Introduction to Preventive Medicine

CHAPTER OUTLINE

Sections 1 and 2 of this text focus on epidemiology and biostatistics, two basic sciences for preventive medicine and public health. This section (3) focuses on the theory and practice of preventive medicine. Preventive medicine and public health share common goals, such as promoting general health, preventing specific diseases, and applying epidemiologic concepts and biostatistical techniques toward these goals. However, preventive medicine seeks to enhance the lives of **individuals** by helping them improve their own health, whereas public health attempts to promote health in **populations** through the application of organized community efforts. Although this section (Chapters 14-23) emphasizes preventive medicine and Section 4 (Chapters 24-30) focuses on public health issues, a seamless continuum binds the practice of preventive medicine by clinicians, the attempts of individuals and families to promote their own and their neighbors' health, and the efforts of governments and voluntary agencies to achieve analogous health goals for populations.

I. BASIC CONCEPTS

Western medical education and practice have traditionally focused on the diagnosis and treatment of disease. Diagnosing and treating disease will always be important, but equal importance should be placed on the preservation and enhancement of health. Although specialists undertake research, teaching, and clinical practice in the field of preventive medicine, prevention is no longer the exclusive province of preventive medicine specialists, just as the care of elderly persons is not limited to geriatricians. *All* clinicians should incorporate prevention into their practice.

A. Health Defined

Health is more difficult to define than disease. Perhaps the best known definition of health comes from the preamble to the constitution of the World Health Organization: "Health is a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity." This definition is strengthened by recognizing that any meaningful concept of health must include all dimensions of human life, and that a definition must be positive, not only the absence of disease. Nevertheless, the definition has been criticized for two weaknesses: (1) its overly idealistic expectation of complete well-being and (2) its view of health as static, rather than as a dynamic process that requires constant effort to maintain.

B. Health as Successful Adaptation

In the 1960s, Dubos[1] noted that "the states of health or disease are the expressions of the success or failure experienced by the organism in its efforts to respond adaptively to environmental challenges." Environmental challenges have also been called "stress." Stress denotes any response of an organism to *demands,* whether biologic, psychological, or mental.[2] Researchers who developed the concept of **stress** correctly understood that different **stressors** could induce stress that is either helpful **(eustress)** or harmful **(distress).** Good health requires the presence of eustress in such forms as exercise (for the heart, muscles, and bones) or infant stimulation. An individual in good health also may experience some distress, but in the interest of maintaining good health, this must be limited to a level to which the organism can adapt.[3] An individual may adapt successfully to environmental stressors in the short term, but a requirement for constant, major adaptation may exact a serious toll on the body, particularly on the lungs and the neural, neuroendocrine, and immune systems. The ongoing level of demand

for adaptation to stressors in an individual is called the **allostatic load** on an individual, and it may be an important contributor to many chronic diseases.[4]

C. Health as Satisfactory Functioning

Often what matters most to people about their health is how they function in their own environment. The inability to function at a satisfactory level brings many people to a physician more quickly than does the presence of discomfort. Functional problems might impinge on a person's ability to see, to hear, or to be mobile. As Dubos[5] states, "Clearly, health and disease cannot be defined merely in terms of anatomical, physiological, or mental attributes. Their real measure is the ability of the individual to function in a manner acceptable to himself and to the group of which he is a part." Breslow[6] describes health as "both (1) the current state of a human organism's equilibrium with the environment, often called health status, and (2) the potential to maintain that balance."

However health is defined, it derives principally from forces other than medical care. Appropriate nutrition, adequate shelter, a nonthreatening environment, supportive relationships, and a prudent lifestyle contribute far more to health and well-being than does the medical care system. Nevertheless, medicine contributes to health not only through patient care, but also indirectly by developing and disseminating knowledge about health promotion, disease prevention, and treatment.

II. MEASURES OF HEALTH STATUS

Measures of health status can be based on mortality, on the impact of a particular disease on quality of life, and on the ability to function. Historically, measures of health status have been based primarily on **mortality data** (see Chapter 2). Researchers assumed that a low age-adjusted death rate and a high life expectancy reflected good health in a population. Another way to account for premature mortality in different age groups is the measure of **years of potential life lost** (YPLL). This measure is used mainly in the field of injury prevention. In YPLL, deaths will be weighted depending on how many years a person might have lived if he or she had not died prematurely. This measure gives more weight to deaths occurring in young people.

Using measures of mortality alone has seemed inadequate as an increasing proportion of the population in developed countries lives to old age and accumulates various chronic and disabling illnesses. An appropriate societal goal is for people to age in a healthy manner, with minimal disability until shortly before death.[7] Therefore, health care investigators and practitioners now show increased emphasis on improving and measuring the **health-related quality of life.** Measures of the quality of life are *subjective* and thus more challenging to develop than measures of mortality. However, efforts to improve the methods for measuring quality of life are ongoing.[8]

An example of such a measure is a **health status index.** A **health index** summarizes a person's health as a single score, whereas a **health profile** seeks to rate a person's health on several separate dimensions.[9] Most health indices and profiles require that each subject complete some form of questionnaire. Many health status indices seek to adjust life expectancy on the basis of morbidity, the perceived quality of life, or both. Such indices also can be used to help guide clinical practice and research. For example, they might show that a country's emphasis on reducing mortality may not be producing equal results in improving the function or self-perceived health of the country's population. When clinicians consider which treatments to recommend to patients with a chronic disease, such as prostate cancer, this approach allows them to consider not only the treatment's impact on mortality but also its side effects, such as incontinence and impotence. Describing survival estimates in terms of the quality of life communicates a fuller picture than survival rates alone.

Life expectancy traditionally is defined as the average number of years of life remaining at a given age. The metric of **quality-adjusted life years** (QALY) incorporates both life expectancy and "quality of life," the perceived impact of illness, pain, and disability on the patient's quality of life.[10] For example, a patient with hemiparesis from a stroke might be asked to estimate how many years of life with this disability would have a value that equals to 1 year of life with good health (healthy years). If the answer were that 2 limited years is equivalent to 1 healthy year, 1 year of life after a stroke might be given a quality weight of 0.5. If 3 limited years were equivalent to 1 healthy year, each limited year would contribute 0.33 year to the QALY. Someone who must live in a nursing home and is unable to speak might consider life under those conditions to be as bad as, or worse than, no life at all. In this case the weighting factor would be 0.0 for such years.

Healthy life expectancy is a less subjective measure that attempts to combine mortality and morbidity into one index.[11] The index reflects the number of years of life remaining that are expected to be free of serious disease. The onset of a serious disease with permanent sequelae (e.g., peripheral vascular disease leading to amputation of a leg) reduces the healthy life expectancy index as much as if the person who has the sequela had died from the disease.

Other indices combine several measures of health status. The **general well-being adjustment scale** is an index that measures "anxiety, depression, general health, positive well-being, self-control, and vitality."[12] Another index is called the **life expectancy free of disability**, which defines itself. The U.S. Centers for Disease Control and Prevention (CDC) developed an index called the **health-related quality of life** based on data from the Behavioral Risk Factor Surveillance System (BRFSS).[13] Using the BRFSS data, CDC investigators found that 87% of U.S. adults considered their health to be "good to excellent." Also, the average number of good health days (the number of days free of physical and mental health problems during the 30-day period preceding the interview) was 25 days in the adults surveyed.[14]

Several scales measure the ability of patients to perform their daily activities. These functional indices measure activities that directly contribute to most people's quality of life, without asking patients to estimate the quality of life compared to how they would feel if they were in perfect health. Such functional indices include Katz's **activity of daily living** (ADL) **index** and Lawton-Brody's **instrumental activities of daily living** (IADL) **scale.** These scales have been used extensively in the geriatric population and for developmentally challenged adults. The ADL index measures a person's ability independently to bathe, dress, toilet, transfer, feed, and

control their bladder and bowels. Items in the IADL scale include shopping, housekeeping, handling finances, and taking responsibility in administering medications. Other scales are used for particular diseases, such as the **Karnofsky index** for cancer patients, and the **Barthel index** for stroke patients.

III. NATURAL HISTORY OF DISEASE

The natural history of disease can be seen as having three stages: the predisease stage, the latent (asymptomatic) disease stage, and the symptomatic disease stage. Before a disease process begins in an individual—that is, during the **predisease stage**—the individual can be seen as possessing various factors that promote or resist disease. These factors include genetic makeup, demographic characteristics (especially age), environmental exposures, nutritional history, social environment, immunologic capability, and behavioral patterns.

Over time, these and other factors may cause a disease process to begin, either slowly (as with most noninfectious diseases) or quickly (as with most infectious diseases). If the disease-producing process is underway, but no symptoms of disease have become apparent, the disease is said to be in the **latent (hidden) stage.** If the underlying disease is detectable by a reasonably safe and cost-effective means during this stage, screening may be feasible. In this sense, the latent stage may represent a **window of opportunity** during which detection followed by treatment provides a better chance of cure or at least effective treatment, to prevent or forestall symptomatic disease. For some diseases, such as pancreatic cancer, there is no window of opportunity because safe and effective screening methods are unavailable. For other diseases, such as rapidly progressive conditions, the window of opportunity may be too short to be useful for screening programs. Screening programs are detailed in Chapter 16 (see Table 16-2 for screening program criteria).

When the disease is advanced enough to produce clinical manifestations, it is in the **symptomatic stage.** Even in this stage, the earlier the condition is diagnosed and treated, the more likely the treatment will delay death or serious complications, or at least provide the opportunity for effective rehabilitation.

The **natural history of a disease** is its normal course in the absence of intervention. The central question for studies of prevention (field trials) and studies of treatment (clinical trials) is whether the use of a particular preventive or treatment measure would change the natural history of disease in a favorable direction, by delaying or preventing clinical manifestations, complications, or deaths. Many interventions do not prevent the progression of disease, but instead slow the progression so that the disease occurs later in life than it would have occurred if there had been no intervention.

In the case of myocardial infarction, risk factors include male gender, a family history of myocardial infarction, elevated serum lipid levels, a high-fat diet, cigarette smoking, sedentary lifestyle, other illnesses (e.g., diabetes mellitus, hypertension), and advancing age. The speed with which coronary atherosclerosis develops in an individual would be modified not only by the diet, but also by the pattern of physical activity over the course of a lifetime. Hypertension may accelerate the development of atherosclerosis, and it may lead to increased myocardial oxygen demand, precipitating infarction earlier than it otherwise might have occurred and making recovery more difficult. In some cultures, coronary artery disease is all but unknown, despite considerable genetic overlap with cultures in which it is hyperendemic, showing that genotype is only one of many factors influencing the development of atherosclerosis.

After a myocardial infarction occurs, some patients die, some recover completely, and others recover but have serious sequelae that limit their function. Treatment may improve the outcome so that death or serious sequelae are avoided. Intensive changes in diet, exercise, and behavior (e.g., cessation of smoking) may stop the progression of atheromas or even partially reverse them.

IV. LEVELS OF PREVENTION

A useful concept of prevention that was developed or at least popularized in the classic account by Leavell and Clark[15] has come to be known as **Leavell's levels.** Based on this concept, all the activities of clinicians and other health professionals have the goal of prevention. There are three levels of prevention (Table 14-1). The factor to be prevented depends on the stage of health or disease in the individual receiving preventive care.

Primary prevention keeps the disease process from becoming established by eliminating causes of disease or by increasing resistance to disease (see Chapter 15). **Secondary prevention** interrupts the disease process before it becomes symptomatic (Chapter 16). **Tertiary prevention** limits the physical and social consequences of symptomatic disease (Chapter 17). Which prevention level is applicable also depends on which disease is the focus or what conditions are considered diseases. For example, controlling cholesterol levels in an otherwise healthy person can be primary prevention for coronary artery disease (e.g., if the physician treats incidental high cholesterol before the patient has any signs or symptoms of coronary artery disease). However, if the physician considers hypercholesterolemia itself to be a disease, treating cholesterol levels could be considered secondary prevention (i.e., treating cholesterol level before fatty atheromatous deposits form). For hypertension, efforts to lower blood pressure can be considered primary, secondary, or tertiary prevention; primary prevention might be measures to treat prehypertension, secondary prevention if the physician is treating a hypertensive patient, or tertiary prevention for a patient with symptoms from a hypertensive crisis.

A. Primary Prevention and Predisease Stage

Most noninfectious diseases can be seen as having an early stage, during which the causal factors start to produce physiologic abnormalities. During the predisease stage, atherosclerosis may begin with elevated blood levels of the "bad" low-density lipoprotein (LDL) cholesterol and may be accompanied by low levels of the "good" or *scavenger* high-density lipoprotein (HDL) cholesterol. The goal of a health intervention at this time is to modify risk factors in a favorable direction. Lifestyle-modifying activities, such as changing to a diet low in saturated and *trans* fats, pursuing a consistent program of aerobic exercise, and ceasing to smoke

Table 14-1 Modified Version of Leavell's Levels of Prevention

Stage of Disease and Care	Level of Prevention	Appropriate Response
Predisease Stage		
No known risk factors	Primary prevention	**Health promotion** (e.g., encourage healthy changes in lifestyle, nutrition, and environment)
Disease susceptibility	Primary prevention	**Specific protection** (e.g., recommend nutritional supplements, immunizations, and occupational and automobile safety measures)
Latent Disease		
"Hidden" stage; asymptomatic disease	Secondary prevention	**Screening** (for populations) or **case finding** (for individuals in medical care) and treatment if disease is found
Symptomatic Disease		
Initial care	Tertiary prevention	**Disability limitation*** (i.e., institute medical or surgical treatment to limit damage from the disease and institute primary prevention measures)
Subsequent care	Tertiary prevention	**Rehabilitation** (i.e., identify and teach methods to reduce physical and social disability)

Modified from Leavell HR, Clark EG: *Preventive medicine for the doctor in his community,* ed 3, New York, 1965, McGraw-Hill.
*Although Leavell originally categorized disability limitation under secondary prevention, it has become customary in Europe and the United States to classify disability limitation as tertiary prevention because it involves the management of symptomatic disease.

cigarettes, are considered to be methods of primary prevention because they are aimed at keeping the pathologic process and disease from occurring.

1. Health Promotion

Health-promoting activities usually contribute to the primary (and often secondary and tertiary) prevention of a variety of diseases and enhance a positive feeling of health and vigor. These activities consist of nonmedical efforts, such as changes in lifestyle, nutrition, and the environment. Such activities may require structural improvements in society to enable more people to participate in them. These improvements require societal changes that make healthy choices easier. Dietary modification may be difficult unless a variety of healthy foods are available in local stores at a reasonable cost. Exercise is more difficult if bicycling or jogging is a risky activity because of automobile traffic or social violence. Even more basic to health promotion is the assurance of the basic necessities of life, including freedom from poverty, environmental pollution, and violence.

Health promotion applies to noninfectious diseases and to infectious diseases. Infectious diseases are reduced in frequency and seriousness where the water is clean, where liquid and solid wastes are disposed of in a sanitary manner, and where animal vectors of disease are controlled. Crowding promotes the spread of infectious diseases, whereas adequate housing and working environments tend to minimize the spread of disease. In the barracks of soldiers, for example, even a technique as simple as requiring soldiers in adjacent cots to sleep with their pillows alternating between the head and the foot of the bed can reduce the spread of respiratory diseases, because it doubles the distance between the soldiers' upper respiratory tracts during sleeping time.

2. Specific Protection

Usually, general health-promoting changes in environment, nutrition, and behavior are not fully effective. Therefore, it becomes necessary to employ specific protection (see Table 14-1). This form of primary prevention is targeted at a specific disease or type of injury. Examples include immunization against poliomyelitis; pharmacologic treatment of hypertension to prevent subsequent end-organ damage; use of ear-protecting devices in loud working environments, such as around jet airplanes; and use of seat belts, air bags, and helmets to prevent bodily injuries in automobile and motorcycle crashes. Some measures provide specific protection while contributing to the more general goal of health promotion. Fluoridation of water supplies not only helps to prevent dental caries but also is a nutritional intervention that promotes stronger bones.

B. Secondary Prevention and Latent Disease

Sooner or later, depending on the individual, a disease process such as coronary artery atherosclerosis progresses sufficiently to become detectable by medical tests, such as cardiac stress test, although the individual is still asymptomatic. This may be thought of as the latent (hidden) stage of disease.

For many infectious and noninfectious diseases, *screening tests* allow the detection of latent disease in individuals considered to be at high risk. Presymptomatic diagnosis through screening programs, along with subsequent treatment when needed, is referred to as *secondary prevention* because it is the secondary line of defense against disease. Although screening programs do not prevent the causes from initiating the disease process, they may allow diagnosis at an earlier stage of disease, when treatment is more effective.

C. Tertiary Prevention and Symptomatic Disease

When disease has become symptomatic and medical assistance is sought, the goal of the clinician is to provide tertiary prevention in the form of disability limitation for patients with early symptomatic disease, or rehabilitation for patients with late symptomatic disease (see Table 14-1).

1. Disability Limitation

Disability limitation describes medical and surgical measures aimed at correcting the anatomic and physiologic

components of disease in symptomatic patients. Most care provided by clinicians meets this description. Disability limitation can be considered prevention because its goal is to halt or slow the disease process and prevent or limit complications, impairment, and disability. An example is the surgical removal of a tumor, which may prevent the spread of disease locally or by metastasis to other sites. Discussions about a patient's disease also may provide an opportunity ("teachable moment") to convince the patient to begin health promotion techniques designed to delay disease progression (e.g., to begin exercising and improving the diet and to stop smoking after a myocardial infarction).

2. *Rehabilitation*

Although many are surprised to see rehabilitation designated a form of prevention, the label is correctly applied. Rehabilitation may mitigate the effects of disease and prevent some of the social and functional disability that would otherwise occur. For example, a person who has been injured or had a stroke may be taught self-care in activities of daily living (ADLs; e.g., feeding, bathing). Rehabilitation may enable the person to avoid the adverse sequelae associated with prolonged inactivity, such as increasing muscle weakness that might develop without therapy. Rehabilitation of a stroke patient begins with early and frequent mobilization of all joints during the period of maximum paralysis. This permits easier recovery of limb use by preventing the development of stiff joints and flexion contractures. Next, physical therapy helps stroke patients to strengthen remaining muscle function and to use this remaining function to maximum effect in performing ADLs. Occupational and speech therapy may enable such patients to gain skills and perform some type of gainful employment, preventing complete economic dependence on others. It is legitimate, therefore, to view rehabilitation as a form of prevention.

V. ECONOMICS OF PREVENTION

In an era of "cost consciousness," there are increasing demands that health promotion and disease prevention be proven economically worthwhile. Furthermore, many people in the political arena promote prevention as a means of controlling rising health care costs. This argument is based on the belief that prevention is always cost-saving. One way to examine that claim is to look at the cost-effectiveness of various preventive measures and compare them to the cost-effectiveness of treatment for existing conditions.

As outlined in Chapter 6, **cost-benefit analysis** compares the costs of an intervention to its health benefits. In order to compare different interventions, it becomes necessary to express the health benefits of different interventions with the same metric, called **cost-effectiveness analysis** (Box 14-1). Examples for such metrics are mortality, disease, and costs, or their inverse: longevity, disease-free time, and savings. A subtype of cost-effectiveness analysis is **cost-utility analysis,** which has the outcome of the cost/quality-adjusted life year, also called the **cost-effectiveness ratio** (CER). A recent comparison of the CER of various preventive measures with treatments for existing conditions found that both preventive and curative measures span the cost-effectiveness spectrum; both can be cost-saving, favorable, or unfavorable.[16] Much depends on the frequency of the disease in the population and the characteristics of the preventive measures. Tables of the most valuable clinical services are available.[17] The Partnership for Prevention has been founded as a national not-for-profit health organization dedicated to evidence-based prevention grounded in "value."[18]

There are particular challenges to demonstrating benefits for preventive measures and achieving meaningful adoption.

A. Demonstration of Benefits

Scientific proof of benefits may be difficult because it is often impractical or unethical to undertake randomized trials of harm using people as subjects. For example, it is impossible to assign people randomly to smoking and nonsmoking groups. Apart from some research done on animal models, investigators are limited to observational studies, which usually are not as convincing as experiments. Life is filled with risks for one disease or another, and many of these operate together to produce the levels of health observed in a population. These risks may be changing in frequency in different subpopulations, making it impossible to infer what proportion of the improvement observed over time is caused by a particular preventive measure. If there is a reduction in the incidence of lung cancer, it is difficult to infer what proportion is caused by smoking reduction programs and what proportion by the elimination of smoking in workplaces and public areas, the increase in public awareness of (and action against) the presence of radon in homes, and other factors as yet poorly understood. Lastly, clinical research is expensive. A majority of research on treatment and diagnosis modalities is sponsored by pharmaceutical companies. The money spent by them to support clinical research is vastly greater than the research dollars spent on prevention. Therefore, some of the lack of data might result from the lack of large-scale, well-funded studies.

B. Delay of Benefits

With most preventive programs, there is a long delay between the time the preventive measures are instituted and the time that positive health changes become discernible. Because the latent period (incubation period) for lung cancer caused by cigarette smoking is 20 years or more, benefits resulting from investments made now in smoking reduction programs may not be identified until many years have passed. There are similar delays between the time of smoking cessation and the demonstration of effect for other smoking-related pulmonary problems, such as obstructive pulmonary disease. Most chronic diseases can be shown to have long latent periods between when the causes start and the disease appears.

C. Accrual of Benefits

Even if a given program could be shown to produce meaningful economic benefit, it is necessary to know to whom the benefits would accrue. For example, a financially stressed health insurance plan or health maintenance organization might cover a preventive measure if the financial benefit were fairly certain to be as great as or greater than the cost of providing that benefit, but only if most or all of the

Box 14-1 Cost-Benefit and Cost-Effectiveness Analysis

Cost-benefit analysis measures the costs and the benefits of a proposed course of action in terms of the same units, usually monetary units such as dollars. For example, a cost-benefit analysis of a poliomyelitis immunization program would determine the number of dollars to be spent toward vaccines, equipment, and personnel to immunize a particular population. It would determine the number of dollars that would be saved by not having to pay for the hospitalizations, medical visits, and lost productivity that would occur if poliomyelitis were not prevented in that population.

Incorporating concepts such as the dollar value of life, suffering, and the quality of life into such an analysis is difficult. Cost-benefit analysis is useful, however, if a particular budgetary entity (e.g., government or business) is trying to determine whether the investment of resources in health would save money in the long run. It also is useful if a particular entity with a fixed budget is trying to make informed judgments about allocations between various sectors (e.g., health, transportation, education) and to determine the sector in which an investment would produce the greatest economic benefit.

Cost-effectiveness analysis provides a way of comparing different proposed solutions in terms of the most appropriate measurement units. For example, by measuring hepatitis B cases prevented, deaths prevented, and life-years saved per 10,000 population, Bloom and colleagues were able to compare the effectiveness of four different strategies of dealing with the hepatitis B virus:

1. No vaccination
2. Universal vaccination
3. Screening followed by vaccination of unprotected individuals
4. A combination of the screening of pregnant women at delivery, the vaccination of the newborns of women found to be antibody positive during screening, and the routine vaccination of all 10-year-old children

After estimating the numbers of persons involved in each step of each method and determining the costs of screening, purchasing, and administering the vaccine, and delivering medical care for various forms and complications of hepatitis, Bloom et al. calculated that the fourth strategy would have an undiscounted cost of about $367 (or a discounted cost of $1205) per case of hepatitis B prevented and concluded this was the strategy with the lowest cost. (The CDC now recommends immunizing all infants against hepatitis B.)

The chaotic situation in the United States regarding costs and charges under different health insurance plans and in different hospitals makes it difficult to estimate medical care costs. The situation can be dealt with partly by performing a **sensitivity analysis** with spreadsheets in which different costs per item are substituted to see how they affect the total cost.

In addition, the concept of **discounting,** which is important in business and finance, must be used in medical cost-benefit and cost-effectiveness analysis when the costs are incurred in the present but the benefits will occur in the future. Discounting is a reduction in the **present value** of delayed benefits (or increase in present costs) to account for the **time value of money.** If the administrators of a prevention program spend $1000 now to save $1000 of expenses in the future, they will take a net loss. This is because they will lose the use of $1000 in the interim, and because with inflation the $1000 eventually saved will not be worth as much as the $1000 initially spent. The use of discounting is an attempt to adjust for these forces.

To discount a cost-benefit or cost-effectiveness analysis, the easiest way is to increase the present costs by a yearly factor, which can be thought of as the interest that would have to be paid to borrow the prevention money until the benefits occurred. For example, if it costs $1000 today to prevent a disease that would have occurred 20 years in the future, the present cost can be multiplied by $(1 + r)^n$, where r is the yearly interest rate for borrowing and n is the number of years until the benefit is realized. If the average yearly interest rate is 5% over 20 years, the formula becomes: $(1 + 0.05)^{20} = (1.05)^{20} = 2.653$. When this is multiplied by the present cost of $1000, the result is $2653. The expected savings 20 years in the future from a $1000 investment today would have to be greater than $2653 for the initial investment to be a net (true) financial gain.

From Bloom BS, Hillman AL, Fendrick AM, et al: A reappraisal of hepatitis B virus vaccination strategies using cost-effectiveness analysis. *Ann Intern Med* 118:298–306, 1993.

financial benefit would accrue to the insurance plan in the near future. If plan members switch insurance plans frequently, or if most of the financial benefit would go to the enrollees or a government rather than to the insurance plan, the prevention program would be seen as only a financial cost by the insurance plan.

The same principle is true for the even more financially strapped budgets of local, state, and federal governments. If the savings from prevention efforts would go directly to individuals, rather than to a government budget, the elected representatives might not support the prevention effort, even if the benefits clearly outweighed the costs. Elected representatives may want to show results before the next election campaign. Disease prevention may show results only over an extended time and may not lend itself to political popularity. Even so, there seems to be growing political support for at least the concept of prevention as a medical priority.

D. Discounting

If a preventive effort is made now by a government body, the costs are present-day costs, but any financial savings may not be evident until many years from now. Even if the savings are expected to accrue to the same budgetary unit that provided the money for the preventive program, the delay in economic return means that the benefits are worth less to that unit now. In the jargon of economists, the present value of the benefits must be discounted (see Box 14-1), making it more difficult to show cost-effectiveness or a positive benefit-cost ratio.

E. Priorities

As the saying goes, "the squeaky wheel gets the grease." Current, urgent problems usually attract much more attention and concern than future, subtle problems. Emergency

care for victims of motor vehicle crashes is easy to justify, regardless of costs. Although prevention may be cost-effective, it may be difficult to justify using money to prevent crises that have not yet occurred. The same dilemma applies to essentially every phase of life. It is difficult to obtain money for programs to prevent the loss of topsoil, prevent illiteracy, and prevent the decay of roads and bridges. Even on an individual level, many patients do not want to make changes in their lives, such as eating a healthier diet, exercising, and stopping smoking, because the risk of future problems does not speak to them urgently in the present. As a broader example, although the level-five hurricane Katrina was expected for the U.S. Gulf Coast, inadequate preparations were made by the individuals, cities, and states involved and by the federal government.

VI. PREVENTIVE MEDICINE TRAINING

Physicians desiring to become board-certified as specialists in preventive medicine may seek postgraduate residency training in a program approved for preventive medicine training by the **Accreditation Council for Graduate Medical Education.**[19] Certification in preventive medicine must be in one of the following three **subspecialty areas:**

- General preventive medicine and public health
- Occupational medicine
- Aerospace medicine

Occasionally, a physician becomes certified in two subspecialties (most often the first and second areas listed). A few medical residency programs offer a combined residency in a clinical specialty (e.g., internal medicine) and preventive medicine. A residency program in medical toxicology is governed by a tripartite board, with representatives from the American boards of preventive medicine, pediatrics, and emergency medicine.

Certification in preventive medicine requires 3 years of residency. The first postgraduate year is called the *clinical year.* It consists of an internship with substantial patient care responsibility, usually in internal medicine, family practice, or pediatrics, although other areas are acceptable if they provide sufficient patient responsibility. The internship may be done in any accredited, first-postgraduate-year residency program. A few preventive medicine residency programs offer the first postgraduate year, but most do not. The second postgraduate year is called the *academic year* and consists of course work to obtain the master of public health (MPH) degree or its equivalent. The course work may be pursued in any accredited MPH program and need not be done in a formal preventive medicine residency program, although there are some advantages in doing so. The third postgraduate year is called the *practicum year,* and it must be completed in an accredited preventive medicine residency program. It consists of a year of supervised practice of the subspecialty in varied rotation sites, and it is tailored to fit an individual resident's needs. It typically includes clinical practice of the subspecialty; experience in program planning, development, administration, and evaluation; analysis and solution of problems (e.g., problems related to epidemics); research; and teaching. Some residency programs offer preventive medicine training combined with other specialties, such as internal medicine, pediatrics, or family medicine. Typically, in these cases, the training time is shorter in a combined program than if residents did both programs sequentially.[20]

The certification examination has two parts: a core examination and a subspecialty examination. The core examination is the same for all three subspecialties and covers topics such as epidemiology, biostatistics, environmental health, health policy and financing, social science as applied to public health, and general clinical preventive medicine. Further information for specialty training and board examination is available on the Internet (see Websites).

VII. SUMMARY

Preventive medicine seeks to enhance the lives of patients by helping them promote their health and prevent specific diseases or diagnose them early. Preventive medicine also tries to apply the concepts and techniques of health promotion and disease prevention to the organization and practice of medicine (clinical preventive services). Health is an elusive concept but means more than the absence of disease; it is a positive concept that includes the ability to adapt to stress and the ability to function in society. The three levels of prevention define the various strategies available to practitioners to promote health and prevent disease, impairment, and disability at various stages of the natural history of disease. Primary prevention keeps a disease from becoming established by eliminating the causes of disease or increasing resistance to disease. Secondary prevention interrupts the disease process by detecting and treating it in the presymptomatic stage. Tertiary prevention limits the physical impairment and social consequences from symptomatic disease. It is not easy for prevention programs to compete for funds in a tight fiscal climate because of long delays before the benefits of such investments are noted. Specialty training in preventive medicine prepares investigators to demonstrate the cost-effectiveness and cost benefits of prevention.

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