What Can Technology Do to, and for, Family Medicine?

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Medical technology can be divided into information technology, diagnostic technology, and therapeutic technology. These technologies can enhance the care of patients in a family practice; they also have the potential to diminish or fragment family practice when the technologies can only be provided by specialists. While some family physicians have an aversion to technological advances, we believe it is imperative that family physicians participate in the development of technologies that enhance family practice and improve patient outcomes in primary care practice. These include electronic medical records, decision support systems, tools for managing medical information, and others. Criteria are presented to help determine when these new technologies should be adopted into practice.

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"Technology . . . is a queer thing. It brings you great gifts with one hand, and it stabs you in the back with the other *(*C.P. Snow [1905–1980], English novelist, scientist, government official).

Introductory Scenario

Gregg Samsa, MD, was not having a good day. He looked at and smelled the sandwich in front of him. It was not what he ordered. He had faxed his usual order for a lettuce, tomato, cucumber, and cheese sandwich to the local deli, but the fax had smudged and what he was about to eat was a lettuce, tomato, and Limburger cheese sandwich.

It had been like this all day, starting early in the morning when he accidentally sat on his palm computer and reduced the touch screen to rubble. Then, when he arrived at the office, he had 50 e-mails demanding a response. Five of the e-mails were from medical information services with which he had been registered by each of the five managed care plans he worked with. Each message identified three or four articles that he just *had* to know about, yet most of the articles dealt with problems he rarely saw, measured outcomes he didn't care about, and didn't answer *his* questions. Another dozen e-mails were from pharmacies with questions about five formularies—too bad his electronic medical record could only handle one formulary. The medical records also couldn't do genograms, follow episodes of care, or link family members together. It was good at billing, however, which made sense because the group practice's administrator had selected it.

Another 20 e-mails were from patients, with questions that ranged from the interesting to the inane. One message was from a mother whose mentally retarded son had tuberous sclerosis. Someone on a Web-based support group had suggested that patients with tuberous sclerosis should have annual renal ultrasounds since they could develop tubers in the kidneys. What did Dr Samsa think should be done? Dr Samsa didn't have a clue since this was his only patient with tuberous sclerosis. After considerable effort, he determined that tubers infrequently caused renal failure, and there was not much that could be done about them, anyway. However, he could not convince her that screening was a waste of time and money.

The most annoying e-mail came from the State Health Department. They informed Dr Samsa that their routine computerized screening of controlled drug prescription patterns had revealed that Dr Samsa's prescription of benzodiazepines was outside the predicted range. Would he please forward within 10 days the electronic records of all patients for whom he had prescribed benzodiazepines in the past year to the Health Department for their review.

As he smelled his sandwich, Dr Samsa reflected that sometimes the technology revolution smelled too. He longed for the good old days when television was black

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and white, communication was face-to-face, and he carried all his tools in a little black bag. The day was only half over.

Introduction

The revolution in technology and the rapid pace of technological innovation are facts of life. Although we have all been frustrated with technology and may empathize with Dr Samsa's longing for the simpler days of the little black bag, it will not happen. Change at a rapidly increasing rate is inevitable.

The scenario described above illustrates a nightmare vision of technology implemented without the input of family physicians and without attention to the needs and values of our discipline. How can we avoid this scenario? How can technology help us be better family physicians and provide a higher quality of care for our patients? In this article, we discuss the influence of technology on family practice and family physicians and propose guidelines for the evaluation of new technologies.

This article begins with a discussion of technology and the history of technologic change in family medicine. Next, the risks and benefits for family practice of information, diagnostic, and therapeutic technologies will be discussed in detail. We will close by proposing guidelines for the evaluation and adoption of new technologies and identifying ways that we can manage technology to our benefit.

Medical Technology

Medical technology can be broadly divided into three categories. The first is information technology, which includes computerized data systems, e-mail, the Internet, fax machines, cellular phones, handheld computers and portable digital assistants, electronic medical records, and smart cards. The second is diagnostic technology, such as fiber-optic endoscopy and genetic analysis. The third is therapeutic technology, including the evolving application of biotechnology to human disease.

Different technologies have the potential to both enhance and diminish family practice. Examples of technologies that enhance family practice include the ability to measure oxygen saturation and prothrombin times in the office, the use of proton pump inhibitors that simplify the treatment of gastrointestinal esophageal reflux, and the problem-oriented medical record. Examples of technologies that have diminished family practice include the increasing complexity of treatments for Acquired Immune Deficiency Syndrome (AIDS) and cancer, taking patients with these conditions outside of the realm of family practice and limiting these therapies largely to the province of specialists.

Information technology can be both a benefit and a challenge for family physicians. The benefit occurs because it provides a great opportunity to improve quality of care. In particular, information technology can increase family physicians' access to information and, perhaps more importantly, increases patients' access to information. However, it also presents a challenge because it raises the standard to which family physicians are held accountable, mandating that they stay abreast of new advances in clinical medicine.

Tension Between Medical Technology and Family Practice

There has always been a tension between technology and the practice of family medicine.[1] Family practice is a specialty of breadth and diversity, caring for patients of all ages regardless of their specific problems; family practice does not rely on any specific technologies the way technology defines the practice of radiation oncology, invasive cardiology, and anesthesiology. Indeed, rather than focusing on technological care, the fundamental essence of family practice is that its practitioners care for persons as individuals and as members of families, not merely as biomedical constructs. Family practice epitomizes the fact that although technology is important to medical practice, the practice of medicine needs to go beyond technology to understand the full range of biopsychosocial factors that affect our patients. The family physician's interface with many technologies is to serve as a trusted and informed consultant to patients, advising them about which technological interventions might be appropriate for them in a specialist-driven medical system perceived as using technological interventions for technology's sake.

Family practice's emphasis on breadth of service, compassion, and caring, rather than technological prowess, may be self-sustaining within the specialty. That is, future family physicians (ie, medical students) attracted to family practice as a career may naturally be more interested in interacting with and caring for patients than with mastering the latest technological skills. Thus, each generation of family physicians may lack enthusiasm for technology, especially when compared to physicians in other specialties.

Family physicians, however, can and do master procedures such as colonoscopy, upper gastrointestinal endoscopy, and others. But, doing so and retaining proficient procedural skills requires a commitment of time and a reorienting of practice priorities toward that procedure. This prioritization toward a specific procedure detracts from the physician's ability to provide breadth of care to a diversity of patients. The challenge, therefore, is to use technology to enhance the fundamental goals and principles of family medicine, rather than have technology dictate or interfere with them.

Ultimately, as a specialty, we must determine and achieve a balance between our healthy emphasis on interpersonal communication with patients on the one

hand and our sometimes unhealthy "technophobia" on the other. New technologies have enhanced all aspects of our lives, and our medical practices should be no exception. When one of the authors of this article took his well-worn 1994 Saturn automobile to the dealership in Lansing, Mich, for the first time, the maintenance supervisor was able to log onto an electronic automotive record and see in moments a summary of every preventive maintenance measure and repair that had been performed on the car at dealerships around the nation, including dates and costs. How many physicians can now do the same for their patients? Don't our patients deserve at least the same level of service as our cars?

Historical Perspective

Innovations and changes in technology are not new phenomena. What is new is the number of innovations and the speed with which they are disseminated into medical practice. George Papanicoulau first demonstrated the effectiveness of the Pap smear in the 1920s, but it was not until the 1940s that it was accepted into practice. Contrast that with the acellular pertussis vaccine, or the hemophilus influenza vaccine, which became standard of care within a year of approval by the FDA.

There has also been an increase in the number of specialists (and decline in generalists) needed to support and use many of the new technologies. Since 1949, when the explosion of new technology began, the increase in specialists has been dramatic. In 1940, three of every four physicians in patient care were general practitioners; by 1949, that proportion had shrunk to two out of every three physicians.[2] In 1975, family physicians accounted for only 13.8% of the physician population.[2]

Many of the diagnostic technologies used by family physicians on a daily basis in the office are old—dating from the 19th or early 20th centuries. These include the thermometer (developed in 1850), the sphygmomanometer (1896), the X ray (1895), and the electrocardiograph (1901).[3] Family physicians certainly refer patients for sophisticated new lab tests and diagnostic procedures and subsequently interpret the results, but the technologies actually carried out in the office are usually older.

It is important to note that it is not just medical technologies that influence the practice of medicine. Nonmedical technologies also can have important effects on the practice of medicine. For example, the automobile and the telephone have profoundly changed medical practice. Prior to the telephone, physicians would get a summons to come to a particular home. They often had no idea whether the problem was trivial or life threatening, and the trip to the patient's home could sometimes take hours or days. The automobile changed everything, not only making it easier for doctors to get to patient's homes but also making it reasonable and more efficient for the patients to come to the doctor. This resulted in a shift of medical care from the home to the office. In the 1920s, 50% of medical calls occurred in the home; by the 1950s, this had decreased to 20%; by 1990, house calls comprised only 2% of patient visits.[3]

The most important technology affecting medicine in the last half of the 20th century was the invention of the computer and its associated technologies. Computers affect all aspects of our lives and our profession. Computers have facilitated a revolution in the dissemination of information and methods of communication revolution. They have also been essential for development of diagnostic tools such as ultrasound, echocardiography, CT scanning, and MRI. Therapeutic advances in pharmaceuticals and genetic engineering have occurred only because of computer technology.

The answer to the question "What can technology do to and for family practice?" largely depends on how well family physicians use and adapt to these various technological innovations. The remainder of this article is devoted to a discussion about specific aspects of several technologies: information technology, diagnostic technology, and therapeutic technology. The discussion will emphasize the current and potential effects of these technologies on clinical family practice.

Information Technology

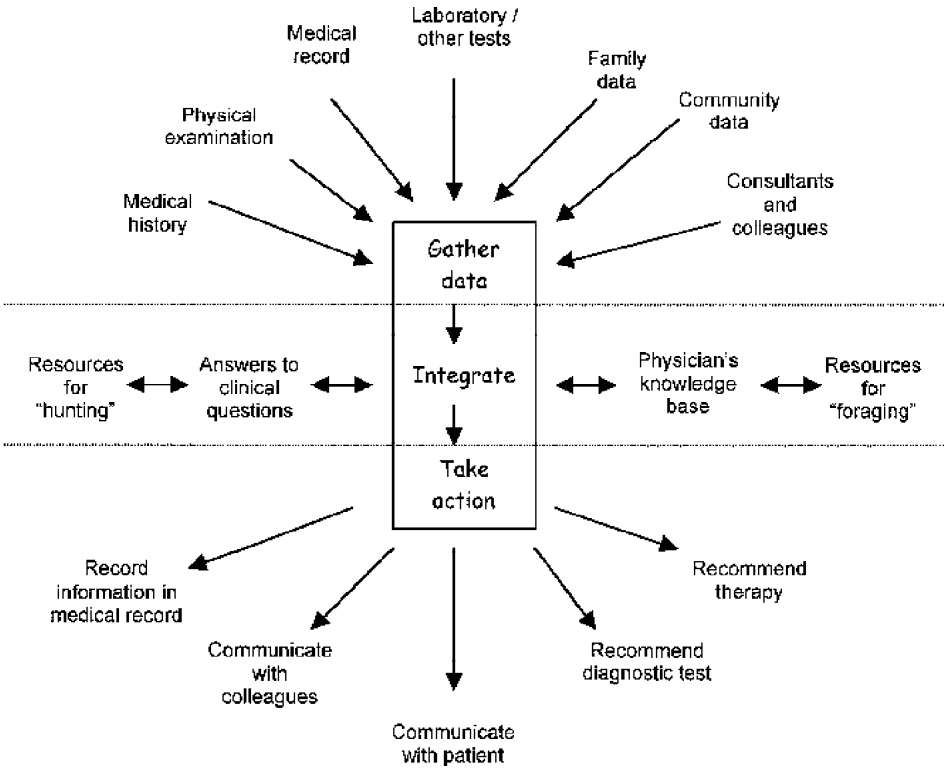
"Technology is so much fun but we can drown in our technology. The fog of information can drive out knowledge" (Daniel Boorstin [1914–], US historian.

Effective management of medical information is a core task for family physicians. It involves efficiently gathering information from the patient, colleagues, the medical record, and other sources; integrating that information with the physician's medical knowledge and other sources of medical information to come up with a management plan; and communicating the resulting recommendations to the patient, medical record, and colleagues. This process is summarized in Figure 1.

Effective management of information is facilitated by information technologies, which can be divided into medical record technology, decision support, communications, and medical knowledge base management. These new information technologies should be carefully evaluated like any other technology for their effect on the quality, cost, and processes of care. But, it is fact of life that these computer-based technologies are here to stay and that they will change how care is delivered. In fact, while Bleich noted that "Any doctor who could be replaced by a computer deserves to be,"[4] we would add that physicians who ignore computers do so at their own peril and to the potential detriment of their

Figure 1

The Flow of Information in Primary Care Practice



patients. Ten years from now, it will sound as absurd for a family physician to say, "I don't like computers" as it would be to now say, "I don't like stethoscopes."

Computerized information systems have the potential to improve care in many ways. They can decrease medical errors, increase opportunity for shared decision making, increase opportunity for collaboration with colleagues and consultants, and improve decision support and the future development of "intelligent" computers that can anticipate and meet your information needs. At the same time, poorly designed electronic information systems, including some currently available systems,[5] that are poorly integrated into the workflow of a family practice office can increase costs and decrease efficiency. Current computerized information systems should, therefore, be considered works in progress.

Finally, it is important to recognize that innovations in information technology do not necessarily involve computers. Weed's problem-oriented medical record,[6] the medical genogram,[7] and Slawson et al's concept of POEMs[8] are all examples of advances in information technology that did not involve or require computers. However, computers can enhance each of these innovations, and computers will make possible an entirely new generation of innovations that provide better access to information, all of which can be integrated into the medical record.

Medical Records

The first modern revolution in medical records was Weed's problem-oriented medical record, proposed in 1968.[6] The basic concepts of problem lists, medication lists, and a note organized around the headings *subjective, objective, assessment,* and *plan* have taken firm root in clinical family practice.

The next revolution in medical record technology is now underway—conversion to electronic medical records (EMRs). In England in 1995, approximately 55% of practices used computers to obtain clinical information during office visits,[9] a number that is surely higher by now. In comparison, however, only about 5% to 10% of practices in the United States use an EMR. The low rate of EMR use in the United States occurs despite studies showing that use of EMRs increases the use of preventive services with no decline in patient satisfaction and an increase in the length of office visits by only about a minute.[9]

It is important that the continuing development and implementation of EMRs involve family physicians, to assure that EMRs reflect the needs of our practices. Ideally, an EMR should allow family physicians to (1) track episodes of care, not just discrete events, (2) create family genograms, (3) quickly obtain information on members of a family, (4) integrate information about the community to allow a community-oriented approach, (5) gather data for practice-based research, and (6) integrate transparently with evidence-based, continuously updated, decision support systems.

Decision Support

The complexity of decision support systems varies from simple to complex. Simple systems use paper-based scoring systems and decision rules for a variety of medical conditions, such as assessing cardiac risk or ankle injury.[10,11] Or, they may involve a set of index cards in a tickler file to provide the clinician with a reminder about patients overdue for mammograms or Pap smear.

However, most current work with decision support systems involves computers. Examples include computerized reminder systems to increase use of preventive and screening services, improve drug prescribing, assist with diagnosis, and help choose the best therapy. A systematic review in 1998 identified 68 studies of computer-based decision support systems. Two thirds of studies demonstrated that use of a computerized decision support system was associated with an improvement in physician performance; nearly half showed an improvement in patient outcomes.[12]

Unfortunately, many decision support systems are either isolated from EMRs or do not require an EMR to function. Such systems may be linked with billing data, or they may require separate entry of data by staff. Ideally, future decision support systems will integrate with an EMR. They should be customizable to some extent by the user without requiring the skills of a computer programmer. There should also be a system for keeping the decision support information up to date, such as by downloading updates from the Internet. While previous surveys suggest that updates are only needed every 6 months, the increasing use of the Internet is likely to raise expectations for the currency of information. In fact, the ability of any physician to communicate with any other physician via electronic mail, and to access any article published in the medical literature, will raise the expectations for family physicians to stay up to date. This is likely to be driven by peer pressure, as physicians see their colleagues access the latest information from the Internet; by patients, who will now have higher expectations for their physician; and by malpractice attorneys, who may begin to redefine what constitutes a community's standard of care.

Communications Technology

New communications technologies will not only affect how we deliver care but will also affect our quality of life as physicians. For example, pagers and cellular phones improved the continuity of care for our patients by making family physicians more accessible. They had a mixed effect, however, on physicians. By creating an expectation that physicians be constantly available, these innovations reduced physicians' free time. On the other hand, the innovations also made it possible for the physician on call to run errands and attend soccer games without being tied to a land-based telephone.

The next major change in communication is likely to involve increasing use of e-mail and electronic document transfer. The primary benefit for family physicians is the possibility of rapid but asynchronous communication with patients, colleagues, insurance companies, and consultants. Asynchronous simply means that both parties do not have to be trying to communicate at the same time, as with a telephone. Instead, patients can send a message to their physician at a convenient time; the physician, in turn, can choose when to respond to the message (and also send copies of the message to the patient's chart or to a consultant). It is already possible to receive e-mails from diabetic patients with a spreadsheet of their blood sugar levels and to respond to these patients with recommendations about therapy, thereby obviating the need for an office visit. Electronic document transfer also makes it possible to review a letter from a consultant and then file it in the patient's chart. An e-mail to an insurance company could have the pertinent progress notes from the patient's record attached to it without any retyping or double entry of data.

With these benefits of electronic communication, however, comes the need to retool the office practice to deal with it. For example, communication systems should be secure and password protected to maximize confidentiality of patient information. Physicians need to develop office protocols for dealing with e-mail, just as they have an office protocol for faxes, telephone calls, and office visits. Physicians should only deal with e-mails requiring their specific expertise, while appropriately trained office staff should handle other messages. Issues to be addressed in the future include whether insurance companies should pay physicians for answering questions by e-mail, especially when e-mail communication replaces an office visit; what kind of security, if any, is needed for the system; how to communicate e-mail policies to patients; and how to deal with patients and others who abuse e-mail.

Managing the Medical Knowledge Base

Because the practice of family medicine is not limited by age, gender, or presenting problem, it is an information-intensive specialty. Consider more limited specialties such as dermatology, otorhinolaryngology, and ophthalmology as counterexamples. Each of these disciplines has only a handful of truly important original research journals each year, and a practitioner can reasonably be expected to review them on a regular basis. On the other hand, one could argue that family physicians could potentially find useful information in multidisciplinary research journals (eg, *British Medical Journal, Journal of the American Medical Association,* and *New England Journal of Medicine*), and the family medicine research journals (eg, *Journal of Family Practice, Journal of the American Board of Family*

Practice, and *Family Medicine*), and perhaps many subspecialty journals (eg, *Gastroenterology, Pediatrics, Circulation,* etc). There are also numerous other potential sources of information, including translation journals, pharmaceutical representatives, colleagues, and lectures. Obviously, a busy practicing family physician cannot review all of these information sources on a regular basis.

Instead, family physicians tend to use two approaches to gathering information: foraging and hunting (Figure 1). Foraging is the regular process of reviewing new information and adding it to the physician's knowledge base. Since the average physician reads journals for 2 to 8 hours per month,[13] strategies are needed to identify the most useful information. Hunting, by contrast, is driven by clinical questions that arise during the care of specific patients.[8,14] The information needs of family physicians are greater than those of more limited specialists and typically amount to about one clinical question for every one to two outpatients seen.[1]

Shaughnessy et al have defined the usefulness of medical information as a formula:[14,15] Usefulness of medical information = (relevance x validity) / work.

Thus, the most useful information is highly relevant, highly valid, and is obtained with little work. Shaughnessy et al further define the most relevant information as "patient-oriented evidence that matters" (POEMs)—articles that deal with a common or important primary care problem, use outcomes that are important to patients, and have the potential to change our practice if valid.[14,16] Validity is defined using the standard criteria of the Centre for Evidence-based Medicine,[17] and they advocate reducing work by relying on high-quality secondary sources of information, such as the Cochrane Library, InfoRetriever, the *Journal of Family Practice* POEMs feature, and the *ACP Journal Club.*

Diagnostic Technology

For more than 200 years, physicians have used diagnostic technologies such as the stethoscope, urinalysis, radiography, and blood testing to augment or even replace their history and physical examination skills. Often, though, technologies have been adopted without a clear demonstration of benefit for patients. Rather, there is a "technological imperative" that drives the adoption of technology before there is evidence of benefit to patients, based only on a demonstration of improved diagnostic accuracy or an improvement in disease-oriented endpoints.

New diagnostic technologies, while seemingly desirable, are not always associated with an improvement in patient-oriented outcomes, and they may even be harmful to patients. For example, a careful cost-effectiveness analysis suggested that men screened with the prostate-specific antigen (PSA) test suffer a *decrease* in quality-adjusted life years, compared with an unscreened population. This occurs because some of the treatments given for PSA-detected low-grade prostate cancers may diminish quality of life.[18] Similarly, while the Thin-Prep and PapNet technologies are touted as being more sensitive than standard Pap smears, most of the lesions identified are of questionable clinical significance.[19,20] Thus, the increased use of the Thin-Prep tests instead of the standard, less-costly Pap smears, may lead to a decrease in cervical cancer screening by women without health insurance, which may, in turn, lead to an increase in cervical cancers diagnosed at a later, symptomatic, and less-curable stage. Both the PSA and Thin-Prep tests may, therefore, be an example of a better test that yields worse outcomes. Ideally, demonstration of improved patient outcomes should precede adoption of a new technology.

On the other hand, holding all tests in all situations to the high standard of demonstrating a benefit in patient-oriented outcomes is unrealistic and even unwise. In some cases, particularly where treatment of the diagnosed condition is of clear benefit, a demonstration of increased diagnostic accuracy alone may be sufficient. For example, a test that more accurately identifies children with pneumonia or meningitis, conditions with significant morbidity and mortality for which there are effective treatments, should not necessarily be held to the higher standard. This is particularly true when the new test is less expensive or less invasive than the older test.

Another issue arises when the introduction of a diagnostic technology may harm the core values of family medicine. For example, many gastroenterologists recommend colonoscopy as the preferred screening test for colon cancer, and recent studies provide preliminary support for that recommendation. However, improvements in the ability to detect polyps must be balanced against the loss of continuity with patients, the actual effect on patient-oriented outcomes (which has not been demonstrated), and the feasibility of such an approach in rural and otherwise isolated family practices.

Therapeutic Technology

It is difficult to imagine the technologies that will be used by physicians in the future. Areas of intense research and speculation include nanotechnology, gene therapy, and "designer" pharmaceuticals. Nanotechnology involves creating tiny "machines" that will traverse our bodies, fighting infections and killing nascent cancers, like a real-life "Fantastic Voyage." Gene therapy involves insertion of new genes and repair of damaged ones, thereby curing previously untreatable chronic diseases. Designer pharmaceuticals are already in use. An example is raloxifene, a designer estrogen that offers some of the benefits of estrogen while avoiding some of the adverse effects.[21]

We propose that, before widespread use, such new therapies demonstrate an improvement in patient-oriented outcomes, such as the quality of life, quantity of life, symptom improvement, or cost. If the therapy is intended to be used in primary care settings, it should ideally have been evaluated in that setting; if evaluated elsewhere, there should be convincing evidence that it will deliver similar benefits in the primary care setting.

Finally, we should be investigating the effect of new technologies on the practices of family physicians. As noted earlier, treatment of AIDS and cancer has largely left the domain of family practice, but this loss has been balanced by clear improvements in outcomes that might not be possible in the family practice setting. It may be that care for these problems will return to the domain of family practice if, in the future, even newer technologies are developed that are more effective, less complex, and amenable to administration in a primary care setting. Lewis Thomas speaks of "half-way technologies"—ie, those that require considerable expertise to implement because of their complexity.[22] More fully realized therapeutic technologies may actually become simpler to use. An example of the transition from a complex half-way technology to a simpler, more fully realized technology is the management of peptic ulcer disease. Twenty years ago, management of peptic ulcers involved dietary modification, lifetime acid suppression, and, not infrequently, surgical intervention. Management of peptic ulcers was frequently in the domain of surgeons. Now, management of peptic ulcer disease involves in-office testing for *Helicobacter pylori* and adminstration of antibiotics and acid-inhibiting drugs. Simplification of treatment has resulted in a return of treatment to the domain of the family physician. As technological advances occur in the future, we are likely to see many other treatments return to the domain of family practice.

Evaluating New Technology

> It is only by the rational use of technology, to control and guide what technology is doing, that we can keep any hopes of a social life more desirable than our own, or in fact of a social life which is not appalling to imagine. (C.P. Snow)

For each area of technology discussed in this article, it is important that family physicians carefully consider the effect of the technology on their patients, their specialty, and their practice's financial viability. A financially solvent low-tech practice is better than a bankrupt high-tech practice, assuming that patient outcomes are equivalent. Below, we propose guidelines for the evaluation and adoption of new information, diagnostic, and therapeutic technologies (Tables 1 and 2).

Information Technology

Mastery of information technology is crucial and may be a make-or-break issue for the specialty of family practice. Because of the breadth of our specialty, we must be masters of information management and communications. This means research into and adoption of the best and most cost-efficient systems designed for clinical family practice, family physicians, and their patients. Family medicine organizations, including the American Academy of Family Physicians, the Society of Teachers of Family Medicine, and the North American Primary Care Research Group, must actively sup-

Table 1

Guidelines for the Adoption of Information Technologies

An information technology should be adopted if it meets all of the following criteria:

1. The technology should support and enhance one or more of the core principles of family practice (continuity, comprehensiveness, quality of care, family-centered care).
   and
2. If appropriate, the technology should support use of genograms, family charting, and other elements important to providing family-centered care.
   and
3. The technology should not impede communication with colleagues, patients, and consultants.
   and
4. If appropriate, the technology should support the performance of practice-based research.

Table 2

Guidelines for the Adoption of Diagnostic Technologies

A diagnostic technology should be adopted if it meets criteria 1 or 2 and both criteria 3 and 4.

1. Use of the diagnostic technology has been shown to improve patient-oriented outcomes more than alternative tests.
   or
2. The diagnostic technology is less expensive, safer, or can be delivered more conveniently for patients than an alternative test, when use of the latter has already been shown to improve patient-oriented outcomes.
   and
3. Use of the diagnostic technology is not expected to be in conflict with core values of family physicians (continuity, comprehensiveness, quality of care, family-centered care).
   and
4. The additional cost of a new diagnostic technology will not reduce access to care and thereby worsen patient-oriented outcomes.

Table 3

Guidelines for the Adoption of Therapeutic Technologies

A therapeutic technology should be adopted if it meets all three of the following criteria:

1. The technology should improve patient-oriented outcomes.
   and
2. It should have been evaluated in the primary care setting, or there should be convincing evidence that it will perform similarly in the primary care setting.
   and
3. The benefits of the new technology must be weighed against the potential harms to core values of family medicine (continuity, comprehensiveness, quality of care, family-centered care).

port the evaluation and incorporation of information technologies into practice. In fact, the specialty of family practice must demonstrate leadership among medical specialties in adopting new information technologies.

Therefore, we recommend that every department of family medicine and every family practice residency program must teach its graduates the following competencies in information technology. First, they must teach residents how to identify the most useful clinical information by understanding the principles of information mastery and POEMs. Second, residents must develop the ability to do a critical appraisal of a research article and, perhaps more importantly, to understand the critical appraisals performed by others. Third, residents must become facile with computers and the Internet as tools for accessing and managing medical information. Finally, residents should be able to understand and apply guidelines for the evaluation and adoption of new information technologies (Table 1).

Physicians already in practice should develop these same skills. In addition, practicing family physicians must take the lead in integrating decision support systems with electronic medical records. These systems should synthesize the best available evidence on primary care topics and make the evidence readily available to physicians at the point of care.

Diagnostic and Therapeutic Technology

Family physicians should be leaders in the evidence-based, cost-efficient use of new diagnostic and therapeutic technologies. However, we should be selective about the technologies that we choose to provide ourselves and those we recommend for our patients. Guidelines for the evaluation and adoption of new diagnostic and therapeutic technologies are shown in Tables 2 and 3.

Concluding Scenario

Jean Picard walked into her office and turned on the computer. Great: only five e-mails. One was from her favorite medical information service, which systematically reviewed nearly 100 journals for articles relevant to her practice and sent her a couple of useful synopses every day. Her triage nurse had forwarded an e-mail from one of her diabetic patients, with a spreadsheet of his blood sugars and blood pressures. She reviewed them quickly, replied to the patient, and filed the e-mail in his electronic record. The triage nurse had handled the other nine e-mails from patients.

Jean liked their electronic medical record, which had eliminated many of her routine administrative tasks and also allowed her to enter data using free text, menus, or prewritten templates. Her current patient, Ms Petersen, was presenting with dyspepsia. The record let her quickly see that this was the third visit for this episode of abdominal pain, that the *Helicobacter pylori* was negative, and that she had not had a therapeutic response to the ranitidine prescribed on the first visit. Maybe gallstones? Wondering about the best test to rule out cholelithiasis, Dr Picard pressed the "evidence" button, selected "diagnosis" and "imaging studies" from the submenus, and received a two-line summary suggesting that ultrasound was still the best initial test.

Ms Petersen mentioned that her husband needed a refill on his blood pressure medication. Because the record linked family members, it was easy to bring up her husband's record and authorize the refill. Dr Picard scanned the genogram and, with a little chit-chat about the mother, learned that she lived in Florida and had just been diagnosed with breast cancer. In addition to concern about her mother's health, Ms Petersen was also concerned about her own risk of breast cancer. In response, Dr Picard pulled up the 2005 update of the Gail Breast Cancer Risk Model. She entered the data from Ms Peterson's personal genetic risk analysis and was able to assure Ms Petersen that her risk of breast cancer was only slightly higher than average and well under 5% for the next 20 years. Interestingly, the dyspepsia had started around the same time as her mother's diagnosis. Maybe there was a relationship? Hmm. Now we're getting somewhere. Family practice can be so satisfying sometimes!

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