year more frequently than they selected most traditional clinical CME topics. This educational need is particularly great in small towns and in settings where some computerized hospital data are already available.**

résumé

OBJECTIF **Décrire les perceptions relatives aux besoins de formation des médecins de famille en informatique et en utilisation d'ordinateurs.**

CONCEPTION **Un questionnaire envoyé par la poste.**

CONTEXTE **Des pratiques d'omnipraticiens ou de médecins de famille au Canada.**

PARTICIPANTS **Les médecins (489 ont répondu au questionnaire envoyé à 2 500 médecins) susceptibles d'assister à des séances de FMC au Centre McGill. Deux questionnaires reçus en double ont été exclus de l'analyse.**

MÉTHODOLOGIE **Quatre domaines ont fait l'objet de l'étude: le profil de pratique, les besoins en FMC clinique, les besoins en FMC professionnelle et les modes d'apprentissage préférés. Les données ont été entrées sur dBase IV; les analyses ont été exécutées sur SPSS.**

PRINCIPAUX RÉSULTATS **Dans les 487 questionnaires retenus aux fins d'analyse, «l'informatique et les ordinateurs» étaient mentionnés plus souvent qu'aucun autre domaine diagnostique clinique, qu'aucun autre domaine professionnel, et que tous les domaines liés aux groupes de patients et aux services à l'exception de trois, comme sujet où un perfectionnement du savoir et des habiletés était nécessaire dans la prochaine année. La plupart des médecins n'avaient pas accès à un soutien informatique dans la pratique (62,6%); les médecins qui traitaient des nouveau-nés, des tout-petits ou des patients hospitalisés étaient davantage susceptibles de signaler une forme quelconque de soutien informatique.**

CONCLUSIONS **Les médecins de famille ont choisi le savoir et les habiletés en informatique et en utilisation d'ordinateurs comme domaine à perfectionner dans la prochaine année plus souvent que la majorité des sujets de FMC clinique traditionnels. Ce besoin d'éducation se fait surtout sentir dans les petites villes et dans les milieux où des données hospitalières informatisées sont déjà disponibles.**

RESEARCH
·················
Continuing educational needs
in computers and informatics

*I*n this era of cost containment, guidelines, care maps, and complex care, there seems to be an underlying assumption that computerized support for clinical decisions, general medical knowledge, and patient information systems will be readily available, will be quickly accessible, and will allow physicians to deliver better quality care.

Many health care system analysts highlight the importance of developing applications of medical informatics, such as computer-assisted decision making, information storage and quick retrieval, and information support systems.[1-8] Others stress the importance of computer literacy for health professionals, and particularly for physicians, who will have to be linked to and familiar with software and computer systems both locally and worldwide in order to provide best care in complex care environments.[6,9-12] Scant if any evidence indicates that physicians can or will use such systems, however, or that these systems would result in better care or better health outcomes. Some studies suggest that physicians encounter barriers to adapting to information technology.[13-17]

The health care environment is becoming more dependent on computer systems and is changing so dramatically that physicians who do not continually update their computer literacy skills might not be able to deliver services in the future. Physicians will likely need education to cope in this changing practice environment.

Family physicians, on whom the shift to ambulatory and home care will rely, are particularly likely to feel the need for education in medical informatics and computer skills. An extensive literature search, however, failed to uncover any assessment of family physicians' perceived educational needs in computers and medical informatics (**Table 1**).

Some interesting papers in family medicine describe the computer as a tool for practice support and for continuing medical education (CME): for example, teaching physicians to use computer support; to select the right tools for particular practice environments; to use the Internet and the World Wide Web for general CME; and to access protocols, guidelines, and care maps to support clinical decisions.[10,16,18-30]

···

Dr McClaran *is a CME Research Associate and an Associate Professor of Family Medicine at McGill University in Montreal, Que.* **Dr Snell** *is Associate Dean for CME at McGill University.* **Dr Duarte-Franco** *is a CME Research Associate and an Assistant Professor of Family Medicine at McGill University.*

A large body of international literature describes developing and implementing computer systems designed to support family medicine: by linking hospital records to community physicians[31]; by providing support for decisions[32] and practice-based learning[33]; by linking population-based needs with electronic health records[6,17]; by identifying family grouping systems[25]; and by identifying tools and approaches suitable for family physicians' offices.[34] The most comprehensive review articles, however, do not specifically address family physicians or their educational needs.

Using computers for demographic patient information and for billing purposes is becoming more common in a variety of health care settings, including family medicine.[35,36] These activities do not demand that clinicians have computer skills, but rather that their support staff do. Using computers specifically to access local care protocols, care maps, and guidelines or other decision support tools purported to improve practice or make practice more efficient, which require physicians to have computer skills, is probably less widespread.[21,25,35,37] As well, physicians who consider themselves computer literate on home computers are not necessarily likely or able to use computers for their own CME or practice support.[38-40]

Notably absent in all the literature mentioned above are needs assessments for CME and family physicians' perceptions of their needs. This lack suggests that the educational needs of practising family physicians, as identified by themselves, have not been studied. Computer literacy, computer systems, and application of medical informatics as a topic of CME in family medicine has not been studied. To determine whether primary care practitioners feel the need to improve their knowledge and skills in computers and informatics in the coming year, we surveyed physicians who might attend the McGill Centre for CME in Montreal.

METHODS

A questionnaire on CME needs was enclosed in a mailing to 2500 physicians in general or family practice in Canada. These physicians are the usual target audience for activities sponsored by the McGill Centre for CME. The questionnaire addressed five areas: physicians and their training, practice setting, clinical and problem areas physicians wished to improve, professional areas physicians wished to improve, and preferred

RESEARCH
•••••••••••••
**Continuing educational needs
in computers and informatics**

Table 1. **Literature search for terms "informatics and computers"**

DATABASE	RELATED TERMS/CLASSIFICATION	DEFINITIONS
MEDLINE	Information science	Information science: automated system applied to the patient care process, including diagnosis, therapy, and systems of communicating medical data within health care settings

	Medical informatics (MI)
	• Applications (MI)
	• Decision making (computer assisted [CA])
	  – diagnosis (CA)
	  – therapy (CA)
	• Information storage and retrieval
	• Information systems
		Medical informatics: field of information science concerned with analysis and dissemination of medical data through application of computers to various aspects of health care and medicine

	Computing (MI) • Literacy • Systems • Methodology • Software	Computer literacy: general learning, knowledge, and fluency with computer terms; becoming familiar with how computers operate and are programmed
ERIC	Medical education Information science Information technology Information networks Computer science Computer literacy	Computer literacy: awareness or knowledge about computers (capabilities, applications, limitations). Might include ability to interact with computers to solve problems
CINAHL	Information science Informatics • Computers and computerization • Computer literacy	Computer literacy: extent of knowledge and experience of computers
	Health informatics	Health informatics: analysis, use, and dissemination of health information through computer technology
	Medical informatics	(No scope display)
	Nursing informatics	(No scope display)
SocioFile	Computer literacy Medical informatics Computers	Title, abstract, heading word, key phrase
Social Sciences Abstracts	Medical informatics Computing Computer literacy	Title, abstract, subject heading word

learning methods and formats for formal and informal CME.

The questions on educational needs in both clinical and professional areas allowed physicians to indicate up to five areas in which they wished to improve "knowledge or skills in the coming year." Clinical areas included diagnosis-related groups, system groupings (by biologic systems), patient-centred areas, and service areas (eg, child care, elder care, emergency conditions, drug therapy). Professional areas included ethical problems in practice; informatics and computers; legal problems; issues in practice management, such as time management, physicians as managers, and financial management; and critical appraisal of the literature.

These CME areas were not defined in the questionnaire; interpretation was left to individual respondents. The McGill faculty committee for CME, which

RESEARCH
....
**Continuing educational needs
in computers and informatics**

Table 2. **Demographic characteristics of study population:** *N = 487.*

CHARACTERISTICS	%
Sex	
• Male	64.8
• Female	35.2
Year of graduation	
• 1953–1984	60.7
• 1985–1994	39.3
Certification	
• College of Family Physicians of Canada	50.7
• None or other	49.3
Population where practice is located	
• < 10 000	22.1
• 10 000 – < 50 000	21.6
• 50 000 – 500 000	37.0
• > 500 000	19.3
Population served (y)*	
• Neonates – 1	79.2
• 1 – 4	83.3
• 5 – 17	89.4
• 18 – 64	95.8
• 65 – 99	90.2
Practice setting*	
• Hospital inpatients	42.5
• Community clinic	16.8
• Hospital outpatients and emergency	42.9
• Long-term care	13.7
• Office	73.7
– solo	31.1
– group	42.6
Have computer or informatics support*	
• For admissions	20.0
• For hospital length of stay	14.9
• For patient profile	21.9
• For patient medication list	13.8
• For any of the above	37.4
• For none of the above	62.6
Selected informatics and computers for study in coming year	
• Yes	54.8
• No	45.2

Responses were nonexclusive.

includes several College-certified family physicians (CCFPs), supported this survey. The survey instrument itself was developed by the CME research team that included a practising family physician, the Associate Dean of CME in consultation with the Associate Dean of Faculty Development, and a biostatistician (certified in family medicine).

Demographics
The first part of the questionnaire sought information on sex, year of graduation, and certification; the second part on size of town of practice site, population served, practice settings, and availability of computer support; part three on physician selection of clinical fields (for comparison); and part four on whether physicians selected informatics and computers as an area for improvement of knowledge and skills in the coming year. Two of the 489 responses were duplications; 487 questionnaires were retained for analysis.

Statistical methods
Data were entered on dBASE IV and analyzed using SPSS statistical software for PCs. Univariate analysis was carried out. On bivariate analysis, variables tested for association with physician selection of informatics and computers were sex, year of graduation, certification, size of town, population served, practice setting, and current access to computer or informatics support. Also, for bivariate analysis, variables tested for association with physicians having access to computer printouts were sex, year of graduation, certification, size of town, population served, and practice setting. Based on the number of variables, the exploratory nature of the survey, and the total number of respondents, level of significance for *P* was set at .05.

RESULTS

Response rate was 19.6%, 489 of a mailing to 2 500 names from the large CME mailing list. Of 489 questionnaires returned to the CME office, two were duplicates and were excluded from the analysis. The remaining 487 respondents constitute the study population.

The 487 physicians in the study population were mostly men (64.8%), had graduated more than 10 years ago (60.7%), were certificated in family medicine (50.7%), served towns of < 500 000 population (80.7%), served all age groups (79.2% to 90.2%), and worked in solo or group practices (73.7%). Many provided hospital services (42.5% inpatient, 42.9% outpatient or emergency) (**Table 2**). Most had no computer support of any kind in any of the settings where they worked (62.6%). Computer printouts were available to 20.0% of physicians regarding admissions, 14.9% regarding length of stay, 21.9% regarding patient profiles, and 13.8% regarding patient medications.

More than half (54.8%) the physicians in the study selected informatics and computers as an area where

RESEARCH
••••••••••••••
**Continuing educational needs
in computers and informatics**

they would like to improve knowledge and skills over the following year. The proportion of physicians selecting this topic was larger than for any traditional clinical CME areas, larger than for most clinical patient groups and service areas, and larger than for any of the professional areas (**Table 3**).

Bivariate analysis revealed that physicians selecting informatics and computers were more often men (60.7% versus 45.6% women, P = .003), served towns of < 50 000 population (62.0% versus 48.5%, P = .004), and had practice settings equipped to provide printouts of patients' length of stay in hospital (68.6% versus 52.4%, P = .01) (**Table 4**).

Physicians serving hospital-based patients (45.9% versus 31.0% not providing this service, P = .0009), caring for neonates (40.5% versus 26.0%, P = .008), and serving patients aged 1 to 5 years (40.5% versus 22.5%, P = .002) were more likely than those not serving these types of patients to have access to computer support and printouts (**Table 5**).

DISCUSSION

Our survey was designed to determine family physicians' perceived CME needs and to provide a current database for ongoing educational research. The frequency with which clinical subjects were signaled was congruent with the education planning committee's expectations. The authors expected that computer support and medical informatics applications would be signaled frequently as learning methods (part 5 of the questionnaire), but not necessarily as educational subject matter or topics (part 4) and certainly not as frequently, let alone more often, than most clinical areas (part 3).

Our study shows that most respondents regarded computers and informatics as an important area for enhancing knowledge and skills in the coming year, that computer support in practice is currently minimal, and that many more physicians report a desire to improve knowledge and skills in informatics than report access to computer support in their practice settings. Further, improving computer skills was identified by family physicians as an educational need more frequently than most clinical areas traditionally regarded as core CME. Frequency of selection of computer knowledge and skills as a priority for learning was greater for men than women, greater for physicians in small towns, and greater for physicians who already had access to computer support or printouts from hospitals. While current access to computer support is limited, it is more likely to be available

Table 3. Clinical and professional areas signaled by family physicians for improving knowledge and skills in the coming year: $N = 487.$

SKILL AREA	%
PROFESSIONAL	
Informatics and computers	54.8
Office management, efficiency	43.4
Legal issues	41.7
Financial management	40.1
Practical ethical concerns	38.2
Time management	38.0
Critical appraisal of literature	36.8
Physician as manager	22.9
CLINICAL: DIAGNOSTIC GROUPS AND BODY SYSTEMS	
Nervous system	51.3
Musculoskeletal system	49.1
Circulatory system	39.9
Hematologic and immune systems	38.9
Nutrition and metabolism	38.7
Skin, subcutaneous tissue, breast	38.0
Endocrine system	37.8
Psychological problems	37.0
Eye, ear, nose, throat	28.6
HIV infections (AIDS)	26.2
Respiratory system	23.5
Digestive system	20.2
Reproductive systems	18.4
Pregnancy and childbirth	17.4
Kidney and urinary tract	15.1
CLINICAL: PATIENT GROUPS, SERVICES	
Drug therapy	76.7
Ambulatory management or care	67.3
Acute or emergency conditions	64.0
Sports medicine	48.5
Elder care	46.4
Work-related issues	41.3
Patient education	39.5
Rehabilitation	38.7
Child care	32.1
Alcohol or drug problems	31.3
Family interviewing	31.3
Malignant diseases	26.4
Patients and their families	23.1
Women as patients	20.2
Newborns	17.2

RESEARCH
∙∙∙∙∙∙∙∙∙∙∙∙∙∙
**Continuing educational needs
in computers and informatics**

Table 4. **Proportions of the 54.8% of physicians who selected "Informatics and Computers" as an area to improve knowledge and skills over the following year, by selected characteristics:** *N = 487.*

CHARACTERISTICS	PROPORTION WITH CHARACTERISTIC WHO SELECTED INFORMATICS AND COMPUTERS (%)	P VALUE
Sex		.003
• Male	60.7	
• Female	45.6	
Year of graduation		.09
• 1953–1984	57.5	
• 1985–1994	49.5	
Certification by College of Family Physicians of Canada		.9
• Yes	55.2	
• No	54.4	
Population where practice is located		.004
• < 10 000	69.9	
• 10 000 – < 50 000	54.2	
• 50 000 – 500 000	48.8	
• > 500 000	48.3	
Population served (y)	Yes/no	
• Neonates – 1	55.9/50.5	.4
• 1 – 4	56.6/45.8	.09
• 5 – 17	56.1/43.5	.1
• 18 – 64	56.2/18.8 *	
• 65 – 9	55.5/48.8	.4
Practice setting	Yes/no	
• Hospital inpatients	57.9/52.8	.3
• Community clinic	53.2/55.4	.7
• Hospital outpatients and emergency	59.9/51.3	.07
• Long-term care	59.4/54.3	.4
• Office	54.1/57.3	.6
Have computer or informatics support	Yes/no	
• For any category below	57.1/53.5	.5
• For admissions	60.6/53.4	.2
• For hospital length of stay	68.6/52.4	.01
• For patient profile	55.9/54.5	.8
• For patient medication list	50.8/55.5	.5

Small cell size renders comparison invalid. Only three physicians not serving patients age 18 to 64 selected the topic.

Table 5. **Proportion of family physicians reporting access in their practice to any computer printout by selected demographic and practice characteristics:** *N = 483*

CHARACTERISTICS	PROPORTION WITH CHARACTERISTIC WHO HAD ACCESS TO COMPUTER SUPPORT (%)	P VALUE
Sex		.1
• Male	40.4	
• Female	32.9	
Year of graduation		.6
• 1953–1984	36.7	
• 1985–1989	34.3	
• 1990–1994	41.3	
Certification by College of Family Physicians of Canada		.1
• Yes	40.5	
• No	34.0	
Population where practice is located		.2
• < 10 000	43.8	
• 10 000 – < 50 000	35.9	
• 50 000 – 500 000	37.5	
• > 500 000	34.8	
Population served (y)	Yes/no	
• Neonates-1	40.5/26.0	.008
• 1 – 4	40.5/22.5	.002
• 5 – 17	38.2/31.4	.3
• 18 – 64	37.8/30.0	.5
• 65 – 99	38.6/27.7	.1
Practice setting	Yes/no	
• Hospital inpatients	45.9/31.0	.0009
• Community clinic	43.2/36.2	.2
• Hospital outpatients and emergency	38.6/36.4	.6
• Long-term care	47.0/35.8	.3
• Office	38.9/33.1	.5

of computer support that could facilitate physicians' CME,[10,19,21,22,26,31,40,42-47] ours is the first study to examine physicians' own perceptions of their educational needs in this area.

The gap between the present work environment and the image of future practitioners surrounded by a universe of knowledge, guidelines, and patient-specific data immediately available for instantaneous access and integration appears immense: only 13.8% of physicians have access to computerized medication lists, and only 14.9% receive data on hospital length of stay, 20.0% on admissions, and 21.9% on patient profiles. That physicians perceive a need to enhance their knowledge and skills in computers

for physicians caring for hospital inpatients, neonates, and young children.

Medical informatics has burgeoned as a science with the assumption that the information highway will assist clinicians to make better decisions faster if they have quick access to clinical guidelines and outcomes.[7,16,17,25,32,33,35,41] While much has been written about computer literacy for physicians and examples

RESEARCH
••••••••••••••
Continuing educational needs
in computers and informatics

and informatics suggests that even the minimal support currently available is not helping them manage their patients better and faster. Further, physicians can anticipate an increasing need for knowledge and skills as their work environments become increasingly complex.

Implications for family physicians

The Canadian Medical Association's physician resource survey, *Taking the Pulse*, describes Canadian physicians' practice environments and aspects of computer support[36]; Anthes et al[21] describe Internet resources for family physicians in Canada; Young and Beswick[32] describe computer support for general practice in the United Kingdom; Ebell et al[35] describe family physicians' use of computers; and Kripalani et al[26] describe interest in computer-assisted self-directed learning as a method for CME. While these studies are important to family physicians, none address computers and informatics as a CME topic.

Our study population is similar to those in the studies mentioned above. Our study, however, goes beyond describing the practice environment or need for computer support and identifies educational needs as defined by family physicians themselves.

Implications for CME providers

The fact that family physicians look to their traditional CME providers to assist them in acquiring computer skills has implications for CME planners. Providers will have to become familiar with content areas not traditionally associated with CME, for example, decision support systems, literature searches, and hospital information systems.

Providers could be called on to teach physicians how to use computer systems and how to select appropriate software and hardware. Computers and informatics are not just tools for CME; they are topics and content.

Limitations

In our needs assessment, questions concerning computers and informatics were concrete and straightforward and required yes or no responses. While the questionnaire did allow for brief comment on computer support in the practice setting, no systematic identification of detailed educational needs was sought. Further study is required to determine specific educational objectives.

Mailed questionnaires are an established method of determining physicians' opinions and educational

Key points
- Results of this survey showed which clinical and professional areas Canadian family physicians considered priorities for improving knowledge and skill during the coming year. Almost 55% of respondents selected informatics and computers, more than chose any other professional area, and more than chose most clinical areas.
- Men and those practising in towns of < 50 000 population were more likely to choose computers and informatics. Current access to computers in practice was limited (37.4% of respondents). Physicians doing inpatient care and caring for neonates or children younger than 5 years were more likely to have access to computers.
- There is a huge gap between the perception that family physicians have access to and use information available through computers and the reality of actual use.

Points de repère
- Les résultats de cette enquête faisaient ressortir les domaines cliniques et professionnels que les médecins de famille canadiens considéraient prioritaires comme besoins de perfectionnement du savoir et des habiletés durant la prochaine année. Près de 55% des répondants ont choisi l'informatique et les ordinateurs, soit un plus grand nombre que ceux ayant signalé tout autre domaine professionnel et plus que ceux ayant choisi la plupart des domaines cliniques.
- Les hommes et ceux qui exerçaient dans des villes de moins de 50 000 âmes étaient davantage susceptibles de choisir l'informatique et les ordinateurs. L'accès actuel aux ordinateurs dans la pratique se révélait limité (37,4% des répondants). Les médecins traitant des patients hospitalisés ainsi que ceux qui soignaient des nouveau-nés et des enfants de moins de cinq ans étaient plus susceptibles d'avoir accès à des ordinateurs.
- Il existe un large écart entre la perception et la réalité à l'effet que les médecins de famille ont accès à l'information au moyen d'ordinateurs et s'en servent effectivement.

needs and for providing a base for educational research. Nevertheless, caution is required in interpreting the results of such surveys. Educational program planning is traditionally based on surveys of constituents, and educational research has been validated across regions.

RESEARCH
···············
**Continuing educational needs
in computers and informatics**

The response rate of 19.6%, while similar to that of other large CME needs surveys, suggests that generalization of results to all family physicians must be considered with caution. Because responses came from across Canada and because demographic data on physicians was similar to that found in *Taking the Pulse*[36] and in studies by Ebell et al in Michigan,[35] it is probably safe to say that the family physicians in our study were representative of all physicians who use formal educational activities and look to formal CME to help them provide high-quality care.

CONCLUSION

Family physicians in this survey selected computers and medical informatics as an area in which to improve knowledge and skill in the coming year more frequently than they selected most traditional clinical areas. It is likely that family physicians anticipate that complex care environments require access to computer-based information and decision support. Continuing medical education providers and planners must rise to the challenge of providing medical informatics as a curriculum topic for family physicians as well as a method of CME delivery. The fact that current practice support lags behind physicians' perceived needs is important. Regional health authorities must attend to physicians' needs for computerized access to clinical and decision-support information to ensure continuing improvement in care. ♣

References
1. Bloor R. Review of medical informatics the essentials. *Addict Biol* 1997;2(3):363.
2. Cimino JJ. Beyond the superhighway: exploiting the Internet with medical informatics. *J Am Med Inf Assoc* 1997;4(4):279-84.
3. Hasman A. Challenges for medical informatics in the 21st century. *Int J Med Inf* 1997;44(1):1-7.
4. Haux R. Aims and tasks of medical informatics. *Int J Med Inf* 1997;44(1):9-20.
5. Kidd M. Informatics in family practice: an Asia-Pacific perspective. *Int J Biomed Comput* 1995;40(2):81-3.
6. Robins SC, Rigby MJ. Electronic health records as a key to objective health care needs assessment beyond the hospital boundary. *Medinfo* 1995;8(Pt 1):285-9.
7. Rosenberg W, Donald A. Evidence-based medicine: an approach to clinical problem-solving. *BMJ* 1995;310(6987):1122-6.
8. Zvarova J. On the medical informatics structure. *Int J Med Inf* 1997;44(1):75-81.
9. Cope DW, Sherman S, Robbins AS. Restructuring VA ambulatory care and medical education: the PACE model of primary care. *Acad Med* 1996;71(7):761-71.
10. Dixon DR, Dixon BJ. Adoption of information technology enabled innovations by primary care physicians: model and questionnaire development. In: *Proceedings The Annual Symposium on Computer Applications in Medical Care* 1994. p. 631-5.
11. Parboosingh JT. Learning portfolios: potential to assist health professionals with self-directed learning [PC Diary/ MOCOMP]. *J Cont Educ Health Prof* 1996;16:75-81.
12. Valenta AL, Wigger U. Early results of user profiles: physicians' opinions on the use of information technology. In: *Proceedings/AMIA Annual Fall Symposium* 1996. p. 65-9.
13. Lock C. What value do computers provide to NHS hospitals? *BMJ* 1996;312(7043):1407-10.
14. Shelstad KR, Clevenger FW. Information retrieval patterns and needs among practicing general surgeons: a statewide experience. *Bull Med Lib Assoc* 1996;84(4):490-7.
15. Vanzyl AJ, Cesnik B. A model for connecting doctors to university-based medical resources through the Internet. In: *Proceedings The Annual Symposium on Computer Applications in Medical Care* 1995. p. 517-21.
16. Vincent C, Schneeweiss R. How family physicians choose an office computer system. *J Am Board Fam Pract* 1992;5(3):275-80.
17. Wilson AE, Pollock C, Weekes T, Dowell A. Can general practice provide useful information? Evaluation of a primary health care information project in northern England. *J Epidemiol Community Health* 1995;49(3):227-30.
18. Muus KJ, Geller JM. Patterns of information technology adoption among rural health providers in North Dakota. In: *Rural sociological society*. Norfolk, Va: Rural Sociological Society; 1990. Association paper No. 90523783.
19. Anderson JG, Jay SJ, Perry J, Anderson MM, Schweer HM. Informal communication networks and change in physicians' practice behavior. In: *Proceedings of The Annual Conference on Research in Medical Education* 1988; 27: 127-32.
20. Anderson JG, Jay SJ, Schweer HM, Anderson MM. Physician utilization of computers in medical practice: policy implications based on a structural model. *Soc Sci*

RESEARCH
....
**Continuing educational needs
in computers and informatics**

Med 1986;23(3):259-67.

21. Anthes DL, Berry RE, Lanning A. Internet resources for family physicians. *Can Fam Physician* 1997;43:1104-13.

22. Chao J. Continuing medical education software: a comparative review. *J Fam Pract* 1992;34(5):598-604.

23. Gorton TA, Cranford CO, Golden WE, Walls RC, Pawelak JE. Primary care physicians' response to dissemination of practice guidelines. *Arch Fam Med* 1995;4:135-42.

24. Hayward R, Guyatt GH, Moore KA, McKibbon A, Carter AO. Canadian physicians' attitudes about and preferences regarding clinical practice guidelines. *Can Med Assoc J* 1997;156(12):1715-23.

25. Hogg WE, Crouch H. Incorporating the family into a computerized office registration system. *Fam Med* 1993;25(2): 131-4.

26. Kripalani S, Cooper HP, Weinberg AD, Laufman L. Computer-assisted self-directed learning: the future of continuing medical education. *J Cont Educ Health Prof* 1997;17(2):114-20.

27. Perkin RL. Continuing medical education revisited. *Can Fam Physician* 1993;39:2288.

28. Reznick CB, Anderson WA. Training in basic computer skills for academic physicians the certificate of added qualification approach. *Teach Learn Med* 1996;8(2):98-101.

29. Shaughnessy AF, Slawson DC, Bennett JH. Becoming an information master: a guidebook to the medical information jungle. *J Fam Pract* 1994;39(5):489-99.

30. Vanek EP, O'Connor K, Pomiecko E. Using a computerized information network for assessing programming needs. *J Cont Educ Health Prof* 1994;14(2):115-8.

31. McGowan J, Evans J, Michl K. Networking a need: a cost-effective approach to statewide health information delivery. In: *Proceedings The Annual Symposium on Computer Applications in Medical Care* 1995. p. 571-5.

32. Young AJ, Beswick KB. Decision support in the United Kingdom for general practice: past, present, and future. *Medinfo* 1995;8(Pt 2):1025-9.

33. Purves IN. Facing future challenges in general practice: a clinical method with computer support. *Fam Pract* 1996;13(6):536-43.

34. Yee N, Thompson JM. Computerizing the modern physician's office. A practical guide. *Can Fam Physician* 1993;39:2429-6.

35. Ebell MH, Gaspar DL, Khurana S. Family physicians preferences for computerized decision-support hardware and software. *J Fam Pract* 1997;45(2):137-41.

36. Canadian Medical Association. *Taking the pulse. The CMA physician resource survey*. Ottawa, Ont: Canadian Medical Association; 1997.

37. Franco ED. Études des besoins de formation médicale continue des omnipraticiens du Québec. *L'Omnipraticien* 1997;1(6):5-7.

38. Association des médecins de langue française du Canada poll Léger & Léger. Utilisation d'Internet par les médecins de langue française au Québec. *Actualité Méd* 1997;18(14):1.

39. Jette R. The truth is out there… and I'm closing in on it! Taking the pulse: the Canadian Medical Association physician resource survey. *Can Med Assoc J* 1997;157(9):41-4.

40. Kerr D, Toghill P, Klar B. CME and the role of the *Journal of the Royal College of Physicians of London. J R Coll Physicians Lond* 1996;30(3):246-51.

41. Young HL. Medical education by satellite: the EuroTransMed experience. *J Audiov Media Med* 1995;18(2):75-8.

42. Beck JR, Shultz EK, Edwards BR. Medical informatics for the other ninety percent: the Dartmouth experience. *Acad Med* 1990;65(5):298-301.

43. Friedman CP. The virtual clinical campus. *Acad Med* 1996;71(6):647-51.

44. Jay SJ, Casebeer L, Woods JR, Nyhuis AW, O'Toole JB. Community hospital and medical school cooperation in continuing medical education. *Acad Med* 1995;70(2):136-41.

45. Richardson ML, Norris TE. On-line delivery of continuing medical education over the World Wide Web: an on-line needs assessment. *Am J Roentgenol* 1997;168(5):1161-4.

46. Scott CJ. Applied adult learning theory: broadening traditional CME programs with self-guided computer-assisted learning. *J Cont Educ Health Prof* 1994;14(2):91-9.

47. Storey PB. The future of computers in continuing medical education. *Mobius* 1983;3(4):56-63.

• • •