CHAPTER 20
Performance, Instruction, and Technology in Health Care Education

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Editors' Introduction

In this chapter, Craig Locatis discusses the role of instructional design and technology in health care settings, especially as related to educating and training physicians and other health professionals. Although professional education is stressed, he also addresses related areas, such as patient and consumer health education. The chapter begins with an overview of education in different areas of health and a brief history of medical education. The latter is used to frame a discussion of education and training in the health care field and the factors currently driving the application of technology and the design of instruction. Educational issues important to the health science community are identified, and an attempt is made to portray the overriding concerns of those working with education and training in health care.

Knowledge and Comprehension Questions

1. Name five settings for performance technology and education and training in health care, and two areas where performance technology is applied and education is developed that cut across the other five settings.
2. Name three reports that affected health professions education and discuss the impact of each.
3. What is content specificity in clinical problem solving and what are its implications for health professions education?
4. What is problem-based learning and what salient research findings of clinical reasoning support it?
5. What is evidence-based medicine and what is the relationship between evidence-based medicine and problem-based learning?
6. What characteristics and features of health professions education besides problem-based learning and evidence-based medicine are important to consider when designing performance and education interventions involving technology?
7. Name four factors affecting the development of technology-based performance and instruction applications in the health care field.

Education and performance technology are employed in different settings. General societal forces affect each context, and those working in a given setting have their own priorities, values, and culture. All of these factors affect the education and training agenda and, consequently, the way technology is used and instruction is created. In this chapter, I review the role of technology in supporting performance and instruction in health care settings, especially as it relates to educating and training physicians and other health professionals. I emphasize medical education particularly, since many trends in medicine carry over to other health science disciplines. Although professional education is stressed, related areas, such as patient and consumer health education, also are addressed.

The chapter begins with an overview of education activities in different health contexts and a brief history of medical education. The latter is used to frame discussion of education and training in health care and the factors currently driving technology application. Clinical reasoning, problem-based learning, and evidence-based medicine are discussed and educational issues important to the health science community are identified.

At the end of this chapter appears a list of annotated URLs to online applications that are either examples of education and performance technology in varied health settings or illustrations of how a theoretical approach has been instantiated in practice. Readers are encouraged to consult the URLs, which are organized to coincide with certain sections of the chapter. They will add meaning and definition to the concepts presented, and some are useful in their own right as health information sources.

The Health Care Education Context

One of the first things that you learn working in the health care field is that it is very broad. Most of us associate health care with hospitals and doctors' offices. The health care field not only involves the delivery of health services, but also biomedical research. It includes the medical profession and its varied subspecialties plus the professions of veterinary medicine, dentistry, nursing, allied health, and public health. Biotechnology (the use of DNA and protein sequences to engineer biological substances) and medical informatics (the application of information and communication technology to support medical research, practice, and education) are emerging as new subspecialties due to advances in genetics and computer science. The health field not only includes varied professions and specialty groups, it also embraces such related sciences and disciplines as anatomy, biochemistry, molecular biology, physiology, and psychology. In addition to academic institutions, hospitals, clinics, and research centers, the health care field also can include certain regulatory agencies and industries involved in drug manufacturing, genetic engineering, and medical instrumentation. When you take a pet to the vet, visit a pharmacy, eat in a restaurant, or buy food at the grocery store, someone in the health sciences, either directly or indirectly, has affected your life.

Health care is comprised of varied subsettings that include (1) academic medical centers and health professions schools, (2) government agencies, (3) pharmaceutical and biotechnology companies and private foundations, (4) professional societies and health associations, and (5) hospitals, clinics, and other caregiving institutions. Two other "settings" are consumer health and continuing education.

The most obvious subsettings for education and training in health care are the professional schools. Medical schools have departments of medical education that evaluate students and courses and develop curricula; departments of biomedical communication that do medical illustration, photography, and video; and academic departments in medical informatics doing teaching and research related to the application of computer and information technologies. They may have telemedicine offices for distant consultation and learning. Medical libraries provide computing and information resources supporting research, practice, and education and, typically, have learning resource centers. Other health professional schools may have one or more similar departments depending on size, and large university medical centers may have several professional schools sharing a single medical library. Health professions schools not only offer courses, but also develop interactive multimedia education programs on CD-ROM or for the Internet.

Government health agencies, pharmaceutical companies, hospitals, and clinics train staff internally and often provide training to others. Some of the external training is geared to keeping public health and other professionals up to date, but much of it is focused on educating the general public and providing consumer health information.

Private foundations focusing on health underwrite the development of health education programs and publish their own materials of interest to professionals and consumers. Professional associations are most actively involved in continuing education. In addition to holding conferences and publishing journals, they produce tutorials and case studies online, on CD-ROM, or in other media formats. Some offer virtual journal clubs online, electronic bulletin boards where health professionals can discuss information appearing in publications. They also offer information in their medical specialty areas for the general public.

Consumer health and continuing education cut across the other health education and training settings. Consumer health includes general education about wellness, health issues, and specific diseases as well as skills training (e.g., first aid) and patient education. Most health professionals are required to complete a certain number of hours of continuing education each year and almost every medical school and professional society has a continuing medical education (CME) program. Sometimes CME credit is provided for attending workshops and conferences, but it also can be obtained by documenting use of educational materials, many of which are online.

Medical Education: a Brief History

Another of the first things that you learn in the health field is the key roles physicians play in providing health care and in leading teams of other health professionals. This leadership extends to management and other areas outside the direct delivery of care (e.g., hospital administration and drug development). Trends and standards in medical education often spill over into other domains as a consequence. But there are additional reasons why medical education affects other health professions. There tends to be more research and evaluation of medical education programs, so much of the empirical evidence guiding education and training in health care emanates from medicine. Other health professions often mimic medicine's teaching methods. Nursing and public health schools, for example, have adopted many of the case-based teaching methods that are currently popular in medicine. Knowing the evolution of medical education is very helpful in understanding the culture of health care and the role of technology.

In the United States, medical education does not commence until one has obtained a baccalaureate degree, and the education process itself can be divided into three phases—undergraduate education comprising the years in medical school, graduate education comprising time in residency, and postgraduate and continuing education to obtain knowledge and certification in additional areas or keep current in one's field. The history of medical education also can be divided into three phases: a prescientific phase, a scientific or "Flexner" phase emphasizing selected disciplines and specialties, and a post-Flexner phase focusing on problem solving and cognition in addition to science.

Prescientific Phase

It can be argued that educational technology has had a place in medicine from the time of Andreas Vesalius and Leonardo da Vinci. Their drawings, based on dissection of anatomical structures, were some of the first attempts to codify medical knowledge based on direct observation rather than speculation, superstition, or religious beliefs, and can be viewed as "research works" as well as teaching aids. Although "science" in medicine dates back to the Renaissance, it was not until the early 1900s that there was a concerted movement to develop a scientific foundation for the medical curriculum, at least in the United States.

Scientific Phase

In 1910, a report by Abraham Flexner to the Carnegie Foundation for the Advancement of Teaching documented the evolution of medical teaching from apprenticeship to more formal education. The "Flexner Report" noted that the first medical schools in the United States in the late 1700s were university affiliated and devised to more efficiently teach basic information that would better prepare students for apprenticeship. At the time of the report, most schools were independent, commercial enterprises that emphasized didactic instruction, and had minimal facilities and no hospital affiliation. Doctors could graduate by memorizing symptoms and doses (e.g., if fever, give quinine). Laboratories, except those used for dissection, were usually absent and there was very little emphasis on the biological sciences and new medical technologies (e.g., stethoscopes, thermometers, x-rays, and laboratory tests) that were revolutionizing medicine at the time.

The Flexner Report called for the reaffiliation of academic programs with colleges, universities, and hospitals, and the introduction of scientific rigor. The following key observation was elaborated in later sections of the report:

> For purposes of convenience, the medical curriculum may be divided into two parts, according as to the work is carried on mainly in laboratories or mainly in the hospital; but the distinction is only superficial, for the hospital is itself in the fullest sense a laboratory. In general, the four year curriculum falls into fairly equal sections: the first two years are devoted mainly to laboratory sciences—anatomy, physiology, pharmacology, pathology; the last two to clinical work in medicine, surgery, and obstetrics. (p. 57)

Scientific rigor and empiricism were the primary concerns, and the scientific method was the glue holding the two parts of the curriculum together. It was assumed that the scientific method could be employed for diagnosing and treating individuals as well as for biomedical research.

The Flexner Report was very influential, revolutionizing teaching and practice by introducing the concept of "scientific medicine" (Bonner, 1998). While medical education improved as a result, the form of medical education the Flexner Report established remained essentially unchanged for 70 years (Association of American Medical Colleges, 1984). Whether intentional or not, its categorization of laboratory and clinical science led to bifurcation of the medical curriculum.

Post-Flexner Phase

In the 1960s and 1970s a movement for problem-based learning (PBL) began that was a reaction to what many perceived as the uncoupling of scientific and clinical content (Albanese & Mitchell, 1993). Its proponents differentiated between learning content within a problem-solving context and applying knowledge to solve problems after it is acquired, arguing that the former approach lets students determine what they need to know and enables them to synthesize information from multiple disciplines, develop transferable problem-solving competence, and acquire effective self-study skills for lifelong learning (Barrows & Tamblyn, 1979). The methodology proposed for attaining these goals was exposing students to a rich array of real and simulated patient cases. Cases are presented and students, usually working in groups, have to distill the patient's problems, generate hypotheses, gather data, and, if their background knowledge is lacking, independently research and discuss information bearing on the case (Barrows & Tamblyn).

Interest in PBL increased when the Association of American Medical Colleges's Panel on the General Professional Education of the Physician and College Preparation in Medicine issued *Physicians for the Twenty-First Century* in 1984 (Albanese & Mitchell, 1993). The *GPEP Report*, as it is often called, recommended (1) reducing lectures and providing more time for independent study, (2) integrating basic science and clinical education, (3) requiring more active problem solving, (4) promoting application of information science and computer technology, (5) considering social science and humanities undergraduate coursework in addition to science when admitting students to medical school, and (6) providing clinical learning experiences in settings other than hospitals. There was concern that students entering medicine were too narrowly focused, that memorizing facts took precedent over acquiring skills, values, and attitudes, that too much emphasis was placed on curing disease at the expense of promoting health, and that the population of patients in hospitals did not reflect the patient population most physicians encounter in practice.

The Association of American Medical Colleges (AAMC) issued another report, *Medical Education in the Information Age*, in 1986 that also impacted medical curricula (Salas & Brownell, 1997). It defined *medical informatics* as a developing body of knowledge and set of techniques concerning the organization and management of information in support of medical research, education, and patient care and called for including informatics in the medical curriculum through the use of databases, decision support systems, and computer-based education. The knowledge explosion in medicine mandated the use of these information systems to teach problem solving, to keep physicians current, and to facilitate lifelong learning.

Factors other than reports from the AAMC have influenced change. Indeed, the reports themselves are to some extent an outgrowth of some of the research and development on clinical problem solving, medical education, and computer-based instruction that was going on at the time, that continues to be conducted, and that still drives reform.

Problem-Based Learning and Evidence-Based Medicine

Allowing students to learn basic and clinical science in the context of cases is supported by research on clinical reasoning indicating that expertise is largely a function of previous problem-solving experience. Problem-solving expertise is dependent on the type of patient cases encountered, rather than involving application of general scientific methods and hypothetico-deductive reasoning as Flexner suggested (Norman, 1985; Patel, Evans, & Groen, 1989). Instead, it depends on acquiring rich, elaborated conceptual information about particular diseases and illnesses (content-specific knowledge) that can be associated with problems patients present (Schmidt, Norman, & Boshuizen, 1990). As expertise develops, problem solving becomes automatic and more a matter of pattern recognition than of formal deduction (Norman, 1985; Patel et al., 1989). Pattern recognition is important in clinical reasoning on several levels. On the one hand, it is recognizing constellations of symptoms patients present as manifestations of different diseases and conditions, but it also involves interpreting images and visual information, such as abnormalities in x-rays or features of skin rashes (Norman et al., 1996).

Other research has documented the benefits of problem-based learning. Meta-analyses and literature reviews indicate that students in PBL curricula perform as well or better than those in traditional programs on clinical reasoning tests, but somewhat less well on basic science exams. PBL students also have much more favorable attitudes about how they are taught (Albanese & Mitchell, 1993; Vernon & Blake 1993). There is also evidence that PBL students tend to integrate, retain, and transfer information better and that they have superior self-directed learning skills (Norman & Schmidt, 1992). Given that the costs and outcomes of traditional and PBL programs are about the same, but PBL is far more enjoyable, some have gone so far as to conclude that the choice between the two approaches is analogous to deciding whether to reproduce by sexual intercourse or by artificial insemination (Norman, 1988).

Since clinical problem solving research strongly supports exposing students to a range of cases representative of what they may encounter in practice and the patients that students are likely to encounter in hospital wards in their clinical clerkships may be unrepresentative and insufficient, computer-based patient management simulations have been identified as one means of providing problem-solving experiences and measuring performance (Barnett, 1989; Norman, Muzzin, Williams, & Swanson, 1985; Piemme, 1988). Computer simulation is an active area of research (Dev et al., 2002; Eva, Neville, & Norman, 1998; Luecht, Hadadi, Swanson, & Case, 1998; Sandrick, 2001).

The movement for evidence-based medicine (EBM) is partially an outgrowth of problem-based learning. EBM involves formulating clinical questions, finding evidence in the medical literature that addresses the questions, critically appraising the evidence, and applying the evidence to specific patients (Craig, Irwig, & Stockler, 2001; Evidence-Based Medicine Working Group, 1992; White, 2004).

One aspect of the EBM movement is to develop meta-analyses and systemic reviews of the literature to produce reliable summaries of the research related to varied medical problems. Another aspect is to apply the methodology in the medical curriculum so that students become so accustomed to consulting information sources while learning that they will continue to do so in practice (cf. Burrows, Moore, Arriaga, Paulaitis, & Lemkau, 2003; Finkel, Brown, Gerber, & Supino, 2003; Wadland, Barry, Farquhar, & White, 1999; White, 2004). There are problems implementing evidenced-based medicine in graduate education and practice where there are time constraints in providing real-time patient care (Green, 2000), and there are many clinical problems where evidence for conclusive solutions is lacking (Myrmel, Lai, & Miller, 2004). Although some have argued that there needs to be more evidence about the effectiveness of evidence-based medicine (Green, 1999), the approach complements problem-based learning.

Other Observations about Health Science Education

Although the current thrust is toward case-based, problem-solving approaches to teaching and the use of evidence in the process of learning and providing care, there are other points that need to be made about health care education. They relate to the roles of risk, altruism and professionalism, sensory perception, science, and educational innovation in health professions curricula. Some of these factors may seem obvious, but they are worthy of discussion nonetheless.

Risk

There is much at stake in health professions education. The subject matter taught, the skills learned, and the techniques and technologies employed can have life-threatening consequences. The health field is one area where errors in learning literally can be a matter of life or death. Moreover, the risks in health education and practice are not only for patients, but also for health practitioners and students. Health professionals do not wear rubber gloves because they are trying to make fashion statements. They are exposed to contagious diseases and work with hazardous substances routinely. The education of health professionals is serious business, which is one reason clinical problem solving and medical education programs are subject to ongoing evaluation and research.

Altruism and Professionalism

The health professions are helping professions. The idea of healing and helping people is more than just rhetoric to those electing careers in health care. The Hippocratic Oath and guidelines published by professional associations and government agencies set standards for conduct. Since the health professions are some of the few where work involves literally laying hands on others, interpersonal skills and open communication are needed to build trust and address the psychosocial aspects of disease (Stewart, 1995; Stewart, Brown, Boon, Galajda, & Sangster, 1999). This dimension of caregiving is so important that medical schools routinely hire actors and laypersons especially trained to mimic varied diseases and conditions that students have to interview and examine. The use of these "standardized" patients and other methods for teaching and assessing professionalism are being actively researched (American Association of Medical Colleges & National Board of Medical Examiners, 2002).

Sensory Perception

It goes almost without saying that most of the work of biomedical practitioners and researchers depends on making observations and reasoning about them. Some of the observations involve numerical data, such as when doctors and nurses take blood pressure or when epidemiologists plot the occurrence and spread of disease. Others involve sounds, such as when doctors and nurses listen to breathing and heartbeat. Most involve images that can be visual representations of numerical values, such as EKGs, or "raw data," such as skin lesions that physicians see during physical examinations, cellular alterations and adaptations that pathologists identify with microscopes, and x-rays and other images that radiologists interpret. The sensory nature of the raw data dealt with by most health professions makes it hard to imagine how biomedical researchers and practitioners could learn without exposure to audiovisual and multimedia information. A diagnosis literally can be seen in a biopsy specimen or a radiograph and there is probably no tougher or sensitive jury when it comes to judging image quality than health professionals.

Science

The role of sensory data in providing health care further underscores the scientific nature of the health professions. Those working with technology addressing performance and instruction in health care collaborate with subject matter experts who are either scientists or practitioners having backgrounds in science, who see teaching as an outgrowth of their efforts to provide care or conduct research, and who are probably less likely than other academics to have their ego involved in their teaching. They are, however, unlikely to accept changes in education without evidence.

Innovation

The penchant for science in health care does not necessarily stifle creativity or engender conservatism, and in fact may foster willingness to experiment with new technologies and teaching methods. Some of the more innovative educational technology applications have been in health care and many of these have been created by health science faculty and practitioners working intuitively on their own. Several of the earliest computer applications in the 1960s involving the development of databases, expert systems, and educational simulations were in the medical field (Blois & Shortliffe, 1990; Hoffer & Barnett, 1990), as were some of the earliest applications of interactive television and satellites for telemedicine (cf. Foote, Parker, & Hudson, 1976; Park, 1974).

Use of advanced computing and network technologies for consultation and education currently are active areas of health science research (Lindberg, 1995). Current work includes representing the entire adult human male and female anatomy digitally (Ackerman, 1998), establishing a collaboratory where scientists and teachers in embryology can work together and provide distance learning online (Cohen, 2002), and developing immersive, virtual reality environments using 3-D images and haptic feedback for surgical planning and training (Dev et al., 2002; Sandrick, 2001). Some innovations are only feasible for use at large medical centers and many may not be widely adopted. Still, on the whole, there is a general inclination in health care to at least experiment with new methods.

Factors and Issues Affecting Performance and Education

Some of the most significant factors affecting performance, the development of instruction, and the application of educational technology in health care are knowledge and research, costs and managed care, regulations and standards, and convergence.

Knowledge and Research

Knowledge advances rapidly in health care, and its currency and integrity are overriding concerns. The volume and timeliness of knowledge has made information technology an important ingredient in education and practice (Salas & Brownell, 1997). As the cost of information technology continues to decline, its use becomes more feasible. When the National Library of Medicine's Medline database of the published medical literature was first ported to CD-ROM, medical libraries could treat searching it as a fixed cost because the database was available by annual subscription instead of on a charge per search basis. This enabled greater student access to current medical research (Rapp, Siegel, & Woodsmall, 1989) and put pressure on faculty to keep themselves more up to date. Now that the Internet has eliminated the National Library of Medicine's need to support a separate telecommunications system for database access, online searching is free to everyone and this may put more pressure on practitioners to keep more current as well. The ubiquity of health information on the Internet from varied sources has expanded the knowledge integrity and timeliness problem, however. It has exacerbated the need to develop standards for health information and guidelines for helping nonprofessionals judge its quality and appropriateness (Robinson, Patrick, Eng, & Gustafson, 1998). One solution is for doctors to prescribe information sources as well as medicine (Bader & Braude, 1998).

Costs and Managed Care

Although tuition for some health professions (e.g., medicine or dentistry) can be high, education is a cost center, not a profit center, for health care institutions. These costs often are underwritten from income generated by hospitals and clinics. Attempts to curtail rising health care costs, especially with the introduction of managed care, not only affect the delivery of health services, but of professional education and training as well. There is more pressure on faculty to spend less time teaching and more time seeing patients and to limit the duration of individual patient encounters, further eroding the time faculty can coach students at the bedside or examination room (American Association of Medical Colleges & National Board of Medical Examiners, 2002).

drawing on problem solving, learning, and educational research.

6. Write a summary of what you believe would be the ideal performance support system for medical practice and provide a rationale for each feature. How would the system relate to existing or proposed systems for computerized medical records and current databases of medical knowledge? Would the system have features for synchronous or asynchronous collaboration among practitioners or patients?

7. Inspect the websites of several schools in the health professions and examine course descriptions and syllabi. Decide whether each school follows a predominately traditional or problem-based learning approach. Identify objectives and resources at each site supporting your judgment.

8. Examine several popular health care sites for the general public. Identify those that appear to provide better or more scientifically sound information. Generate criteria for evaluating the quality of online health information.

Annotated URLs

Academic Educational Resource and Innovation Examples

Loyola University Medical School/LUMEN—The LUMEN project is an effort to make major portions of medical education publicly accessible online. **http://www.meddean.luc.edu/lumen/**

Stanford University Medical School—The websites describe Stanford resources on CD or available online. Advanced educational research projects in surgical simulation are also discussed at the SUMMIT sites.

Educational Learning Technology Services homepage: **http://anc.stanford.edu/Edtech/index.html**

SUMMIT homepage: **http://summit.stanford.edu**

Current projects page: **http://summit.stanford.edu/research/current.html**

University of Iowa Virtual Hospital—The Virtual Hospital was an effort to make major portions of medical education publicly accessible online and to provide other medical information resources to practitioners. Although the site ceased operations in January 2006, much of its content remains available. Homepage: **http://www.vh.org**

University of Utah Medical Library/Knowledge Weavers—The Knowledge Weavers are a group that consults with faculty on the development of course materials. The program at the University of Utah also is part of a consortium supporting the HEAL project, a repository of sharable educational objects for health education.

Homepage: **http://medlib.med.utah.edu/kw/**

Health Assets Education Library (HEAL): **http://www.healcentral.org/index.jsp**

University of Washington/Department of Medical Education and Biomedical Informatics—The sites describe an academic program in medical education and informatics, offer a link to an online patient education program indicative of those used in problem-based learning, and provide examples of online continuing education courses typically offered by medical schools.

Homepage: **https://www.dme.washington.edu/**

Patient simulation page: **https://www.dme.washington.edu/patientsimulation/overview.html**

Continuing education online courses: **http://uwcme.org/site/courses/online.php**

Visible Embryo Project—A project to develop a repository of resources in embryology that can be shared among institutions.

Homepage: **http://netlab.gmu.edu/visembryo/index.html**

Products and animations: **http://www.uic.edu/com/surgery/embryo/index.htm**

Government Educational Resource Examples

Centers for Disease Control and Prevention (CDC)—The sites are to online and other resources that keep public health professionals up to date in epidemiology, biochemistry, and related fields and provide timely training in response to emergencies arising from epidemics or bioterror. The National Training Laboratory Network at CDC uses satellites and the Internet to link state health departments with videoconferences and webcasts.

Homepage: **http://www.cdc.gov**

National Training Laboratory Network: **http://www.phppo.cdc.gov/nltn/**

National Institutes of Health—The various institutes of the National Institutes of Health fund development of educational materials. Its videocast department regularly broadcasts seminars and meetings via the Internet on a range of health topics.

Homepage: **http://www.nih.gov**

Videocast page: **http://videocast.nih.gov**

Visible Human Project—A project to develop an image database of the entire male and female adult anatomy as both gross anatomy and magnetic resonance images (MRIs) and computer tomography (CT) scans that can be used by others to create diagnostic tools and educational programs.

Homepage: **http://www.nlm.nih.gov/research/visible/visible_human.html**

Additional websites—Check out the National Institute of Health and National Library of Medicine websites listed under Consumer Education, following.

Company/Foundation Educational Resource Examples

Pfizer—The site has links to information concerning use of company products and to health resources geared to different populations.

Homepage: **http://www.pfizer.com**

Merck Pharmaceuticals—The company maintains the Merck Medicus website for health professionals and the Merck Source site with resources for the general public.

Merck Medicus: **http://www.merckmedicus.com**

Merck Source: **http://www.mercksource.com**

Foundations—The Kellogg, Nemours, and Robert Wood Johnson foundations are three of the more active in funding health research and education programs. Nemours has funded the DuPont Children's Hospital PedsEducation and KidsHealth websites for health professionals and consumers (see Clinic and Hospital URLs, following).

Kellogg Foundation homepage: **http://www.WKKF.org**

Nemours Foundation homepage: **http://nemours.org**

Robert Wood Johnson Foundation homepage: **http://www.rwjf.org**

Professional Society and Health Association Educational Resource Examples

American Academy of Pediatrics—Its site typifies consumer health information offered by many health professional societies.

Homepage: **http://www.aap.org/**

American College of Cardiology—The ACC has an online catalog to education resources for cardiologists as well as online information and media resources, some of which cardiologists can use with their patients.

Homepage: **http://www.acc.org**

American Heart Association—The AHA website is consumer oriented, with cooking tips and other information for maintaining a healthy heart.

Homepage: **http://www.americanheart.org**

iPeds Interactive Journal of Pediatrics—This electronic journal in pediatrics consists mainly of interactive case presentations. Questions regarding diagnosis and treatment are interspersed throughout the case presentations.

http://www.medconnect.com/ipeds/ipedsmain.asp

Radiological Society of North America Education Portal—The RSNA website provides case studies, tutorials, and a virtual journal club for students and health professionals. It offers information about different imaging techniques for the general public.

http://www.rsna.org/education/

Hospital/Clinic Websites and Educational Resource Examples

Brigham and Women's Hospital—This Harvard-affiliated institution is typical of the kind of information provided by hospitals.

Homepage: **http://www.brighamandwomens.org**

DuPont Children's Hospital—This hospital provides education for health professionals at its PedsEducation website and information on health topics geared especially for children at its KidsHealth website.

DuPont Children's Hospital PedsEducation: **http://www.pedseducation.org**

DuPont Children's Hospital KidsHealth: **http://www.kidshealth.org**

Mayo Clinic—The three websites listed mirror the three activities of the clinic. One provides information about the clinic itself, another provides information for patients and consumers about their health, and the third provides information about its academic programs as a teaching institution.

Patient information: **http://www.mayoclinic.com**

Clinic information: **http://www.mayoclinic.org**

Academic information: **http://www.mayo.edu**

Consumer Educational Resource Examples

National Library of Medicine—The NLM maintains databases to the medical literature that are of primary interest to health professionals, but its MedlinePlus site is for the general public. It has links to online health resources that have been independently vetted to insure content integrity and has medical dictionaries and tutorials to help consumers understand health concepts. The ClinicalTrails website is of interest to persons wanting to participate in clinical trials of new drugs and therapies, usually persons for whom conventional care has been unsuccessful.

Homepage: **http://www.nlm.nih.gov**

MedlinePlus: **http://medlineplus.gov**

ClinicalTrials: **http://clinicaltrials.gov**

National Institutes of Health—All the institutes comprising the NIH offer some form of consumer health information related to the health problems that each addresses. The various institute homepages can be accessed from the NIH institutes page.

Homepage: **http://www.nih.gov/icd/**

Additional websites—Check out virtually all the Clinic and Hospital sites, the Professional Society and Health Association sites, and the Pfizer and Merck sites in the Company/Foundation sites listed previously.

Continuing Medical Education Educational Resource Examples

Cyberounds—This commercial website offers engaging CME involving online discussions about cases in specialties posted by experts.

Homepage: **http://www.cyberounds.com**

University of Florida—This medical school CME website streams presentations made at the school as a way to extend access to practitioners in the field.

Grand Rounds: **http://medinfo.ufl.edu/cme/grounds/index.shtml**

University of Washington—The University of Washington Continuing Medical Education site is typical of the CME offering of many medical schools.

Continuing education online courses: **http://uwcme.org/site/courses/online.php**

Additional websites—See all the professional Society and Health Association websites listed previously.

Websites of Organizations Concerned with Problem-Based Learning

American Association of Medical Colleges—The AAMC has been instrumental in providing information about problem-based learning. It establishes curriculum and evaluation guidelines for medical schools.

http://www.aamc.org

National Board of Medical Examiners—Most states have their own tests for licensure and certification, but the NBME is the primary national licensure and certification agency that is honored by most states. It is developing tests to measure problem solving and has sponsored research about the approach.

http://www.nbme.org

The University of Washington Patient Simulation Page—This is an example of a highly interactive online case that illustrates the approach.

Patient simulation page: **https://www.dme.washington.edu/patientsimulation/overview.html**

Additional websites—Check out most of Professional Society and Health Association websites listed previously.

Websites of Organizations Concerned with Evidence-Based Medicine

Agency for Healthcare Research and Quality—This government agency does technology assessments summarizing the research on different medical practices and therapies. It provides evidence based guidelines for providing clinical care and supports the National Guideline Clearinghouse.

Homepage: **http://www.ahrq.gov/**

National Guideline Clearinghouse: **http://www.guideline.gov**

Bandolier—An independent journal summarizing research evidence related to health. It has been supported by the United Kingdom's National Health Service and is currently supported by Oxford University Medical School and by subscription.

http://www.jr2.ox.ac.uk/bandolier/

Cochrane Collaboration—An independent organization of volunteers contributing summaries of medical research in varied specialty areas.

http://www.cochrane.org

Healthgate—A private company providing evidence-based medicine services. Online tutorials on different evidence-based approaches to care are provided.

http://www.healthgate.com

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