Has general practitioner computing made a difference to patient care? A systematic review of published reports

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Abstract

***Objective*—To review findings from studies of the influence of desktop computers on primary care consultations.**

***Design*—Systematic review of world reports from 1984 to 1994.**

***Setting*—The computerised catalogues of Medline, BIDS, and GPlit were searched, as well as conference proceedings, books, bibliographies, and references in books and journal articles.**

***Subjects*—30 papers met the inclusion criteria and were included for detailed review.**

***Interventions*—A validated scheme for assessing methodological adequacy was used to score each paper.**

***Main outcome measures*—Papers were rated on sample formation, baseline differences, unit of allocation, outcome measures, and follow up. Differences in outcomes were also recorded.**

***Results*—Four of the six papers dealing with the consultation process showed that consultations took longer. Doctor initiated and "medical" content of consultations increased at the expense of a reduction in patient initiated and "social" content. Each of the 21 studies which looked at clinician performance showed an improvement when a computer was used (from 8% to 50%, with better results for single preventive measures). Only one of the three studies looking at patient outcomes showed an improvement (diastolic blood pressure control 5 mm Hg better after one year, with fewer doctor-patient consultations).**

***Conclusions*—Using a computer in the consultation may help improve clinician performance but may increase the length of the consultation. More studies are needed to assess the effects on patient outcomes of using a computer in consultations.**

Introduction

Almost 90% of general practices in Britain are now computerised, many using computers to carry out clerical tasks and repeat prescribing. In addition, 55% of general practitioners use desktop computers to access clinical data during consultations.[1] Indeed, as general practitioner computing is "an integral part of the NHS IT [information technology] strategy,"[2] the government currently spends around £47m on primary care computing each year (NHS Management Executives, personal communications). In the United States computing is seen as "an essential technology for health care."[3]

Computers can help with the care of individual patients through clinical decision support and with the care of groups of patients through strategic decision support. This help can operate at several levels—via access to scientific publications,[4] provision of guidelines and protocols,[5] prompting for missing information,[6] and structured knowledge based systems.[7]

It is often considered axiomatic that the more structured the information system the better the care. However, computers are less likely to be of value in the loosely ordered world of general practice, where people present with a wide variety of undifferentiated problems. This makes evaluating the impact of computers in consultations even more important for primary care, in which intuitive responses may be as valid as more structured management.[8]

Another issue is that in order to improve outcome, possibly computer systems should develop a specifically clinical orientation allowing them to store and generate primarily medical data. However, "the design of many existing electronic medical records derives, implicitly or explicitly, from support for the use of aggregated data for research, audit, finance or planning,"[9] producing a tool possibly structured more for information management than for clinical management.

This review concentrates on the use of computers by clinicians in terms of the effects on consultations, and on patient care in particular, rather than any advantages for administration or research, though both may influence patient care indirectly. The concern that "expensive computing systems are developed and installed in health care institutions without sufficient informed clinical improvement"[10] exists in all aspects of medicine. This review, however, is concerned exclusively with primary care.

Methods

A SYSTEMATIC REVIEW OF PUBLISHED WORK 1984-94

A worldwide review of published work was conducted and prospective studies selected if (*a*) they concerned doctors or nurses in a primary care setting and (*b*) they described any computing system designed for use by a doctor, either in routine clinical practice or for a specific research project. The aspects examined effects on the consultation process, on doctors' task performance, and on patient outcomes.

We searched the computerised databases of Medline, BIDS (which accesses the science, social science, and arts and humanities citation indexes), and GPlit (the primary care subset of the biomedical databases) by using "computers in medicine," "primary care," "family practice," and "medical informatics" as the search terms. We also reviewed books,[11-13] bibliographies,[14-19] and conference proceedings of related topics[20] as well as citations in these books and articles and references provided by colleagues. We excluded studies on aspects such as attitudes, accuracy, and completeness of data; comparisons with consultant letters; and epidemiological studies.

CRITERIA FOR EVALUATING STUDIES

Johnson *et al* reviewed the impact of clinical decision support systems on clinician performance and patient outcomes and proposed a scheme for assessing the

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methodological adequacy of studies on the impact of computers.[15] In their system random allocation to study groups is rated more highly, as it reduces bias. Baseline differences between groups should be eliminated or adjusted for, and the unit of allocation to groups should be the practice in order to minimise the Hawthorne effect (the beneficial effect of participation in research). Measures of outcome should be objective and follow up should be as complete as possible (table I).

Results

Thirty evaluations of computers in primary care met the criteria for review. Six examined the effects on the consultation process[21-26] (see table II), 21 evaluated effects on clinicians' performance of tasks[21 22 27-46] (see table III), and only three measured the impact on patient outcome[47-50] (see table IV). Two studies examined more than one topic (consultation process and doctors' performance)[21 22] and are included in both relevant tables (II and III). By means of the system described, each paper was reviewed and scored by each of us separately. Twenty two of the studies were scored identically. Differences in scores for the others were discussed and an agreed score reached. All 30 studies, including those with low scores, were incorporated to emphasise how little rigorous evaluation of computers in primary care has actually been carried out.

EFFECTS ON CONSULTATION PROCESS

Studies of the effects of computers on the consultation process were concerned mainly with the length of the consultations and the activities included (table II). The studies contained only few doctors (range one to six), indicating the difficulty of assessing the content of consultations. Three studies showed that consultations were 48-54 seconds longer when a computer was used.[21-23] This difference was mainly due to tasks involving the computer. Doctor initiated and "medical" content of the consultations increased at the expense of a reduction in patient initiated and "social" content. Only one study tried to observe the longer term impact of introducing a computer to consultations.[25] After 30 months it found that consultations were on average 90 seconds longer—10 minutes as compared with 8½ minutes for controls. Only one study found no change in the content of the consultations and used a subjective measure to detect differences in the "standard of care attained."[26]

CLINICIAN PERFORMANCE STUDIES

Studies of the effects of computers on clinician performance were the most numerous and were concerned with preventive care, clinical tasks, screening, and repeat prescribing. Many used a more robust methodology, including patient follow up. The emphasis was on immunisation and other preventive tasks (14 studies) and on prescribing (four), fewer studies being concerned with the management of disease (diabetes, one study; hypertension, one study). Only one study examined the performance of doctors in recording presenting symptoms and in generating problem lists.[46] Most of the improvements were in the positive direction (table III). Immunisation rates improved by 8-18%[27-29] and other preventive tasks performed improved by up to 50%.[21 25 30-38] The biggest improvements were noted when single rather than repeated measurements were performed.

Results were better when studies concerned more deprived patient populations,[35] emphasising the potential for opportunistic case finding to reverse the "inverse care law"[39] when supported by an adequate information infrastructure. Consultation based prompting could work only for attenders. Letters or telephone contacts, usually by a nurse,[28 34 35] were more effective strategies for those who rarely visited. Tierney *et al* used a randomised block design and showed that clinical decision support was marginally better than strategic decision support.[31] They also showed that there was no additive effect when both were employed.

Early studies of prescribing confirmed the anticipated time savings for doctors and receptionists, which probably persuaded most practices to buy computers in the first place.[40] Further studies showed that more generic prescribing is encouraged as electronic formularies are adopted, which partly explains the 13-30% reduction in prescribing costs reported.[41-43] However, the few practices concerned in prescribing studies makes their generalisability less certain.

Both studies examining process measures of chronic disease management suggested that improvements are

TABLE I—*Criteria for methodological adequacy*

Sample formation	Baseline differences	Unit of allocation	Outcome measures	Follow up
2 Random	2 None or adjusted	2 Practice	2 Objective or blind	2 >90% of patients
1 Quasi-random	1 Differences unadjusted	1 Doctor	2 Subjective or not blinded	1 80-90% of patients
0 Selected, concurrent, or historical	0 No statement	1 Patient	0 Not explicit	0 <80% of patients

TABLE II—*Effects on consultation process*

Study	Sample formation	Baseline differences	Unit of allocation	Interaction measures	Follow up	Overall score (10)	Process topic	Difference in consultation behaviour	Setting
Herzmark *et al* (1984)[21]	0	1	1	2	0	4	Consultation length Information handling	Consultation 54 seconds longer Doctors found computer stressful	5 Doctors, 374 consultations 137 Computer consultations 237 Non-computer consultations
Pringle *et al* (1985)[22]	2	0	0	2	0	4	Patient stress and arousal Consultation length	No difference in stress; higher arousal with computer Consultation 48 seconds longer	3 Doctors, 120 patients 60 Computer consultations 60 Non-computer consultations
Pringle *et al* (1985)[24]	2	0	0	2	0	4	Consultation topics initiated by doctor or patient	29% Increase in medical topics raised by doctors	3 Doctors, 120 patients 39 Computer consultations 81 Non-computer consultations
Brownbridge *et al* (1985)[26]	0	0	1	1	2	4	Standards of care	No difference	6 Doctors, 60 patients 30 Computer consultations 30 Non-computer consultations
Pringle *et al* (1986)[23]	2	0	0	2	0	4	Consultation length Doctor and patient activities	Consultation 48 seconds longer 4·5% Increase in doctors' speech; 12% less patients' speech; 12% increase in tasks	3 Doctors, 142 patients 93 Non-computer consultations 49 Computer consultations
Weingarten *et al* (1989)[25]	1	1	1	2	1	6	Consultation length	Consultation 90 seconds longer	1 Doctor, 205 patients 112 Computer consultations 93 Non-computer consultations

encouraged.[44,45] The study by Brownbridge *et al* on hypertension[44] also examined a paper protocol, so that the effects of computerisation by itself were difficult to disentangle. The remaining study[46] indicated that a computer can encourage more complete data capture of aspects of consultations which doctors consider important. However, doctors are more resistant to recording data which they consider less essential.[46]

PATIENT OUTCOME STUDIES

Only three studies could be classified as examining patient outcome (table IV). The first concerned doctors completing an encounter form for each patient seen. The data were entered in a remote clinical program and feedback was returned to the study doctors. Though the critique provided was remote from the consultation which produced the data, the doctors nevertheless changed their management of patients in the light of suggestions made (one in three consultations). An average reduction of 5 mm Hg in diastolic blood pressure was recorded for moderately hypertensive patients despite four visits a year fewer than controls.[47] It is reasonable to expect that "patient specific reminders at the time of consultation" would be even more successful.[48] The remaining two studies, which used patient satisfaction as an outcome measure, failed to detect any appreciable change.[49,50]

Discussion

Despite the major cost of computers to the health service, systematic review of published work yielded only 30 papers evaluating their effects on the consultation process, clinician performance, and patient outcomes. Most of these studies indicated a neutral or positive effect when a computer was used. However, every study of the introduction of computing evaluates more than simply a new information system. The

TABLE III—*Details of clinician task performance studies*

Study	Sample formation	Baseline differences	Unit of allocation	Clinician performance	Follow up	Overall score (10)	Clinical aspect	Difference in clinician performance	Setting
Gehlbach *et al* (1984)[43]	2	2	1	2	0	7	Drug prescribing	8% Increase in generic prescribing	32 Doctors, 3702 scripts
McDonald *et al* (1984)[30]	2	2	2	2	0	8	15 Preventive care study actions	14-20% Increase in response to study actions	115 Doctors, 12 467 patients
Pringle *et al* (1985)[22]	2	0	0	2	0	4	Preventive care, smears, blood pressure, tetanus vaccination	16·7% Increase in smears, 55% increase in tetanus vaccinations, 30% increase in blood pressure measurements	3 Doctors, 120 patients
Roland *et al* (1985)[40]	2	2	0	2	1	7	Repeat prescribing	6 min 37 s Receptionist time saved per 2 h period, 11 min 38 s doctor time saved per 10 scripts written, 4·9% fewer pharmacy queries, 38% fewer telephone script requests	5 Doctors, 590 patients
Donald (1986)[41]	0	0	1	2	2	5	Repeat prescribing	13% Reduction in costs	1 Doctor, 1400 patients
Brownbridge *et al* (1986)[44]	0	0	1	1	2	4	Hypertension	33% More pulse examinations, 53% more fundal examinations	3 Doctors, 89 consultations
Tierney *et al* (1986)[31]	2	2	2	2	2	10	13 Preventive care protocols	133% Increase in faecal occult blood tests, 300% increase in mammograms	135 Doctors, 6045 patients
McDowell *et al* (1986)[28]	2	2	1	2	0	6	Influenza vaccinations—patient reminders	25·9% Increase by letter, 26·4% increase by phone, 13·3% increase in person	6 Practices 1420 patients aged >65
McDowell *et al* (1989)[35]	2	2	0	2	0	6	Blood pressure screening—patient reminders	9·6% Increase by computer, 3% increase by phone, 14·6% increase by letter	6 Practices 8298 patients aged >18 in past year
Donald (1989)[42]	0	0	1	2	2	5	Repeat prescribing	21·5-29·5% Reduction in costs: greater when all scripts done on computer	1 Doctor, 1400 patients
Chambers *et al* (1989)[38]	2	2	0	2	0	6	Mammography screening	6·7% More mammograms	30 Doctors, 1262 patients aged >40
McPhee *et al* (1989)[36]	2	2	1	2	2	9	Cancer screening—physician reminders	16-31% Increase, 12-25% increase by audit	62 Doctors, 1969 patients
McDowell *et al* (1989)[34]	2	2	0	2	0	6	Cervical screening—patient reminders	2·4% Increase by doctor, 6·3% increase by phone, 12·2% increase by letter	1587 Patients, 6 practices
Herzmark *et al* (1984)[21]	1	1	1	2	1	6	Preventive care	Increase in tasks done 3-36% more than control, consultation 90 s longer	1 Doctor, 205 patients, 112 computer consultations, 93 non-computer consultations
Mazucca *et al* (1990)[45]	2	2	2	2	0	8	Diabetes	5-15% Increase in blood glucose examinations	114 Doctors, 2791 patients
McPhee *et al* (1991)[37]	2	2	1	2	2	9	Cancer screening—physician reminders	10·5-17·3% Increase in faecal occult blood tests, rectal/pelvic examination, breast examination, Papanicolaou smears, diet/smoking assessment, diet/smoking counselling	40 Doctors, 2400 patients
Ornstein *et al* (1991)[32]	2	2	2	2	0	8	5 Preventive services	Greater increase with doctor and patient reminders, 12·0-18·6% in cholesterol estimations, faecal occult blood tests, tetanus vaccinations, mammograms	49 Doctors, 7397 patients
Rosser *et al* (1992)[27]	2	2	0	2	0	6	Tetanus vaccination	7·8% Increase in vaccinations	6 Practices, 8069 patients
McDonald *et al* (1992)[29]	2	2	1	2	0	7	Influenza vaccinations	Around 15% increase in vaccinations	4555 Patients
Gilliland *et al* (1992)[46]	2	1	1	2	2	8	Presenting symptoms, problems+diagnoses, investigations	17-24% Increase in symptoms recorded, threefold increase in problems recorded, no increase in investigations recorded	9 Doctors, 4318 study consultations, 3575 control consultations
Garr *et al* (1993)[33]	0	2	0	2	0	4	5 Preventive services	0·1-9·5% Increase in tetanus vaccinations, faecal occult blood tests, smears, mammograms	44 Doctors, 7321-8067 patients

TABLE IV—*Details of patient outcome studies*

Study	Sample formation	Baseline differences	Unit of allocation	Outcome measures	Follow up	Overall score (10)	Clinical aspect	Difference in outcome	Setting
McAlister *et al* (1986)[47]	2	1	1	2	2	8	Hypertension	Patients with moderate hypertension had 4·1 fewer visits to doctor per year, 3·8 mm Hg larger decrease in diastolic blood pressure, 4·6% less drop out rate	60 Doctors, 2231 patients
Rethans *et al* (1988)[50]	0	1	0	2	0	3	Patient satisfaction	No change. 66% Of patients worried about privacy	3 Doctors, 263 patients returned questionnaires
Sullivan *et al* (1992)[49]	1	2	0	2	1	6	Patient satisfaction	No overall difference, nor in subscales of general satisfaction, professional care, depth of relationship, and perceived time	4 Doctors; 110 patients before, 6 weeks, and 6 months after computerisation

reason for any observed effect can be hard to disentangle from the effects of other changes that may occur at the same time—for example, greater teamwork, redefining working relations, and consultation with outside resources and training.

Many of the papers highlighted the clinical aspects of decision support in a research setting. However, in many cases it is the more strategic approach which is measured by outcome studies. Their emphasis on the more easily quantified aspects of performance reflects the current reality of available technology. Current systems are poorly placed to support the provision of feedback for strategy planning. Only 24% can audit the clinical content of a patient review and only 52% can audit prescribing activity.[51] Seventy nine per cent of systems cannot perform any statistical analysis and 76% have no graphical ability. The capacity to export data to third party software is also often limited.[52]

The studies reviewed provide evidence that using a computer in a consultation may lengthen that consultation by as much as 90 seconds. Patient initiated and social content may be reduced, though this may be offset by increased clinical performance on the part of the physician. The focus has been on the usefulness of computers in highly structured tasks. These may be laid open to computerisation, but surely the rich interaction of the consultation cannot be replaced by a computer. As Bleich *et al* noted, "Any doctor who could be replaced by a computer deserves to be."[53]

Most of the studies reviewed assessed the effects of computers on the clinician, but future research should centre on outcomes of care for patients. This is problematical because of the wide ranging tasks in primary care consultations, including prevention, current health problems, and public health issues. It is also difficult to determine the link between the process of care and outcomes for patients when clinical problems are diffuse.

The way forward would be randomised controlled trials to evaluate the benefits and drawbacks of existing computer use in consultations for clinicians, support staff, and patients. However, over half of the general practitioners in Britain already have desktop computers and the remainder could be described as laggards who may be reluctant to follow suit. Therefore, we need to look at new methods of evaluating these major changes in "the essential unit of medical practice"[54] such as quasiexperimental and pragmatic trials. The introduction of new aspects of information technology (such as Medline access, Cochrane databases,[55] and decision support systems) should also be examined.

It is five years since Mike Pringle challenged the suppliers of general practitioner computing systems to work with clinicians to improve the quality of patient care.[56] Only by clearly documenting the successes, failures, and lessons learnt will computers enable general practitioners "cum technologica caritas."

Key messages

- Fifty five per cent of general practitioners in Britain use desktop computers to access clinical data during consultations
- Using a computer during a consultation lengthens the consultation time by 48-90 seconds
- Use of a computer during consultations improves immunisation rates by 8-18% and other preventive tasks by up to 50%
- Using a computer during consultations does not seem to have appreciable impact on patient satisfaction
- More work is needed to assess the effects of primary care computing on patient outcomes

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1 Department of Health. *Computerisation in GP practices, 1993 survey.* Leeds: NHS Management Executive, 1993.
2 Leaning M. The new information management and technology strategy of the NHS. *BMJ* 1993;307:217.
3 Dick RS, Steen EB, eds. *The computer-based patient record: an essential technology for health care.* Washington, DC: National Academy Press, 1991.
4 Bradley P. Computers in primary health care. *Computing Bulletin* 1993;49: 151-60.
5 Johnson P. Flexible protocols at the touch of a keyboard. *Practice Computing* 1991;6:47-9.
6 Barnett GO. The application of computer-based medical record systems in ambulatory practice. *N Engl J Med* 1984;310:1643-50.
7 Shortliffe EH, Perrault L, Wiederhold G, Fagan L, eds. *Medical informatics.* Wokingham: Addison Wesley, 1990.
8 Feinstein AR. The need for humanised science in evaluating medication. *Lancet* 1972;ii:421-3.
9 Rector AL, Nowlan WA, Kay S. Foundations for an electronic medical record. *Methods Inf Med* 1991;30:179-86.
10 Wyatt JC. Clinical data systems, part 1: data and medical records. *Lancet* 1994;344:1543-7.
11 Llewelyn H, Hopkins H. *Analysing how we reach clinical decisions.* London: Royal College of Physicians Publications, 1993.
12 Essex B. *Doctors, dilemmas, decisions.* London: BMJ Publishing Group, 1994.
13 Sheldon M, Brooke J, Rector A, eds. *Decision making in general practice.* London: MacMillan, 1994.
14 Wyatt JC. Clinical data systems, part 3: development and evaluation. *Lancet* 1994;344:1682-8.
15 Johnson ME, Langton KB, Haynes B, Mathieu A. Effects of computer-based clinical decision support systems on clinician performance and patient outcome. *Ann Intern Med* 1994;120:135-42.
16 Mugford M, Banfield P, O'Hanlon M. Effects of feedback of information on clinical practice: a review. *BMJ* 1991;303:398-402.
17 Effective Health Care. *Implementing clinical practice guidelines. Bulletin 8.* Leeds: University of Leeds, 1994.
18 Haynes RB, Walker CJ. Computer aided quality assurance. A critical appraisal. *Arch Intern Med* 1987;147:1297-301.
19 Grimshaw JM, Russell IT. Effect of clinical guidelines on medical practice: a systematic review of rigorous evaluations. *Lancet* 1993;342:1317-21.
20 Wyatt J, Spiegelhalter D. Field trials of medical decision aids. In: Clayton PD, ed. *Proceedings of the 15th annual symposium on computer applications in medical care.* Washington, DC: American Medical Informatics Association, 1991:3-7.
21 Herzmark G, Brownbridge G, Fitter M, Evans A. Consultation use of a computer by general practitioners. *Journal of the Royal College of General Practitioners* 1984;34:649-54.
22 Pringle M, Robins S, Brown G. Computer assisted screening: effect on the patient and his consultation. *BMJ* 1985;290:1709-12.

23 Pringle M, Robins S, Brown G. Timer: a new objective measure of consultation content and its application to computer assisted consultations. *BMJ* 1986;293:20-2.
24 Pringle M, Robins S, Brown G. Topic analysis: an objective measure of the consultation and its application to computer assisted consultations. *BMJ* 1985;290:1789-91.
25 Weingarten MA, Bazel D, Shannon HS. Computerised protocol for preventive medicine: a controlled self-audit in family practice. *Fam Pract* 1989;6:120-4.
26 Brownbridge G, Evans A, Wall T. Effect of computer use in the consultation on the delivery of care. *BMJ* 1985;291:639-42.
27 Rosser W, Hutchison BG, McDowell I, Newell C. Use of reminders to increase compliance with tetanus booster vaccination. *Can Med Assoc J* 1992;146: 911-7.
28 McDowell I, Newell C, Rosser W. Comparison of three methods of recalling patients for influenza immunisation. *Can Med Assoc J* 1986;135:991-7.
29 McDonald CJ, Hui SL, Tierney WM. Effects of computer reminders for influenza vaccination on morbidity during influenza epidemics. *MD Comput* 1992;7:532-4.
30 McDonald CJ, Hui SL, Smith DM, Tierney WM, Cohen SJ, Weinberger M, *et al.* Reminders to physicians from an introspective computer medical record. A two-year randomized trial. *Ann Intern Med* 1984;100:130-8.
31 Tierney WM, Hui SL, McDonald CJ. Delayed feedback of physician performance versus immediate reminders to perform preventive care. *Med Care* 1986;24:659-66.
32 Ornstein SM, Garr DR, Jenkins RG, Rust PF, Arnon A. Computer-generated patient reminders. Tools to improve population adherence to selected preventive services. *J Fam Pract* 1991;32:82-90.
33 Garr DR, Ornstein SM, Jenkins RG, Zemp LD. The effect of routine use of computer-generated patient reminders in a clinical practice. *Am J Prev Med* 1993;9:55-61.
34 McDowell I, Newell C, Rosser W. Computerized reminders to encourage cervical screening in family practice. *J Fam Pract* 1989;28:420-4.
35 McDowell I, Newell C, Rosser W. A randomized trial of computerized reminders for blood pressure screening in primary care. *Med Care* 1989;27:297-305.
36 McPhee SJ, Bird JA, Jenkins CNH, Fordham D. Promoting cancer screening. A randomized, controlled trial of three interventions. *Arch Intern Med* 1989;149:1866-72.
37 McPhee SJ, Bird JA, Fordham D, Rodnick JE, Osborn EH. Promoting cancer prevention activities by primary care physicians. Results of a randomized controlled trial. *JAMA* 1991;266:538-44.
38 Chambers CV, Balaban DJ, Carlson BL, Ungemack JA, Grasberger DM. Microcomputer-generated reminders. Improving the compliance of primary care physicians with mammography screening guidelines. *J Fam Pract* 1989;29:273-80.
39 Hart JT, Thomas C, Gibbons B, Edwards C, Hart M, Jones J, *et al.* Twenty five years of case finding and audit in a socially deprived community. *BMJ* 1991;302:1509-13.
40 Roland MO, Zander LI, Evans M, Morris R, Savage RA. Evaluation of a computer assisted repeat prescribing programme in a general practice. *BMJ* 1985;291:456-8.
41 Donald JB. On line prescribing by computer. *BMJ* 1986;292:937-9.
42 Donald JB. Prescribing costs when computers are used to issue all prescriptions. *BMJ* 1989;299:28-30.
43 Gehlbach SH, Wilkinson WE, Hammond WE, Clapp NE, Finn AL, Taylor WJ, *et al.* Improving drug prescribing in a primary care practice. *Med Care* 1984;22:193-201.
44 Brownbridge G, Evans A, Fitter M, Platts M. An interactive computerised protocol for the management of hypertension: effects on the general practitioner's clinical behaviour. *Journal of the Royal College of General Practitioners* 1986;36:198-202.
45 Mazucca SA, Vinicor E, Einterz RM, Tierney WM, Norton JA, Kalasinski LA. Effects of the clinical environment on physicians' response to postgraduate medical education. *American Education Research Journal* 1990;27:473-88.
46 Gilliland AEW, Mills KA, Steele K. General practitioner records on computer—handle with care. *Fam Pract* 1992;9:441-50.
47 McAlister NH, Covvey HD, Tong C, Lee A, Wigle ED. Randomised controlled trial of computer assisted management of hypertension in primary care. *BMJ* 1986;293:670-4.
48 Grimshaw JM, Russell IT. Achieving health gain through clinical guidelines II: ensuring guidelines change medical practice. *Quality in Health Care* 1994;3:45-52.
49 Sullivan FM, Manchip A, Hussain S. Does the arrival of a desk-top computer reduce patients' satisfaction with consultations in general practice? *Theoretical Surgery* 1992;7:454.
50 Rethans JJ, Hoppener P, Wolfs G, Diederiks J. Do personal computers make doctors less personal? *BMJ* 1988;296:1446-8.
51 Harriss C, Pringle M. Do general practice computer systems assist in medical audit? *Fam Pract* 1994;11:51-6.
52 Kinn S, Sullivan FM. Good relations. *British Journal of Healthcare Computing* 1994;11:21-4.
53 Bleich HL, Beckley RF, Horowitz GL, Jackson JD, Moody ES, Franklin C, *et al.* Clinical computing in a teaching hospital. *N Engl J Med* 1985;312: 756-64.
54 Spence J. Function of the hospital outpatient department. *Lancet* 1953;i:275.
55 Chalmers I, Altman DG. *Systematic reviews.* London: BMJ Publishing Group, 1995.
56 Pringle M. The new agenda for general practice computing. *BMJ* 1990;301: 827-8.

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Correction

What do we know about fundholding in general practice?

An authors' error occurred in this article by Dr Jennifer Dixon and Professor Howard Glennerster (16 September, pp 727-30). On page 727 the second sentence under the subheading Control of drugs costs should have read: "In Oxford prescribing costs in fundholding and non-fundholding practices increased, but the rate of increase was lower in fundholding practices [not, In Oxford prescribing costs in fundholding practices decreased while costs in non-fundholding practices increased].[8]"

THE MAN WHO MOST INFLUENCED ME

Teaching by subterfuge

Born in Arklow in August 1897, John Duffy graduated from University College Dublin in 1922. He early fell victim to tuberculosis and spent periods in Swiss and Scandinavian sanatoriums. Thereafter he devoted his life, until his unexpected death on 2 September 1957, to the scientific study of tuberculosis and to the lay and professional antituberculosis campaigns necessary to shake the authorities out of their lethargy and indifference.

Rialto Chest Hospital in Dublin became part of the municipal Tuberculosis Service in 1943, with Dr Duffy as resident medical superintendent. Within a few years despite its Poor Law past, Rialto developed a reputation as the most progressive tuberculosis hospital in the country, a status unequivocally confirmed when an elaborate surgical unit was added in 1949. In those days six months' experience in a chest hospital was a desirable item in a curriculum vitae; fortunately for me sanatoriums in sylvan surroundings were far more attractive to prospective house physicians, so that in 1951 I went to work in the old work house wards. Dr Duffy taught by subterfuge, and a resident did not realise that he was learning a way of life rather than the minutiae of a restricted medical specialty.

The day began with a staff meeting in his office, but he was always available thereafter to give advice on any problem that arose on ward rounds. One afternoon when I sought his help he was lying, or rather standing, in ambush. His tuberculosis was healed but he was now racked by rheumatoid arthritis; he could not walk without the aid of crutches, and when he sat it was only on a high stool or on the edge of his desk. After discussing my patient's problem Dr Duffy took a book from the desk, opened it at a bookmark, and read from Osler's incomparable essay on the master-word in medicine: "Though a little one, the master-word looms large in meaning. It is the open sesame to every portal. . . . With the master-word in your heart all things are possible, and without it all study is vanity and vexation. . . . It is directly responsible for all advances in medicine during the past twenty-five centuries . . . Hippocrates . . . Galen . . . Vesalius . . . Harvey . . . Hunter . . . Virchow . . . Pasteur. Not only has it been the touchstone of progress, but it is the measure of success in everyday life. . . . And the master-word is Work, a little one as I have said, but fraught with momentous sequences if you can but write it on the tablets of your heart and bind it on your forehead. . . . "

Perhaps I was smitten by the lofty sentiments of the passage and realised that he was quietly undermining my ennui, but it was gradually that I came under the spell not so much of Osler's eloquence as of his gentle admirer, barely able to support *Aequanimitas* on his gnarled hands and yet prepared to salvage an idler gaily going along the road to nowhere. Subsequently Dr Duffy, with unrelenting encouragement, cajoled me into using the hospital library and five years later he forced me to leave the chest service to go into basic science. And ever since I have cheerfully been riding my favourite hobby horse.—

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