Chapter 6

Information Technology and the Health of an Aging Population

Introduction

The "information revolution" has profoundly affected business and commerce, recreation, education, security, and social interaction. Until very recently, this revolution has had little apparent effect on most of our health institutions and practices. Yet information technology has changed the entire health system and is a distinctive element in all fields of health. These fields and contributions include:

- **medical education—access to biomedical data bases;**
- **public health and biomedical research-computer modeling and statistical analysis;**
- **health care delivery-construction of diagnosis-related groups;**
- **patient care—access to computer-assisted diagnostic systems;**
- **information management—medical information systems;**
- **occupational health—epidemiological analyses; and**
- **patient education-computerized health risk appraisal instruments.**

Although the rate at which information technology has been incorporated into the health care system has been less rapid than predicted 10 or 20 years ago, it is now clear that it will be an increasingly important part of this system at all levels.

Relatively little attention has been devoted to applying information technology to the specific health needs of the older population, which stands to benefit significantly from its various applications. Information technology can enhance functions diminished by the aging process in the "healthy" elderly, improve health care for those with acute and chronic medical problems, and enrich the health care services that traditional health care institutions and professionals provide. It can also disseminate information on maintaining and improving health and on the availability of services in new environments such as home and community centers.

Because there are as yet few examples of the application of information technology to the health needs of the older population, this chapter focuses on the *potential* use of information technology. The contribution of information technology to specific health fields, such as patient care and public health, can be extended to their gerontological components. Technological limitations will be overcome in time. The scarcity of current information technology specific to the elderly underscores another focus of this chapter—the *future* elderly. There are profound differences in responsiveness to any technology, including information technology, depending on age. In 10 to 20 years, the elderly are likely to have a completely different view of information technology than their counterparts have today. The difference will be even more dramatic when the "computer generation" becomes eligible for Medicare,

In this context, it is important to recognize the heterogeneity of the older population. Older Americans vary widely in such areas as financial status, health status, and levels of enthusiasm, Many older people look upon computers as another of life's opportunities and challenges (33), while others

---

1A previous OTA report has defined information technology to include "communications systems such as direct broadcast satellite, two-way interactive cable, low-power broadcasting, computers (including personal computers and the new hand-held computers), and television (including video disks and vrideo tape cassettes)" (62). Because of space limitations and the importance of the computer as an access tool to health information, this report more narrowly defines information technology as '(the application of computers and telecommunication systems to the creation, storage, manipulation, and dissemination of information. "

find it difficult to **adapt to the lifestyle changes they** can **bring.**

This chapter restricts the definition of information technology to computers and telecommunications, and focuses on information technology as used by elderly individuals for their health care, either alone or, most often, in conjunction with a physician and other health professionals.

Information technology can be used both to promote preventive behaviors and to help manage chronic conditions. Discussion of its role in the health of America's elderly is important for a number of reasons. The use of information technology by the patient for health purposes has received minimal attention to date, although a large body of literature, including reviews, has looked at information technology in terms of other health fields, albeit without an age-related focus. OTA has produced two such publications, Computer ***Technology in Medicated Education and Assessment (64) and Policy Implications of Medical Information Systems (65).***

As the U.S. population ages, more people will need assistance in functioning, particularly at home. The number of elderly people confined to bed, barring unforeseen changes in disease patterns, is expected to rise from 458,000 in 1977 to 658,000 in 2000. The number of those needing help in getting around their own homes will rise from 1.9 million to 2.7 million during this period, and a similar increase is expected in numbers of those who are limited in carrying out some activities of daily living (19). Some 2.8 million elderly now need the help of someone else to carry out one or more of their daily activities (70). When adapted to the specific needs of the elderly, information technology can be a primary source of such assistance.

The growth of the elderly population will intensify demands on the U.S. health care system, producing significant increases in hospitalization, the use of hospital-based services, and nursing home care (19). By directly assisting with home health care and providing access to information concerning care for the elderly, either at home or on an ambulatory basis, information technology can reduce today's heavy reliance on high-cost institutional services.

Information technology is **expected** to increase the role of the elderly in their own care by improving their access to health information and services. Such technology will be used at home, in physicians' offices, clinics, or in hospitals by the elderly, either alone or with the assistance of others, including health professionals. One form of information technology, networking,[1] has the potential to greatly improve their social interaction, mental health, and access to health and other information.

This chapter discusses what is known **about** information technology and its use by the elderly for health purposes, including the cost of providing the technology. Two major factors underlie such use by the elderly—their ability to use information technology and the extent to which they participate in their health care.

[1]Networking (computer networking) is the transmission of data either to human users or to other computers through connections that link a telecommunications system. In this way, computers can transmit data throughout the Nation and the world, sharing work and data among groups of linked computers.

The elderly's ability to use information technology

The ability to use **information technology such** as the **computer** varies considerably with the older individual. Those with active minds are likely to relish the acquisition of new knowledge; a computer club in Menlo Park, CA, teaches elderly members to program computers as well as to operate them (33). The Elderhostel program at Reed College, which is limited to persons over 62,

offers a hands-on introduction to personal computers as one of its **summer residential academic programs for older adults (49).**

Even the less adventurous older person may welcome operating a computer for health purposes. The level of computer literacy needed to obtain health information need not be high, and the older individual often has assistance; in a community setting, other people are usually available to help. Home use could be facilitated by a family member, neighbor, or a paid or voluntary visitor. Difficulties with independent use of the new technologies may thus be limited to a small segment of the elderly population. Although more than 60 percent of those over 85 have major limitations in activity, this proportion is lower at younger ages. The size of this group is further reduced by the fact that with the exception of visual, neurological, and muscular problems, most of the limitations of those over 85 generally would not constrain their use of a computer terminal.

There has been little study of the ability of older individuals to use computers in general and still less about their ability to use computers for health care. Available evidence indicates that some elderly people enjoy programming and applications software, such as spreadsheets, and others enjoy recreational computer games and communicating by means of computers adapted to their capabilities.

A 1980 study of computer communication and the elderly found them highly receptive to using the computer and appreciative of the control that it afforded them. Interactive communication with other users was preferred over computer games by the subjects, who were residents of an urban retirement hotel. Their favorite game was highly interactive and simulated personal communication. The system required a number of modifications for the older users, including a large display screen and large characters on the keyboard. The presence of a trained computer demonstrator in a small group setting during the initial stages facilitated the learning process. The researchers concluded that additional modifications to the hardware, such as color-coded keys, would increase user satisfaction (18).

red Mee an

C m w g
m

A more recent examination of computer use by the elderly was conducted during a series of workshops held in 1983 in Washington, DC, and surrounding suburban areas (38). A total of 200 individuals, ranging in age from 60 to 95, attended at least one of 14 workshops. The study population was recruited from educational programs for the elderly sponsored by churches, nursing homes, and recreational centers. The response was extraordinarily enthusiastic. To the surprise of the researchers, these older computer users obtained the greatest satisfaction from the programming portion of the workshop. They were apt learners and had the patience required for the task. The participants also enjoyed applications software, such as spreadsheets, but were not interested in most computer games. The study

indicates that at least one segment of the elderly population—those who are active and enthusiastic—are more than ready for the computer age.

Another study found that the "frail elderly" can also benefit from information technology. A study of 50 elderly nursing home residents, whose average age was 85 and who had moderate mental and physical impairments, found that these frail elderly were able to participate in computer games that had been especially adapted for them. Adaptations included slowing down the game so that residents with such handicaps as impaired vision or hearing, tremors, or hemiplegia could enjoy winning. Most of those who were asked to participate were willing and eager to try the computer games; all were willing to try them a second time. The study points out that visual symbols in video games for the elderly must be large and well defined and auditory clues distinct and clear, and that these can be used to exercise and improve memory, enhance hand and eye coordination, and increase ability to concentrate on a task (77).

Although most of today's elderly, or, for that matter, most of today's middle-aged, have had little experience with computers, the evidence, though scant, indicates that they are receptive to using the new technology, either "as is" or when tailored to their needs, The elderly of the future are likely to be more open to using computers because of exposure to them throughout their lifetimes.

The development of new computer and communications technologies for those who are functionally limited is taking place at an astonishingly rapid pace. Computers incorporating features to counteract eyestrain or more serious vision problems are now available commercially. Oversized video displays are relatively inexpensive, but keyboards with large keys are usually custom built and costly (50). Other approaches include enlarging the letters on present keyboards or color-coding letters when only a few input commands are needed.

Display interaction-the use of light pens to obtain information from a computer—is potentially useful for elderly individuals who find it difficult to use a keyboard. The light pen, used in conjunction with a softwaredriven menu that appears on the screen, is pointed at the item of interest in the menu, which is then displayed on the screen. Even severely functionally limited elderly people can make contact with a computer by utilizing a sophisticated light pen that need not make physical contact with the screen in order to activate the computer. The pen is under development for those handicapped by high-level spinal cord injuries and cerebral palsy, or for amputees, among others (28).

Another substitute for a keyboard is the touch-sensitive terminal. The user simply touches a sensitized television screen's computer-generated menu to obtain audio and visual information. Hewlett-Packard is marketing a touch-sensitive system, Bell Laboratories has installed one at Epcot Center for use as an information system by visitors, and Boston's Sheraton Hotel uses one to provide information to its guests on in-hotel services and activities. Many homes are expected to have them by the mid-1980s.

Voice-activated systems that enter data and receive output on microcomputers are rapidly improving in both price and performance, with accurate representation of speech likely by the 1990s (62). Although the capability of current systems to recognize speech is limited, computers can be programmed to recognize a specific voice and follow simple commands.

Another new technique, the transparent access approach, is being used to give handicapped people access to standard hardware and software programs (73). The approach allows a specialized modular design of input and output devices for the handicapped but gives access to software and hardware designed for the general public.

The elderly and self-care

The use of information technology for health purposes by older individuals is also bounded by the extent of their involvement in their health care, either through selfware or through self-help groups. About 75 percent of all health care is estimated to be self-care (41), which substantially eases pressures on the health care system.

Self-care and self-help, as information-based health care activities, are becoming increasingly recognized as legitimate sources of care in the United States (21). Although definitions of these concepts vary, self-care can be generally defined as '(actions that we as individuals perform on behalf of our own, our family's, or our neighbor's well-being" (72).

An individual's interest in being in control of his or her own health care is often considered to be the basis of self-care. This concept can be applied to all levels of health care, including care provided through the use of high technology (40). It also applies to care taken in consultation with health professionals; this application has received the greatest degree of approval from health professionals and appears to be the most appropriate for an elderly population.

Self-help groups are '(clusters of persons who share a common condition, and who come together to offer one another the benefit of their experience and mutual support" (72). Broadly defined, these groups may total several hundred thousand in the united States (37). A recent inventory which used a more restrictive definition identified more than 2,000 U.S. programs offering medical self-care instruction (21).

Self -care encompasses a broad variety of activities, ranging from: 1) daily health practices, such as brushing teeth; to 2) increasing one's knowledge about health through such sources as magazines, pamphlets, and health fairs, and acting upon the information received; to 3) assuming tasks traditionally found in a health professional's realm of practice. This last mode of self% are usually requires formal training in which health skills, such as measuring blood pressure and heart rate, are learned (15).

The delegation to patients of certain tasks usually performed by professional caregivers has long been routine. Diabetics of all ages test their urine and give themselves insulin injections; persons with angina medicate themselves with nitroglycerin. Physicians and the Federal Government encourage women to undertake periodic self-examinations for breast cancer (66). Patients undergoing continuous ambulatory peritoneal dialysis are directly involved in their treatment at home (60). Health education programs, usually initiated by consumers, disseminate a wide variety of skills, such as showing parents how to obtain throat cultures from their children, and teaching women how to take a pap smear or do a pelvic exam. Computer and communications technologies are expected to play an increasingly important role in enhancing the ability of people of all ages to perform tasks traditionally done by professionals.

Although self-care and self-help programs afford wide opportunities for improving general health, many serious issues remain unresolved. These include questions on the degree of commercial involvement in the programs and the extent of professional involvement and support. Participants may feel that there is too much professional input into some programs; physicians are often concerned about the lack of a significant professional component (15). Additional issues include the political implications of certain programs, and problems of evaluating the effectiveness of any program in improving health (21).

Few self-help programs are designed specifically for the elderly, but many existing programs appear to be appropriate for their needs. An important factor in the growth of self-help groups has been the shift in disease patterns from acute to chronic illness. Chronic disease requires greater reliance on the individual, who must actively and continuously modify his or her lifestyle in order to cope with the burden imposed by the disease. Self-help groups are singularly suited to the care of chronic diseases, and many such groups (e.g., the Reach for Recovery Program of the American Cancer Society and the Cardiac Rehabilitation Group of the American Heart Association) have

been established, largely as a result of private funding. Although the prevalence of chronic disease among the elderly is high, few organizations have as yet "taken cognizance of the special needs of the elderly" (15).

Self-care is also well suited to health promotion and disease prevention in terms of health risk-taking behavior. Selfware education can reduce the probability of disease, disability, or premature death from a number of illnesses in which lifestyle has been shown to play a role. The unique circumstances of the elderly make it essential that self-care education be structured to accommodate their specific requirements and expectations, yet little has been accomplished in this area.

Preliminary estimates from a large-scale effort to identify self-care and self-help programs in the United States found at least 25 self-care programs specifically focusing on training or activities for the elderly. Many other programs for the elderly include self-care as part of the curriculum. The programs vary in sponsorship and setting, target group, method of implementation, type and size of staff, and goals and activities (21). Data on the use of information technology in these programs are not yet available (20).

Futurists contend that the use of computers and telecommunications will promote a change away from specialist care to self-care (43,56). At the same time, enhanced interest by consumers in self-care and their greater awareness of health and the value of health information will be important factors in their decisions to use information technology for health purposes.

The Federal Government has played a relatively minor role in promoting self-care and self-help among the older population. The National Institute on Aging (NIA) published an excellent pamphlet on self-care and self-help for the elderly in 1980 (72), and both the National Institute of Mental Health and NIA have provided grants to train paraprofessionals to help organize self-help groups among older people.

Also NIA recently began the funding of research into the nature of older people's behaviors and attitudes (68) in using three levels of health care. The emphasis will be on self-care and informal care and their relevance to health and disease in older people, regardless of whether the behaviors have in fact been found by epidemiological studies to be "risk behaviors."

NIA has also begun accepting proposals under the Small Business Innovation Development Act for self-care research projects for the elderly. The projects are aimed at increasing the self-sufficiency and sense of well-being of older individuals by enabling them to gain confidence in their ability to prevent and manage many of their health conditions. One project would develop a blood pressure self-care modality based on systematic training and education in dietary, exercise, and relaxation techniques. participants would be compared in their ability to control or modify their blood pressure with their counterparts in a conventional medication program (Grant Application to the Small Business Innovation Program, 8/83).

Information technology for health purposes

Computer-assisted health instruction

The use of computer-assisted health instruction is a logical extension of self-care/self-help. The growing use of information technologies for educating the public about maintaining health, and preventing or treating disease, is rapidly increasing the number of software programs on health education and management-diet, exercise, drug interactions, etc.—that can be run on a home computer (8).

The relevance of this technological phenomenon for use by and for the elderly has not yet been widely recognized in either the private or public sector, however. The use of information technologies, particularly the microcomputer, could help the elderly maintain independent liv-

ing, and is likely to be particularly effective when used in conjunction with physicians and other health care providers.

Current efforts to develop such technology specifically for use by the elderly are hampered by lack of interest and lack of funding, but a few projects are underway. A specialty group associated with the American Association of Medical Systems and Informatics, for example, has a specific interest in health assessment of the elderly and automated systems for this age group. Their focus is on information systems support for older Americans, with an emphasis on health promotion and disease prevention, and on developing a computer-assisted personal health management system for promoting the concept of wellness of the elderly (12).

Although very little computer-assisted software health instruction material is being developed specifically for the older population, health software is being produced by all sectors, including the for-profit, not-for-profit, not-for-profit with for-profit sponsorship, and by firms or academic institutions with a wide variety of expertise. A relatively large number of such products has been developed for mainframe computers, and the number of such programs for microcomputers is beginning to grow. The rapid expansion of personal computer capabilities has catalyzed the development of software packages to the extent that the Office of Disease Prevention and Health Promotion of the Public Health Service publishes a list of health promotion software for health educators, other health professionals, and individuals interested in developing good health habits. Topics include basic living skills, general health information, health risk appraisals, stress management, and nutrition and diet (70). Most of the software programs, which are not evaluated, are marketed by for-profit firms and few are inexpensive. The issue of costs and individual application of information technology, including software, is discussed later in this chapters

As in any new product area, problems abound. The field is diverse and unsettled. In some cases, programs are developed by transient "entrepreneurs" who lack subject knowledge and are often forced out of the market. A large number of colleges and universities have developed health instruction materials and are marketing or planning to market their products. Most available software programs have not been evaluated, but the serious issue of establishing evaluation criteria is beginning to be addressed (32).

TYPES OF INSTRUCTIONAL PRODUCTS, DEVELOPERS, PRODUCERS, AND SETTINGS

Private sector health software programs vary widely in both content and price—from nutritional programs that cost as much as $700 (69) to weight control and nutrition programs that help users balance meals and create weekly menus for $39.95 (55). Diabetics, for example, can purchase $100 software programs that focus on their daily fluctuations of blood sugar and insulin.

In the nonprofit sector, the Kellogg Foundation is funding the development of health education and promotion software for use by adolescents and their families, primarily in clinic settings. Topics include alcohol and drug abuse, stress management, smoking, diet and exercise, human sexuality, and family communications (10). The program is being systematically developed, tested with control groups, and evaluated; a preliminary report on its effect on the health knowledge, attitudes, and behaviors of adolescents is scheduled for early 1985.

Manufacturers of the Apple computer have sponsored the development of a number of health information programs at Ohio State university. When one such program, "Kardia," which describes risk factors for heart attack, was assessed by patients in the waiting room of a family practice clinic, 95 percent found it acceptable. patients had to access the program and interact with the material presented; 91 percent said that it was both helpful in providing an understanding of health and very easy to use (17).

A software package developed at the Abbott Northwestern/Sister Kenny Institute, in cooperation with a firm with expertise in microcomputer courseware technology and educational methodology, illustrates how information technology can

3A computer monthly has also published an article listing a number of commercially available nutrition, diet, and fitness software programs (23).

be adapted to the needs of a particular population, in this case hospital patients with low back pain. The Institute is a major medical center that is both an acute care facility and a rehabilitation center; a considerable proportion of its patients suffer acute and chronic low back pain. The software takes the physical status, learning readiness, and motivation of the patient, and the resources of the health care facility into account. The microcomputer is accessible to patients at all hours, so that patients can use it when they are not in pain, and is portable so that the keyboard can be used easily from a wheelchair or at bedside. Segments of the course are short to accommodate to the patient's comfort level and attention span. Upon leaving the hospital, the patient better understands the problem and has received instruction for lifestyle adaptations to protect himself from further injury. The courseware is currently being marketed through the Institute and a computer consulting firm (16).

A computer-based education program for patients with rheumatoid arthritis, written at the University of Connecticut School of Medicine, is one of the few programs that has an evaluation component (78). The program's initial evaluation found that participants demonstrated more positive changes in knowledge, self-reported compliance behaviors, and affect than did a control group. The interactive program is stored on a mainframe computer located at the university's health center, where it can be accessed by telephone from terminals located at any site, and is written in lesson format. Although the program was not developed for the elderly, it does make some provisions for them. A planned software program on osteoarthritis will have several access features for older patients, such as a large-type option, a cutout template that is blocked off and color coded for different functions, and, possibly, a speech synthesizer (57).

The use of computers for in-hospital health education appears ready for major expansion. The American Telephone & Telegraph Co. (AT&T) is exploring the potential for developing computerized health educational materials with Johns Hopkins Hospital and other facilities. Little detailed information is yet available about the project, which is in the planning stage, but it may utilize video disks, and a software program instructing patients in post-heart attack management maybe developed (51).

Software packages for health hazard/health risk appraisals (HHA/HRA) are also proliferating. The HHA/HRA is a technique for health promotion in which the user fills out a questionnaire and then receives information on his or her health status and recommendations for change. The appraisal rates the user's chances of becoming ill or dying from selected diseases by comparing self-described health-related behaviors and personal characteristics to mortality statistics and epidemiological data (74). The appraisal is designed to motivate individuals to change their lifestyle and improve their health (22), but because it generates a statement of probability and not a diagnosis, it can present problems (26). Many consumers lack the expertise needed to distinguish between risk factors and diagnosis and may not understand the information they receive. Thus some researchers contend that computer-assisted appraisals are best when part of a comprehensive program that might include face-to-face interaction with health professionals and written explanatory materials (47).

Few HHA/HRAs have been developed for the elderly population, although a number of instruments are available to health professionals for use in assessing the general functioning of their elderly patients (36)42). Numerous self-administered scales have been developed to measure psychological conditions in the aged (36), and computer games could be devised to measure various aspects of aging, such as cognition (35).

Because many database and methodological problems are associated with the construction of health risk appraisals, their use is controversial (74). Even when coupled with programs known to decrease the prevalence of risk indicators, it is not known whether appraisals will in fact yield dividends of healthier, more productive people and reduced expenditures related to illness, disability, and premature death (26). As is the case with many health care technologies now in use, their role and value have yet to be fully evaluated.

There are also unique problems associated with using health risk appraisal instruments for today's

Chapter 6

Information Technology and the Health of an Aging Population

Contents

	Page
Introduction	159
The Elderly's Ability to Use information Technology	160
The Elderly and Self-Care	163
Information Technology for Health Purposes	164
Computer-Assisted Health Instruction	164
Computer-Assisted Patient-Health Professional interactions	167
Access to Computer-Assistecl Information and Care	171
Federal Activities	173
Research Needs	174
Conclusions	174
Congressional Issues and options	175
Chapter 6 References	179

instruction as by a therapist (1), there is also concern that some programs may simply delay recovery in some cases (76).

The elderly, particularly the home-bound elderly, could profit from the availability and accessibility of computer-assisted mental health instruction. Home computer use could greatly enhance their ability to obtain reliable assistance with psychological problems and anxieties that are often overlooked and untreated. Effective computer-assisted instruction in the mental health field, as in all health fields, will require the guidance of professionals in the development, use, and evaluation of self-help programs.

Information technology can also assist health professionals with the care of the ***dependent*** elderly, who are a minority of the over-65 population, yet use a disproportionate amount of this age group's health services. Frail individuals would benefit from the availability of personal health software that combines diet, exercise, and stress monitoring. They could establish their own biochemical profiles to determine efficacy and safety of particular drugs for themselves (9), and develop diets appropriate for their health maintenance.

Some members of the older population have multiple chronic health problems that require extensive care and treatment (70). Some 77 percent of the elderly have annual Medicare reimbursements of less than $500, but 8.8 percent have average Medicare payments of more than $3,000 (7).

Computer-assisted health care that complements professional **care** may enable chronically ill people **to** remain in their homes when they wish to do so. About 45 percent of the noninstitutionalized elderly presently face limitations caused by chronic disease. Although this ***proportion is*** not likely to change dramatically, the total ***number*** of those limited by chronic disease is projected to rise sharply as the over-65 population grows from 27 million in 1983 to 35 million in 2000. The oldest group of elderly—those over 75, who need the most care—is growing even more rapidly. In 1965, 37 percent of Medicare's elderly enrollees were over 75; by 1981, this proportion had risen to 41 percent (58).

A number of factors point to an increase in the proportion of the chronically ill population who may choose home care over institutional care in the future. An estimated 15 **to** 20 percent of today's institutionalized elderly could be living at home if home health services were available and reimbursable. Such services are gradually becoming reimbursable through a number of funding sources, such as Title XX of the Social Security Act and Title III of the Older Americans Act, Services are also becoming available as a result of the phenomenal growth in segments of the home health care industry. According to the National Homecaring Council, the number of homemaker/home health aide service programs has grown from 300 in 1972 to more than 5,000 in 1984 (45).

Moreover, advances in medical technology now allow services to be provided at home that once required an institutional setting (2). Reductions in size and complexity have made many machines portable. By the late 1980s, consumers are expected to spend at least half a billion dollars annually for electronic devices to be used in the home for health monitoring and disease prevention **(9),** Use of these devices will be limited, however, by the need for accurate diagnosis of illness, which requires training and knowledge to interpret the results of the instrumentation (46). Telecommunication equipment connecting patients and health professionals will facilitate their interaction and enhance the quality of care.

Increases in the supply of U.S. physicians may counteract the need for computer-assisted professional care, since one reason for such care is physicians' disinterest in making house calls. Government estimates indicate an aggregate surplus of physicians by 1990 that will persist into the 21st century (71). Nonetheless, the specific services needed for the homebound elderly may not be available. These projections also point to a shortage of general psychiatrists by 1990 and a near balance in the numbers of family practitioners and osteopathic general practitioners at that time. But the projections did not analyze geriatrics, nor did they account for geographic variation in physician-population ratios. Thus, a surfeit of physicians would not ensure adequate numbers to meet the special needs of either the elderly in general or the homebound elderly in particular.

Among the health information surveys now available at home is "CompuServe, " which gives subscribers access to a medical "bulletin board" that includes listings of health professionals, and affords physicians an opportunity to exchange information. Future applications of such technologies to the needs of specific patients, particularly homebound patients, are likely to be extensive. Instructions on patient care can be programmed for use in the home by the patient or a family member when needed, which may enable home health agencies to reduce the number of home visits by nurses and other health professionals. One exciting application would redefine the term "house call" by connecting homebound patients with physicians' offices; physicians and other health professionals would then be able to make electronic house calls.

Few of these efforts have been directed at the needs of the elderly, but research in such fields as rehabilitative medicine provides insight into the potential for using information technology to give older individuals special care. Adapting technologies for the elderly can be extremely difficult because this population is so heterogeneous, and because the introduction of a technology into their lives must often be accompanied by an educational effort to convince the patient of its utility.

An interactive system of medical monitoring between the patient's home and the professional's office can be designed in a variety of ways. For example, the computer periodically calls patients and prints out routine questions. If the response is abnormal, unusually slow, or not given, the computer notifies the appropriate health professional. In a similar system, "Lifeline," which is now operational, the patient wears a lightweight transmitter that is electronically linked to a health care institution 24 hours a day. To call for help, the user presses a button on the transmitter, sending an electronic signal to the health care institution's computer. The computer identifies the user, notes the time of the signal, and personnel monitoring the system use the information stored in the computer to determine if help is needed. The system automatically sends a signal to the computer if it is not reset twice each day.

Other examples of medical technologies that can be connected to computers, thereby assisting health professionals with patient care, include analog signals from both mechanical and electrical devices that can be converted to digital signals for transmission to health professional computers. If desired, the health professional can transmit information back to the patient or directly to the device, Future medical technologies may operate digitally as do products currently in use, such as watches and bathroom scales, thereby eliminating the need for conversion of signals from analog to digital systems.

"Smart" sensors—those incorporating microprocessors-currently sense and measure blood pressure, pulse rates, body temperature, and electrical activity of the heart, Measurements of other physical functions have been developed for use in rehabilitating handicapped patients; those that have the potential for computer-based processing may be applicable for monitoring the health status of segments of the older population. For example, a patient with a spinal cord injury who has returned home from the hospital can be monitored for the number of times and length of time he or she is out of bed by means of a pressure-sensitive ribbon switch located under the mattress and a strip chart recorder (30). A protocol for computer-based monitoring of such chronic problems has been developed that would enable a physician to monitor the patient's movements (54). Periodic measurements of the movements of a partially bed-bound elderly patient would assist a physician in evaluating the patient's progress.

Computer technology can enable hospital-based approaches for managing chronic diseases to be expanded to the home. A study of cirrhotic ambulatory patients found that they were able to systematically measure and communicate medically and behaviorally significant information (54). A health aide telephoned the data to a laboratory, where they were entered into a computer terminal and analyzed. The method can be used with many chronically diseased patients, and helps involve them in assessing—and potentially managing—their chronic diseases. When adapted for direct linkage to a computer and utilized for an elderly population, the rapid processing of data

provided by ambulatory patients from their homes can promote continuity of care approaching that provided in hospitals.

Various computer and communication ***technol***ogies can be used within the home setting for health purposes without involving consultation with health professionals. Computers that monitor such household functions as turning lights, radios, and televisions off and on, and provide wake-up service by voice synthesizers that speak pre-programmed messages (52) could be programmed to remind elderly persons of medication times, instruct them on diet and medical care practices, and remind them of physician and other health professional visits. Devices could be programmed to track medicinal intake and periodically dispense medicines. A bedside automated programmable dispensing machine has been developed for use in hospitals (s) that may be adaptable for use in the home (6).

Photo credit: Lifeline **Systems, Inc.,** *Watertown, MA*

One type of home-based alarm system is directly linked with a central computer.

Access to compute-assisted information and care

Information technology is expected to enhance the independence of the older population, including the home-bound elderly, but the extent to which older individuals will have access to ***com***puter-assisted information and care is conjectural. For example, their current level of access to the type of information technology known as intersite networking is not known at present. In intersite networking, a home or office terminal and modem are connected to a mainframe by means of a telephone or cable; the "Lifeline" system and arthritis self-care program are two examples. AT&T has conducted preliminary experiments in providing health information in a home setting by networking homes to regional mainframes, but as is traditional in the private sector, information is proprietary and the company has released only scanty information on the developmental process.

The number of elderly who have access to terminals or microcomputers in the home is not known, essentially because the age of individuals owning or having access to personal computers has not been determined. Estimates of the projected penetration of U.S. homes by computers vary widely. A 1983 study estimates that approximately one-fourth of U.S. households will have personal computers by the late 1980s, and a 1979 study by the University of California estimates that at least half of the projected 97 million households in the United States will have them by the end of the decade (8). A third study expects this proportion to exceed two-thirds (8,39). OTA has calculated that by 1986 there will be almost 5 million personal computers used in the home (62). Estimates of the current number of home computers in households also vary substantially. The Wall Street Journal estimates the number as 4.2 million, the InfoCorp at 5.5 million, and Future Computing and the Yankee Group, market research firms, estimate the number as approximately 7.5 million (39).

Although prices for home computers have declined steadily, a major constraint to their access by the older population may be cost. A 1982 report on prices of personal computers found a range from several hundred to several thousand dollars (62). Hand-held computers sold for a few hundred dollars. Although they are deficient in a number of characteristics, such as size of display area, hand-held computers could be designed to connect with other hardware devices and to be linked over a phone line to a larger system in a physician's office, clinic, or community organization.

Prices for personal computers of similar capability are continuing to fall. It is currently possible to purchase a Commodore 64 with a disk drive at a discount store for about $400, which is less than the price of most color television sets. A "Home Teller" program initiated by the Madison National Bank in Washington, DC, offers an installment purchase plan for the Commodore 64; by maintaining a $1)000 interest-free balance and paying $15 a month, a customer can access his or her banking information and own the computer in 36 months. The Chemical Bank in New York and California's Bank of America offer similar plans (4). As soon as the bank customer receives the computer, it can be used for other purposes, including health purposes.

There is little consensus on future computer prices. Software programs for personal computers continue to improve and their prices to decline, but whether this trend will continue is unclear. Perhaps the greatest unknown at this time is the future price of telecommunication services. The price effects of the breakup of AT&T have yet to be determined.

Whatever the future costs of computers, software, and telecommunication services, some members of the elderly population will not find them affordable or attractive, even for health purposes. Although income levels vary widely among those over 65, the elderly tend to be concentrated at the lower end of the income distribution, as shown in table E-II in appendix E. Nonetheless, income, as but one measurement of monetary assets, does not indicate total financial worth. Both savings and committed expenditures will influence the purchase of information technology. Many members of the older population own their own homes and have either paid off their mortgages or are doing so at low interest rates. Their health expenditures, however, are higher than those of any other age group.

Many members of the elderly population will have access to software programs in libraries or community settings, and those who are still employed are likely to find computers in the workplace. Current estimates by International Data Corp. establish the ratio of computer terminals to office workers at 1:5; by the end of the next decade the ratio is expected to be 1:2.

A major obstacle to accessing computer-assisted instruction and care is the incompatibility of equipment. Software programs are usually written for specific microcomputers. The fact that they cannot be transferred between different machines, a problem for users of all ages, is particularly acute for those over 65 because of the scarcity of programs for their use.

Older individuals who have functional limitations have additional access problems in that they often find it difficult TO use computers designed for the general public. More than 11 million visually impaired Americans of all ages (most are over 55) find it difficult or impossible to read information on conventional display screens (3). About half of all Americans who have hearing loss in one or both ears are over 55 and are often unable to understand spoken messages on the terminal or from a computer terminal; many cannot hear the "beeps" some computer programs produce. Many older individuals whose mobility is restricted also find it difficult to reach the equipment or have trouble with keyboard control.

Awareness of the need for special equipment for the handicapped has risen significantly in recent years (73). For the most part, specialized equipment to enable handicapped individuals of all ages to use information technology has not been produced by mass market manufacturers because the demand for such technology has been difficult to demonstrate. Available demographics do not delineate the true number of elderly individuals with specialized needs because older people with functional limitations are not accurately represented in the census or other surveys. Many of those who have limitations cannot respond to surveys because of their limitations-e.g., deafness. Of greater importance is the complexity of payment arrangements for adaptive computer technologies. In almost all cases they have not been considered health devices by Medicare and Medicaid. The availability of appropriate private insurance coverage depends on a number of factors, including employment and State laws.

Until now, specialized equipment has been manufactured by "thin" market manufacturers or has been custom-made, and is not inexpensive (11). Advances in the field are so rapid, however, that it is impossible to forecast the size and configura-

tion of the market in even the very near term. For example, only one company manufactured key guards in January 1984. By April 1984, there were seven brands of key guards on the market.

significant developments in alleviating some of the problems of the functionally disabled are the improvements in standardizing the connections between adaptive devices and commercially available computers and in providing access to standard software programs for those using assistive devices.

whether it is Government's role to intervene on behalf of those older persons who would benefit from the accessibility to health services that computer and telecommunication services would afford is a matter of resource allocation.[4] At this time of Federal financial constraints, Federal resources are not sufficient to provide all technologies to all people who need them. Money that is applied in one area of technology limits that available for other areas. Conversely, it is appropriate for the Government to assist with providing goods and services that the private sector cannot. important considerations in making decisions concerning information technology for the aged include:

1. the degree to which encouraging independent living for the elderly is a priority of Federal resource allocation policy,
2. the cost effectiveness of information technology, and
3. the extent to which information technology will encourage independent living for the elderly.

Federal activities

The level of Federal involvement with information technology and the aged has been minimal. The National Institute on Aging (NIA) of the National institutes of Health (NIH) has sponsored the development of information systems in nursing homes in its teaching nursing home program. OTA has been able to identify several projects that the Federal Government may sponsor that directly address the use of information technology by the elderly for health purposes. One project, still in the planning stage, will investigate the use of microcomputers and computer games to improve elderly people's mental and social interaction. It may be submitted to NIA under the Small Business Innovation Development Act (public Law 97-219). Under the same program, the NIA has received a number of proposals for automatic drug dispensing systems that utilize computer technology.

The use of information technology would be appropriate for other programs for the elderly now under consideration. In planning for a national health promotion campaign for the aged, the Office of Disease Prevention and Health Promotion of the U.S Public Health Service and the Administration on Aging are sponsoring a project aimed at identifying effective ways to communicate health information, particularly on nutrition and fitness, to older people, emphasizing actions that promote health and prevent disease. A current NIA grant and contract solicitation calls for grant applications for research projects designed to identify specific modifications of the social environment, including the home, that may improve the health of middle-aged and older persons (67). Listed as a possible area of investigation is research on technological changes that can be introduced into homes to maintain independent living for frail, older people. In addition, a special grant announcement soliciting proposals to demonstrate and evaluate the impact of covering prevention services in the Medicare program was published in the Federal Register on August 12, 1983. The announcement calls for studies of Medicare reimbursement for a package of prevention services, including health education/promotion services.

The Federal Government has been involved in other fields that have relevance to information technology for the elderly. For example, the Government has played a role in the research, development, and diffusion of information technologies for the handicapped (63). As has been noted, information technology developed for the handicapped can in many cases be used by the elderly.

4A recent **OTA report provides a comprehensive view of the Government's role in technology** for the handicapped (63).

The Federal Government has also played a part in information technology for education in genera] and for special education (62). Some of the information technology developed to instruct retarded children, such as memory aids, could be adapted for use by the elderly.

Research needs

To make the most effective use of information technologies (computers and communications technology) for the elderly requires investigating areas that range from the physical sciences to the social sciences. Current research needs include:

- The effectiveness of selfware/self-help, health education and the specific techniques of HHA/HRA, and home care in promoting and maintaining health and monitoring health care among the elderly. Computer-assisted programs in these areas need special attention with respect to both development and evaluation.
- The economic implications of self-care and self-help.
- The ability of various subgroups (by age, by general health status, and by disability) within the elderly population to use computer and telecommunications technology.
- The development of new and adaptation of current computer and telecommunications technology to the needs of particular subgroups of the older population, according to age, general health status, and disability.
- Methods of involving the elderly in the development and delivery of information technology,
- Methods of encouraging the development and transfer of current and future computer and communications technology to the older population. Of particular importance are proper interactions between the public and private sector to ensure equitable access of elderly persons to information technology, especially those with functional limitations.
- Methods of reducing financial barriers (within reasonable restraints) to the acquisition of appropriate information technology by the older population.
- The application of artificial intelligence to interactive computer programs.
- The evaluation of software programs for safety, effectiveness, and instructional strategy (discussed further in the Congressional Issues and ***Options*** section at the end of this chapter).

Conclusions

A major consideration in formulating policies regarding information technology to be used by an elderly population is matching technologies to users. "Appropriate technology"s is a Clear need in many cases. Also important are the reactions of society and its institutions to existing and future technological capabilities and its willingness to assume financial responsibility for diffusion of various technologies.

As has been stressed throughout this chapter, society has thus far placed little emphasis on the research and development of information technologies specifically for use by the elderly, either alone or in conjunction with health professionals. The preceding list of research needs testifies to the absence of rigorous information. Interest in

---

'In a previous report, **OTA used the term "appropriate technology" to refer to technology that is developed or adapted in response to the needs, desires, and capabilities of disabled people and applied appropriately. The same concept of appropriate technology is used here to refer to appropriate technology for elderly people. It is also recognized, however, that the elderly are an extremely diverse group that includes many older individuals for whom there may be no need to adapt the technology used for the general public (63).**

this area, which has been lacking in the field of information science, is now beginning to surface. Professionals who work with the elderly have begun to realize the assistance that information technology can afford their clientele. Awareness of the potential of information technology in assisting with the health of the elderly population, and cooperation among information scientists, gerontologists, and other pertinent specialists are both very much in their infancy.

The information technology that is available has been developed for other populations, such as the general public, the business community, health care organizations, or the handicapped. Much of it can be adapted to fit the needs, desires, and capabilities of the elderly. Although it is sparse, there is convincing evidence that older people can benefit from using computers. Indeed, many of today's older individuals are completely comfortable with the new technology. The elderly of the future will find computers much "friendlier," in both a technological and a social sense.

Information technology can be used by those over 65 for health purposes in two major ways. One is computer-assisted health instruction. The use of computer-assisted health instruction for the population in general is new, and scant attention has been paid to developing programs for specific populations, such as the elderly. Although the market is growing, the number of software programs currently available is very small, and few have been evaluated. The market is complex in terms of the vendors of such programs. Some programs are developed and distributed by for-profit firms whose substantive knowledge of the subject matter or ability to produce a quality product may be questionable. Other programs are being developed under the aegis of university programs and subsequently marketed. A minute proportion of such programs specifically address the needs of those over 65.

Information technology can also be used to assist health professionals in monitoring the care of older adults. Many available and emerging technologies can be adapted for interactive use by the elderly and health professionals. Yet there remains too little recognition of this potential use, either by manufacturers of the equipment or by their distributors.

Society is on the verge of applying concepts developed in other areas to the needs of the elderly. The time is thus propitious for developing policies that will make a significant contribution to the research, development, and diffusion of information technology appropriate for use by and for older individuals. The appropriate utilization of information technology by the elderly is not, however, inevitable. A key consideration in formulating policies regarding information technology to be used by those over 65 is society's commitment to the use of present and future technological capabilities. Although it is an avowed goal of Federal policy to keep the elderly out of institutions and promote their independence, there are substantial costs involved in the research, development, and diffusion of information technology for the older U.S. population. These costs need to be evaluated against "helping the senior members of society continue as viable participants in its processes" (48).

Congressional issues and options

ISSUE 1: Should **Congress assume major responsibility** for assuring the quality of computer-assisted health instrue ion for the elderly?

These policy options are intended to assure the quality of computer-assisted health instruction for the older population. Most of the alternatives do not require new legislation because sufficient authority has already been written into law. Rather, desired actions could be stimulated by congestsional interest or oversight.

The principal question to be addressed is the extent to which the Federal Government should be involved in activities concerning the quality of

computer-assisted health instruction for the elderly. The use of the technology for all age groups, and particularly the older population, is in a very early stage of development. It is not yet a viable means of promoting, maintaining, or monitoring the health of the older population. But beneficial health-related software programs for this population can be forthcoming if adequately fostered. Because of the possible physical and financial vulnerability of those over 65, the quality and credibility of the content of health-related software programs for this age group require attention.

The Government's role could depend on the types of computer-assisted health programs for the elderly, which vary along a number of parameters. Of particular relevance for the quality issue are the specificity and uniqueness of a program's content, Quality and accuracy of information are necessary to all computer-assisted health education, including gener~ instructions on broad subjects, such as good health habits, the nutritional value of foods, and HHAs/-lRAs. Quality assumes still greater significance in software programs that instruct individuals on managing specific health conditions with counseling, drugs, or medical devices. Quality is also an essential component of an individualized software program that instructs a person on the care of his or her particular medical problem. Because, however, such programs usually require continuous consultations with and revisions by a health professional, some aspects of quality control are informally in place.

Options:

1.1: The private sector could ***assume responsibih"tyfor the*** quality ***of the content of*** health ***instructional software for the elderly.***

Although computer-assisted health instruction is not a new technology, there is as yet no formal mechanism in the private sector to oversee the safety and effectiveness of the content of software programs. Computer-assisted health instruction has been used for a number of years for the education of health professionals. In the early 1970s a number of software programs for the general public appeared on the market, but most were of poor quality and did not achieve commercial success, Interest in the technology has resurfaced with the diffusion of microcomputers into clinics, offices, schools, community centers, and homes. It is conceivable that, if left undisturbed, market forces might eventually eliminate quality deficient health instructional software programs. But today's potential market for computer-assisted instruction is large and poorly informed. The rapid diffusion of the microcomputer throughout society has given millions of people, including older people, **access to** computer-assisted health instruction that did not exist 10 or 15 years ago, As the number of people with access to computers soars in the future, the number of users who lack the expertise to properly evaluate the content of instructional programs will also rise.

Government involvement in generalized descriptive programs that do not differ from published materials would be hard to justify because of the protection afforded publications by the First Amendment. But reputable developers of computer-assisted health instructioniil material attempt to produce programs that do not mimic published matter. The nature of the computer allows for an interactive exchange between the user and the program, which is rarely possible between the reader and a book or other publication. proficient software developers thus attempt to invoke active user participation in constructing their software programs. Whether the Government can assume a role with respect to the quality of interactive instructional software programs has not been determined.

A serious issue arises about actions to be taken in cases where incorrect or inexact information is used in software programs that instruct individuals how to manage mental health problems and how to use drugs or medical devices to manage medical conditions. such information may adversely affect the health status of the user. Because of its general role of protector of the public and its specific role of user of and payer for health technology, the Government is concerned with issues of safety and effectiveness. And the Goverment has found it necessary to assure the safety and effectiveness of health technologies, such as drugs and medical devices, on which the life or death of the user may depend.

1.2: Congress could encourage Federal involvement in validating the quality of the content of health instructional software for the older population.

1.2,a: Congress could require that the Food and Drug Administration(FDA) regulate the safety and effectiveness of the content of all health instructional software for the elderly.

The FDA is currently responsible for regulating the safety and effectiveness of all new drugs and certain medical devices before they are marketed. There is also legal precedent for the FDA to classify certain types of software as medical devices (34). Although manufacturers of medical devices are required by law to conduct tests of safety and effectiveness using FDA guidelines, the definition of effectiveness employed by FDA has limited utility for evaluating the health effects of medical devices under general conditions of use. On the one hand, FDA considers a device to be effective when, on the basis of well-controlled investigations or other valid scientific evidence, the device is shown to have the effect claimed by the manufacturers under the specified conditions of use (21 U.S.C. 260(c)(3)). On the other hand, the Health Care Financing Administration (HCFA) judges the effectiveness of a medical device in terms of its ability to improve health. Thus some devices approved by FDA for marketing purposes are not covered by HCFA for payment under Medicare or Medicaid (79).

The FDA does not have a policy governing the regulation of software used in computer-assisted health instructional programs, but the FDA Task Group on Computers and Associated Software as Medical Devices is studying the issue (31). The problem is determining which types of programs can be considered medical devices. Preliminary decisions are that information management systems and programs that merely transfer information, such as databases, are not medical devices and thus not subject to FDA regulation. Software that describes self-testing, diagnosis, or treatment may be considered to be a medical device except in cases where the software merely copies instructions, i.e., serves as an "automated" book. If the content has been manipulated in any way and concerns diagnosis or treatment, current thinking holds that the software may be considered a medical device.

l.2.b: Congress could charge another established governmental body, or create another governmental body, with responsibility for regulating the safety and effectiveness of the content of software for health instructional material not concerning drugs or medical devices for the elderly or for all health instructional software.

There is no Federal agency, including the FDA, specifically charged with evaluating surgical and medical procedures, including therapeutic counseling, before such services are performed. The quality of the service is governed by the governmental licensure and professional certification of the providers of the service, and the professional accreditation of the providers' educational facilities. Medicare coverage also serves as a minor control of the safety and efficacy of surgical and medical procedures as well as drugs and devices used for the elderly (61). HCFA requires a determination-a coverage decision-f the safety and efficacy of technologies before it will reimburse providers for their use with Medicare beneficiaries.

The FDA does not currently have the expertise to regulate medical products other than drugs and devices. However, as noted previously, the agency is considering the issue of regulating instructional software. The staff could be expanded to include professionals who have the requisite expertise, or professionals from other agencies who have content knowledge could be consulted. Creating a separate body for this one purpose runs counter to current administrative philosophy and operations.

1.3: ***Congress could stimulate the development of standards for assessing the safety and effectiveness of content of software for computer-assisted health instruction programs for the older population. (This option is independent of options 1.1 and I.2).***

Recognized formal standards for use in evaluating the science base or the instructional strategy embedded in computer-assisted health instructional programs for the elderly have not been developed by either the public or the private sector. The director of the Office of Disease Prevention and Health Promotion has decried the lack of a science base and evaluation of the soft-

ware used for health education programs (44). He notes that "many programs have been written by persons with inadequate background in health or health education, and are not being properly reviewed." Moreover, the quality of the instructional notebooks of computer-assisted health programs for the older person has received little attention. Because the way in which information is presented affects the use of the information, a program needs logic and completeness. The task is timely and costly. Although there is a need to address the problems associated with the development of health instructional software, the field is too new to have created voluntary standards to cope with such rapid technological change.[6]

At the present time there is marginal activity among members of the academic community in establishing standards to evaluate the quality of health instructional software (14,32). As has been noted, the FDA is classifying types of software as to their standing as medical devices. At the same time, the FDA is developing standards for assessing those software programs that are classified as medical devices. However, the standards to be used by the FDA in future evaluations are expected to be limited to assessment of the algorithm, or computing method, used in structuring the software program and in implementing the program. If an algorithm relies on various tests of predictive accuracy, including both sensitivity and specificity, the program should perform satisfactorily. However, as a 1981 report by the General Accounting Office (GAO) points out, assessment of an algorithm does not always assure that the science content of a software program is accurate. GAO noted a number of cases in which FDA had evaluated a software program and the medical devices were defective because the software program used by the manufacturer in the medical device was based on calculations unacceptable to the scientific community (59).

Even if the FDA were to expand and modify its evaluation methodology, the FDA process for developing standards has proven very cumbersome. For example, no mandatory performance standards have been developed for Class 11 medical devices since Congress passed the Medical Device Amendments of 1976. Indeed, the 1981 GAO report notes the need to develop alternatives to FDA's performance standards so that assurance can be given within a reasonable period of time that the software of medical devices in general operates as expected.

Neither current nor proposed FDA activities preclude the development and use of standards by the private sector, which has initiated many standards in the health field. voluntary standards can be used in various ways, In some cases, voluntary standards are used solely by their developers, usually an industry, to guide the development of its products and services. In other cases, they have formed the basis of governmental standards; e.g., accreditation standards of the Joint Commission on the Accreditation of Hospitals (JCAH) are the basis for Medicare's conditions for hospital participation in the program. JCAH'S accreditation standards are also used by the private sector to assure the quality of hospital care.

Many professional groups and private enterprises are involved in the research and development of software programs for health instruction purposes, and their number is growing. There is, however, insufficient official communication among the organizations, and no one type of organization has taken the lead in developing voluntary standards for use in evaluating the quality of the content of health instructional software.

One way in which Congress could encourage the process of developing criteria for use in evaluating health instructional materials for the elderly is to encourage the convening of a conference or workshop on the problem. Participants could represent all interested parties, including manufacturers of computers and software, software programmers, researchers in computer science and education, health professionals, educators, consumers, and relevant Government bodies. The conference would illustrate congressional recognition of the need for evaluation standards, initiate a process for their development, and facilitate the cooperation of those with expertise in their formulation.

6 Voluntary standards are generally established by private sector bodies and are available for use by any person or organization, private or governmental (OMB Circular A-119, revised, Oct. 26, 1982).

Chapter 6 references

1. *American Family*, "Experts Say Role of Health Professionals To Change Drastically With Use of Home Computers, " 6(8):1-4, September 1983.
2. Andrews, L. B., and Levin, L., "Self-Care and the Law, " ***Social Policy,*** January-February 1979, pp. 44-49.
3. Arkansas Rehabilitation Research and Training Center, University of Arkansas, '(Access to Information-Age Technologies, " January 1984, mimeo.
4. Bandfield, Lynn, Madison National Bank, Washington, DC, personal communication, December 1983.
5. Barker, K., Pearson, R., Hepler, C., Smith, W., and Pappas, C., '(A Controlled Study of the Effect of an Automated Bedside Dispensing Machine on Medication Errors, " presented at the American Society of Hospital Pharmacists 18th Annual Midyear Clinical Meeting, Atlanta, GA, Dec. 8, 1983.
6. Barker, K., Chairman, Department of Pharmacy Care Systems, Auburn University, School of Pharmacy, Auburn, AL, personal communication, November 1983.
7. Bennerr, H., Silverman, H. A., and Dobson, A., "Medicare: Health Insurance for **the Aged and Disabled, 1976-78, Summary Utilization and Reimbursement by Person, " Health Care Financing Administration, in press.**
8. Bezold, **C., *Computers in Medicine,* vol. 12, No. 4, 1983.**
9. Bezold, **C. (cd.), *Pharmaceuticals in the Year 2000: The Changing Context for Drug R&D*** (Washington, DC: Institute for Alternative Futures, 1983).
10. Bosworth, K., Gustafson, D. H., Hawkins, R. P., Chewning, B., and Day, T., "Adolescents, Health Education, and Computers: The Body Awareness Resource Network (BARN), " ***Health Education/ Microcomputers,* October 1983.**
11. **Brady, M., Trace Research and Development Center, University of Wisconsin, Madison, personal communication, April 1984.**
12. **Buffer, L., Office of Geriatrics, Ohio State Universit,, School of Medicine, College of** Medicine, personal communication, January 1984.
13. ***Bulletins on Science and Technology for the Handicapped,* vol. 3, No. 1, April 1982, and No. 2, winter 1982-83.**
14. Burson, **J., "Standard Review Units in a** CAI **Materials Appraisal Process, "** interim report, unpublished, undated.
15. Butler, R. N., et al., "Self-Care, Self-Help and the Elderly," ***International Journal of Aging and Human Development*** 10(1):95-117, ***1979-80.***
16. **Canine, J., and McWeeny, M., "Microcomputer Patient Education Courseware," unpublished.**
17. Chen, **M. S., Jr., Houston, T. P., and** Burson, **J. L., *Microcomputer-Based Health Education in the Waiting Room: A Feasibilit, Stud,y*** (Columbus, OH: Ohio State University, Division of Computing Services, 1983).
18. Danowski, J. A., and Sacks, W., "Computer Communication and the Elderly," ***Experimental Aging Research*** 6(2):125-135, ***1980.***
19. **Davis, K., "Health Implications of Aging in America," paper prepared for the Office of** Technology **Assessment, conference on the Impact of Technology of Aging in America, Feb. 16-18, 1983.**
20. DeFriese, **G., Health Services Research Center, University of North Carolina, personal communication, October 1983.**
21. **DeFries, G., and Woomert, A., "Self-Care Among U.S. Elderly: Recent Developments," *Research on Aging*** 5:3-23, **March** 1983.
22. **Fielding, J. E. (cd.), "Appraising the Health of Risk Appraisal,"** *AJPH* 72:337-340, **April 1982.**
23. Friefeld, **K., "Body Management," *Personal Computing,* August 1983, p. 60.**
24. Geiss, **G., "Experts Say Role of Health Professionals To Change** Dramatically **With Use of Home Com**puters," *American Family* 6(8):1-4, **September 1983.**
25. Gianturco, **D. T., and Ramm, D., "Use of the Computer in Caring for the Elderly," *Postgraduate Medicine,* August 1971, pp.** 140-49:59.
26. Goetz, **A. A., Duff, J. F., and Bernstein, J. E., "Health Risk Appraisal: The Estimation of Risk," *Public Health Reports,* vol. 95, No. 2, March-April 1980, pp. 119-126.**
27. **Griest, J., "Experts Say Role of Health Professionals To Change Dramatically With Use of Home Computers," *American Family*** 6(8):1-4, **September 1983.**
28. **Gunderson, J., "A** Headpointing **Technique for Use With Standard Computer** Systems: The **Long-Range Optical Headpointer, " Trace Research and Development Center for the Severely** Communically **Handicapped, University of Wisconsin, Madison, July 1983.**
29. Gustafson, **D. G.,** Kestly, **J. J., Greist, H. H., and** Jenson, **N. M., "Initial Evaluation of a Subjective** Bayesian **Diagnostic System," *Health Services Research*** 6:204, ***1971.***
30. **Halstead, L. S., "Longitudinal Unobtrusive Measurements in Rehabilitation, " *Arch. Phys. Med. Rehab.*** 57:189, ***1976.***
31. **Hansel, L., Food and Drug Administration, personal communication, February 1984.**
32. **Home,** D. **A., and Gold, R. S., "Guidelines for Developing Health Education Software, "** *Health Education* **14(6):85-6, 1983.**

33. Hubbard, Linda, "Keys to a Better Life," *Modern* Maturity, June-July 1983.
34. Jorgens, J., Food and Drug Administration, personal communication, February 1984.
35. Kane, R., The Rand Corp., personal communication, August 1983.
36. Kane, R., and Kane, R., *Assessing the Elderly (Lexington, MA: Lexington Books,* 1981).
37. Katz, A., and Bender, A., *The Strength in Us: Self-Help Groups in the Modern World (New* York: New Viewpoints, Franklin Watts, 1976).
38. Kearsley, G., and Furlong, M., Computers *for Kids Over* Sixty (Reading, MA: Addison-Wesley, 1984).
39. Komoski, K., Education Products Information Exchange Institute, quoted in *American Family, vol.* VI, No. 9, October 1983.
40. Levin, L., Yale University, Yale School of Medicine, Department of Epidemiology and Public Health, personal communication, October 1983.
41. Levin, L., "Self-Care and Health Planning)" *Social Policy* 8(3):47-54, November/December 1977.
42. Mangen, D., and Peterson, D., *Compendium of Health Assessments of the Elderly, 1981.*
43. Maxman, G., *The Post-Physician Era (New* York: John Wiley & Sons, 1976).
44 McGinnis, J. M., Preface-Computer Utilization in Health Education: A Challenge for Health Educators, "Microcomputers and Health Education," *Special Issue of Health Education* 14(6):5, October 1983.
45. National Homecaring Council, "Facts About Homemaker-Home Health Aide Service, " New York City, 1984.
46. Rados, B., "Home Is Where the Medical Device Is," *FDA Consumer,* March 1981, pp. 5-7,
47. Raines, J. R,, and Ellis, L. B. M., "A Conversational Microcomputer-Based Health Risk Appraisal," *Computer Programs in Biomedicine* 14, *1982,* pp. 175-184.
48. Ramm, D., and Gianturco, D. T., "Computers and Technology: Aiding Tomorrow's Aged," *The Gerontologist,* Part 1, autumn 1973, pp. 323-326.
49. Reed College, *Alumni Bulletin 62(4),* December 1983.
50. Schwartz, S., University of California Medical School, San Francisco, Department of Psychiatry and Contributing Editor to P.C. World, personal communication, January 1984.
51. Sdao, M., Johns Hopkins University, School of Public Health, personal communication, November 1983.
52. Seisler, J., "A Classical Colonial With an Eye Toward the Future, Washington Home Magazine)" *Washington Post, Nov. 3, '1983,* pp. 16-21.
53. Slack, F. J., Hichs, G. P., Reed, C. G., et al., "A Computer-Based Medical History," *New Engl. J.* Med. 274:194, 1966.
54. Smolen, D., Stein, G. H., Goldstein, M. K., and Rosenshein, J. S., "NEW: An Interactive Data Management System for Monitoring Ambulatory Patients)" *Computer Programs in Biomedicine* 28:71-76, *1978.*
55. Texas Instruments, Inc., "Weight Control and Nutrition," software program, Lubbock, TX.
56. Toffler, A., *The Third Wave (New* York: Morrow, 1980).
57. Trippy, R., University of Connecticut School of Medicine, personal communication, March 1984.
58. U.S. Congress, Congressional Budget Office, *Changing the Structure of Medical Benefits: Issues and Options,* March 1983.
59. U.S. Congress, General Accounting Office, *Software Used in Medical Devices Needs Better Controls To Avoid Compromising Patient Safety,* AFMD-81-95, Aug. 5, 1981.
60. U.S. Congress, Office of Technology Assessment, *Health Technology Case Study: Effectiveness and Costs of Continuous Ambulatory Peritoneal Dialysis,* first draft, in press.
61. U.S. Congress, Office of Technology Assessment, *Medical Technology and Costs of the Medicare Program, OTA-H-227* (Washington, DC: U.S. Government Printing Office, July 1984).
62. U.S. Congress, Office of Technology Assessment, *Information Technology and Its Impact on American* Education, OTA-CIT-187 (Washington, DC: U.S. Government Printing Office, November 1982).
63. U.S. Congress, Office of Technology Assessment, *Technology and Handicapped People, OTA-H-179* (Washington, DC: U.S. Government Printing Office, May 1982).
64. U.S. Congress, Office of Technology Assessment, *Computer Technology in Medical Education and Assessment: A Background Paper,* OTA-BP-H-1 (Washington, DC: U.S. Government Printing Office, September 1979).
65. U.S. Congress, Office of Technology Assessment, *Policy Implications of Medical Information Systems, OTA-H-56* (Washington, DC: U.S. Government Printing Office, November 1977).
66. U.S. Department of Health, Education, and Welfare, *Healthy People* (Washington, DC: U.S. Government Printing Office, 1979).
67. U.S. Department of Health and Human Services, "NIH Guide for Grants and Contracts, Announcement)" Oct. 5, 1983.
68. U.S. Department of Health and Human Services, "NIH Guide for Grants and Contracts, Health Behaviors and Aging: Behavior Geriatrics Research," July 1983.
69. U.S. Department of Health and Human Services,

Office of Disease Prevention and Health Promotion, "Healthfinder—Health Promotion Software," prepared by the National Health Information Clearinghouse, September 1983.
70. U.S. Department of Health and Human Services, National Center for Health Statistics, 1976-77, *Elderly People, Population 65 Years and Over, 1983.*
71. U.S. Department of Health and Human Services, "Report of the Graduate Medical National Advisory Committee," September 1980.
72. U.S. Department of Health and Human Services, Public Health Service, National Institutes of Health, National Institute on Aging, *A Guide to Medical Self-Care and Self-Help Groups for the Elderly*, NIH publication No. 80-1687, revised August 1980.
73. Vanderheiden, G., "Computers Can Play a Dual Role for Disabled Individuals," Byte, September 1982, pp. 136-142.
74. Wagner, E., et al., "An Assessment of Health Hazard/Health Risk Appraisal," *AJPH* 72:347-52, April 1982.
75. *Washington Post* (advertisement for Giant Pharmacies), Dec. 14, 1983
76. Weisenbaum, J., "Experts Say Role of Health Professionals To Change Dramatically With Use of Home Computers," *American Family* 6(8):1-4, September 1983.
77. Weisman, S., "Computer Games for the Frail Elderly," *The Gerontologist* 23:361-363, August 1983.
78. Wetstone, S. L., Sheenan, T. J., Votaw, R., et al., "Evaluation of a Computer-Based Education Lesson for Patients With Rheumatoid Arthritis," unpublished, 1983.
79. Young, D. A., "List and Description of Government Payers," paper submitted to the Committee on Evaluating Medical Technologies in Clinical Use, Institute of Medicine, Natural Academy of Sciences, unpublished, 1984.