

now again, the 1980s have been full of such young people.) Yet, their motivation is not to study molecular biology but medical economics; it is not to master orthopedic surgery but health planning.

Such a new program of professional training will not, of course, be accepted at once. Every newly defined occupation has a struggle. But the services provided by properly educated doctors of public health would prove their value in a few years. The science and art of public health would not remain a weak sister in the family of medicine. It would become a leader in the family of mankind and help nations to achieve the World Health Organization goal of "health for all."

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Massachusetts' Approach to the Prevention of Heart Disease, Cancer, and Stroke

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Synopsis

Heart disease, cancer, and cerebrovascular disease together cause more than two out of three

deaths in the United States annually. These three diseases are largely a result of widespread risk factors such as smoking, unhealthy diet, high blood pressure, physical inactivity, and environmental toxic exposure. The prevalence of these risk factors can be significantly lowered, resulting in major reductions in mortality rates for these diseases.

Thus far, there have been no statewide disease prevention efforts to reduce deaths from all three diseases simultaneously. The Massachusetts Department of Public Health recently began an aggressive statewide program to prevent deaths from these three causes through a reduction in their underlying risk factors. Within 5 years, this program will save at least 2,000 lives annually. Similar efforts by public health agencies and health care practitioners in the rest of the United States could save many thousands of lives.

HEART DISEASE, CANCER, AND CEREBROVASCULAR disease currently cause almost 70 percent of the deaths in the United States. Approximately one-half of these deaths occur before the age of 75, the average life expectancy in the United States, and are therefore considered to be premature. The price to society of these three diseases is enormous. For

example, the total economic costs from heart disease and cerebrovascular disease in the United States have been estimated to be \$80 billion, including health care costs of \$26 billion (1). For Massachusetts, this translates into total economic costs of \$1.5 billion, including health care costs of \$500 million.

The situation is particularly tragic for two reasons. First, the majority of premature deaths from these three causes are preventable. Second, a large number of deaths from these causes that occur after age 75 could either be prevented or substantially delayed. We will summarize the evidence for those two assertions and describe the development of an integrated, statewide approach to preventing all three diseases by the Massachusetts Department of Public Health. We will also discuss the direct relevance of this program for public health agencies and for health care providers throughout the United States.

Leading Causes of Death

The number and percentages of deaths from the 10 leading causes in the United States in 1982 (2) look like this:

<i>Cause of death</i>	<i>Number of deaths</i>	<i>Percent of all deaths</i>
Heart disease	755,592	38.3
Cancer	433,795	22.0
Cerebrovascular disease	157,710	8.0
Accidents	94,082	4.8
Chronic obstructive pulmonary disease ..	59,869	3.0
Pneumonia and influenza	48,886	2.5
Diabetes	34,583	1.8
Suicide	28,242	1.4
Chronic liver disease and cirrhosis	27,690	1.4
Arteriosclerosis	26,823	1.4
All other causes	307,525	15.6

Statistics for 1982 are typical of those in recent years. Although the absolute rates of death from each cause vary slightly among the different States, the relative rank is virtually identical. Heart disease is the leading cause of death in each State and is responsible for almost 40 percent of all deaths nationwide. Second is cancer, which causes 22 percent of all deaths. Cerebrovascular disease follows, accounting for 8 percent of deaths.

Mortality rates for heart disease and cerebrovascular disease have declined significantly over the past two decades in the United States. The reasons for these declines are discussed subsequently. Mortality rates for cancer have increased slightly during this same period, largely due to an increase in the incidence of lung cancer.

Studies conducted during the past 30 years have identified a number of different factors which increase the risk of developing heart disease, cancer, and cerebrovascular disease. Most risk factors for these three diseases fall into two broad categories: lifestyle behaviors and environmental toxic expo-

sure. The most important risk factors for each of the three leading causes of death will be described.

Risk Factors for Heart Disease

More than 80 percent of deaths from heart disease are due to ischemic heart disease, the focus for the discussion that follows. Three major risk factors for ischemic heart disease have been identified in a series of studies of selected American communities: elevated serum cholesterol, high blood pressure, and cigarette smoking (3-5).

The higher the level of each major risk factor, the greater the risk; conversely, the lower the serum cholesterol, blood pressure, and amount smoked, the lower the risk. A serum cholesterol of 220 milligrams per deciliter (mg/dl) increases the risk of developing heart disease twofold compared to a serum cholesterol below 180 mg/dl; a level of 280 mg/dl increases the risk fivefold. The higher a person's blood pressure, the higher the risk of developing heart disease, the risk increasing substantially at levels greater than or equal to 140 mmHg systolic or 90 mmHg diastolic, or both. The more an individual smokes, the greater the risk of developing heart disease.

Each of these major risk factors increases the risk of developing ischemic heart disease independently. On the average, the presence of any one of the three major risk factors for heart disease increases the risk about twofold. When all three are present to a moderate degree, for example, one pack-per-day cigarette smoking, serum cholesterol of 220 mg/dl, and blood pressure of 160/95 mmHg, the risk increases tenfold. When the levels of these three risk factors are higher, the risk increases proportionately, rising as high as twentyfold.

Several studies have also analyzed differences in heart disease rates among the populations of various countries (6-8). These studies have clearly shown that the rate in each country is directly proportional to the average adult serum cholesterol and to the average adult blood pressure. The higher the average level of each of these risk factors, the higher the rate of heart disease for the entire country. This is particularly important for the United States, because the average levels of these two risk factors place the majority of its residents at increased risk. In fact, most heart disease attributable to these risk factors occurs in persons with only modest elevations, such as a cholesterol level of 220 mg/dl, the average level in American adults.

Similarly, studies comparing various countries have shown that the heart disease rates in each

country were directly related to both the prevalence and intensity of smoking (9). The greater the number of people who smoked, the higher the risk of developing heart disease, the risk increasing as the number of cigarettes smoked increases.

The three major risk factors for heart disease are largely a reflection of lifestyle behaviors. For example, elevated serum cholesterol is primarily a result of consuming a diet high in fat, particularly saturated fat. Forty percent of the calories are derived from fat in the average American diet; approximately two-fifths of these are from saturated fat. These percentages considerably exceed those in countries with lower rates of heart disease.

Blood pressure is strongly influenced by several lifestyle habits. The most important of these is dietary salt intake; the more salt a person habitually eats, the greater the risk of developing high blood pressure (10). Second, the more overweight a person is, the greater the likelihood of developing high blood pressure (11). A third important factor is alcohol intake; the greater the alcohol intake, the higher the average blood pressure (12). Fourth, a physically inactive person tends to have a higher blood pressure than a physically active person (13). Finally, there is increasing evidence that diets high in fat can lead to increases in blood pressure (14).

Smoking is a lifestyle behavior by its very nature. Smoking represents one of the most potent and pervasive drug addictions in the United States today.

In addition to the three major risk factors, several minor risk factors for heart disease have been identified. The most important of these is physical inactivity (15–17). As with the other risk factors, the risk is graded in nature, that is, the more inactive a person, the greater the risk. Conversely, the more active a person, the lower the risk. On the average, physical inactivity increases the risk of developing heart disease by one and one-half to two times.

A low level of high density lipoprotein (HDL) cholesterol has been linked to an increased risk of developing heart disease, particularly in persons over age 50; HDL cholesterol levels are higher in persons who are physically active, do not smoke, and are lean (18).

Diabetes raises the risk of developing heart disease approximately two times (19). The use of oral contraceptives raises the risk approximately four times; when combined with smoking, the risk rises to almost 40 times (20). Type A behavior has been linked in several studies to an increased risk of developing heart disease, although other studies have not confirmed this association.

Studies on the role of obesity as an independent risk factor for heart disease are conflicting. Much of the risk due to obesity appears to result from the significant adverse changes it causes in the prevalence of high blood pressure, elevated serum cholesterol, low HDL cholesterol, and diabetes, as well as its strong association with physical inactivity (3). However, recent data suggest that there is probably an additional increase in risk due to obesity above that level which is attributable to the associated differences in the prevalence of these other risk factors (21).

The approximate percentage of ischemic heart disease which is attributable to the most important risk factors—elevated serum cholesterol, smoking, high blood pressure, and physical inactivity—is shown here:

<i>Risk factor</i>	<i>Percent of heart disease cases</i>
Elevated serum cholesterol	30–40
Smoking	20–25
High blood pressure	20–25
Physical inactivity	10–20

It is clear from this table that most heart disease is caused by these four risk factors. It is highly unusual for a person who possesses none of these factors to develop ischemic heart disease. The table also indicates the critical role of elevated serum cholesterol in ischemic heart disease, showing that it is the single most important risk factor for this disease (22).

Risk Factors for Cancer

Cancer represents a multiplicity of diseases, affecting many different sites and caused by a variety of agents. The percentage of cancer deaths by primary site for the United States for 1982, based on data from the National Center for Health Statistics, follows:

<i>Site</i>	<i>Percent of cancer deaths</i>
Bronchus and lung	25.8
Colon and rectum	13.3
Breast	8.7
Prostate	5.4
Pancreas	5.2
All other sites	41.6

The mortality rate for most cancer sites has been relatively stable in the past 20 years, the major exception being lung cancer, which has risen dramatically. The distribution pattern for various

cancer sites in this table is similar to that in virtually every State. It is noteworthy that cancers of the lung, colon, and breast together account for almost 50 percent of deaths from cancer.

Diet is a major determinant of risk for a number of different sites of cancer (23). Excessive dietary fat appears to be the most important dietary risk factor for cancer. A diet high in fat, such as the typical American diet, increases the risk of developing three of the most common cancers: colo-rectal, breast, and prostatic (24). The higher the average fat consumption in a large number of countries studied, the higher the rate of these three cancers; the lower the fat consumption, the lower the rate of these cancers. There is also some evidence linking several less common cancers to excessive dietary fat. The fact that low fat intake is associated with a low rate of cancer is especially important since, as noted, a low-fat diet is also associated with a low rate of heart disease.

Other dietary components have also been linked to the risk of developing cancer. A low level of intake of vitamin A is associated with an increased risk of developing lung cancer (25). A low intake of fiber is associated with an increased risk of developing colo-rectal cancer (26). The average American diet is low in both of these factors. High levels of intake of smoked or pickled foods increase the risk of developing stomach cancer; consumption of these foods has decreased in recent years, as has the incidence of this type of cancer. Finally, there is some evidence linking obesity to an increased risk of developing certain cancers; at least part of this increased risk is most likely due to excessive dietary fat consumption by the obese population rather than to obesity per se (23).

Cigarette smoking is responsible for more than 80 percent of lung cancer (27). It also significantly increases the risk of developing cancers of the mouth, larynx, esophagus, bladder, pancreas, and kidney (28). Smoking may also increase the risk of developing cervical cancer (29).

Excessive consumption of alcohol is a risk factor for several different cancers. These include cancers of the buccal cavity, pharynx, larynx, esophagus, and liver (30). For several of these cancers, alcohol and cigarette smoking act synergistically.

The extent to which exposures to toxic substances in the environment and the workplace contribute to current cancer rates has not been quantified precisely. A few substances such as asbestos have been clearly shown to cause cancer in humans, but many other substances have been insufficiently studied to determine their carcinogenicity. In addition,

exposures to many newer chemicals have occurred only in recent years and it is, therefore, too soon for such exposures to have produced detectable changes in the incidence of cancer.

At least 80 percent of cancers are thought to be attributable to risk factors (31). The approximate percentages of all cancers which are attributable to various risk factors are shown here:

<i>Risk factors</i>	<i>Percent of cancer cases</i>
Unhealthy diet	25-35
Smoking	25-30
Occupational toxic exposures	10-20
Environmental toxic exposures	5-10
Excessive alcohol intake	3-5

It is significant that more than 50 percent of cancers are caused by lifestyle behaviors, that is, by dietary, smoking, and drinking habits (32).

Cerebrovascular Disease Risk Factors

Almost all deaths from cerebrovascular disease are caused by strokes. Approximately 90 percent of strokes are attributable to uncontrolled high blood pressure (33). As is the case with heart disease, the higher a person's blood pressure, the higher the risk of stroke. This increasing risk holds for elevated systolic as well as elevated diastolic blood pressure. The risk increases substantially as the systolic pressure rises above 140 mmHg or the diastolic pressure rises above 90 mmHg, or both. When both systolic and diastolic blood pressures are substantially elevated—systolic greater than 190 mmHg and diastolic greater than 110 mmHg—the risk rises as high as 10 times that of a person with normal blood pressure.

Several minor risk factors for cerebrovascular disease have also been noted. Diabetes raises the risk of cerebrovascular disease approximately two-fold (19). Cigarette smoking may raise the risk up to one and one-half times, although studies have not shown a clear dose-response relationship between the amount smoked and risk of cerebrovascular disease (34). Use of oral contraceptives increases risk two to three times and, when combined with smoking, such use increases the risk as much as seven times (35). Finally, consumption of alcohol increases the risk of developing cerebrovascular disease, the risk rising as the amount consumed increases; much of the increased risk is attributable to the effect of alcohol on blood pressure (36).

Overlap in Risk Factors

The preceding descriptions of the epidemiology of heart disease, cancer, and cerebrovascular dis-

ease demonstrate the considerable overlap between the risk factors for these causes of death. All three diseases are caused by several major and minor risk factors: each of the risk factors can result in several different diseases. These interrelationships are summarized this way:

<i>Risk factor</i>	<i>Heart disease</i>	<i>Cancer</i>	<i>Cerebrovascular disease</i>
Unhealthy diet	XX	XX	XX
Smoking	XX	XX	...
High blood pressure	XX	...	XX
Physical inactivity	X	...	X
Diabetes	X	...	X
Excessive alcohol intake	X	X
Occupational toxic exposures	XX	...
Environmental toxic exposures	X	...

NOTE: XX = major risk factor. X = minor risk factor.

Prevalence of Risk Factors

The magnitude of the problem of preventing these three diseases is compounded by the pervasiveness of the risk factors for them. Estimates of the prevalence of the most important risk factors for these diseases follow:

<i>Risk factor</i>	<i>Percent of adults</i>
Unhealthy diet	80
Physical inactivity	67
High blood pressure	33
Smoking	33
Excessive alcohol intake	10
Diabetes	5
Environmental toxic exposures	100
Occupational toxic exposures	15

The prevalence figures are for adults, but it is important to note that these risk factors generally begin in childhood or early adulthood. Although the estimates are national, the prevalence of these risk factors is quite similar in most States.

The prevalence of these risk factors suggests the magnitude of the public health problem they pose. For example, at least 80 percent of the population eats a diet sufficiently high in fat to increase the risk of developing heart disease and cancer. (37). One-third of all adults, including more than 60 percent of those over age 65, have high blood pressure (38). Most of the population is physically inactive. Virtually everyone is exposed to some level of environmental toxic substances.

The widespread prevalence of these risk factors also means that they are mass risk factors rather than individual ones. Most residents of the United

States should be considered as being at high risk for developing heart disease, cancer, and cerebrovascular disease. Less than 20 percent of the population are at low risk of developing these diseases (22).

Efficacy of Intervention Programs

The epidemiology of the leading causes of death has been recognized for many years. However, evidence that the reduction or elimination of these risk factors results in declines in mortality rates has come forth only in recent years. Although it would appear self-evident that such reductions in mortality would occur, many insisted such proof was necessary before advocating widespread intervention programs. Evidence for the efficacy of risk factor reduction programs in preventing heart disease, cancer, and cerebrovascular disease is herewith highlighted.

High blood pressure. Three large clinical trials on the effects of treatment of high blood pressure showed reductions in mortality from heart disease and cerebrovascular disease of up to 75 percent among groups of patients appropriately treated (39-42). The reductions in mortality experienced by the intervention groups began within 1 year of the inception of these trials. The differences in mortality between the intervention and the control groups widened throughout the 5-year trials. Mortality from heart disease and cerebrovascular disease was more than 20 percent lower in the vigorously treated groups by the end of these trials.

The most successful community-based intervention trial for high blood pressure control was the Connecticut High Blood Pressure Control Program (43). This was a federally funded statewide endeavor to show the effects of a coordinated program of screening, education, and referral of persons with high blood pressure. The full-scale intervention phase began in 1978. By 1981, age-adjusted mortality rates for heart disease had dropped 11.6 percent in Connecticut, as compared to 5.2 percent in the United States as a whole. The declines in age-adjusted mortality rates for cerebrovascular disease were even more impressive: 28.3 percent in Connecticut as compared to 15.5 percent in the United States as a whole.

Smoking. Several studies have shown that within 1 year of quitting smoking, a person's risk of developing heart disease falls by almost 50 percent (44). Subsequently, the risk continues to decrease

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slightly, and by 10 years is equal to that of a nonsmoker.

The risk of developing cancer decreases slowly after quitting smoking (45). Within 10 years of quitting smoking, the risk of developing the seven different types of cancer caused by cigarettes decreases by approximately 50 percent. However, 20 years of smoking cessation are required for an ex-smoker's risk of developing cancer to approach that of a lifetime nonsmoker.

Cholesterol. A large clinical trial to investigate the effectiveness of reduced cholesterol alone on mortality rates for heart disease has recently been completed (46). In the Lipid Research Clinics Coronary Primary Prevention Trial (LRC-CPPT), men on cholesterol-lowering medication and diet experienced a 24 percent lower mortality rate from heart disease after 7 years than men on cholesterol-lowering diets alone. There was a 64 percent reduction in the heart disease mortality rate among men whose serum cholesterol fell more than 25 percent.

Researchers in more than a dozen smaller clinical trials have also looked at the effect of lowering serum cholesterol on the mortality rate for heart disease. Most studies have shown reductions in mortality consistent with those in the LRC-CPPT.

Combined risk reduction programs. Two large clinical trials on the effect of multiple risk factor reduction programs on mortality from heart disease have been conducted. The Oslo study focused on lowering serum cholesterol through diet and on smoking cessation. By the end of 5 years, the mortality rate for heart disease was almost 50 percent lower in the intervention group than in the control group (47).

The Multiple Risk Factor Intervention Trial (MRFIT) study focused on the effect of control of high blood pressure, smoking, and elevated serum cholesterol on heart disease mortality (48). The trial

has been criticized for flaws in its design. Both the intervention group and the usual care group showed reductions in risk factors and in heart disease mortality rates. Overall, the intervention group showed only a 7.1 percent lower heart disease mortality rate than the usual care group.

The most successful community-based intervention trial took place in North Karelia, Finland, from 1972 to 1977 (49-50). This trial involved a comprehensive community program to prevent heart disease through a reduction in the prevalence of smoking, elevated serum cholesterol, and high blood pressure. Using a multiple logistic function for the three risk factors, the Finnish investigators found an overall reduction in risk of 17 percent among men and 12 percent among women. Simultaneously, age-adjusted mortality rates for heart disease declined 3.7 percent annually in North Karelian males and 2.2 percent annually in North Karelian females, as compared to 1.7 percent for males and 1.2 percent for females annually in Finland as a whole.

Finally, the United States as a whole has been undergoing a natural experiment in risk factor reduction over the past two decades (51). Smoking rates have decreased by about 10 percent since 1964. As people have lowered their dietary fat intake during that same period, average serum cholesterol has decreased by approximately 10 mg/dl. Control rates for high blood pressure have improved considerably, especially during the past 10 years. A large number of people have begun exercising regularly. Concomitant with these changes in risk factors, age-adjusted mortality rates for heart disease have declined approximately 30 percent; simultaneously, age-adjusted mortality rates for cerebrovascular disease have declined approximately 50 percent.

There has been some debate about the role played by risk factor reductions in the declining heart disease mortality rate. It is important to note, however, that the Framingham multiple logistic risk function, on the basis of the nationwide changes in smoking rates, average serum cholesterol, and average blood pressure, predicts a decline in the mortality rate for heart disease that is almost identical to that which actually occurred (52).

Previous Disease Prevention Programs

Up until this time, there has been no coordinated, statewide effort anywhere in the United States to prevent heart disease, cancer, and cerebrovascular disease through an integrated multiple risk factor

reduction program. The situation in Massachusetts is typical in this regard. The Massachusetts Department of Public Health has annually funded high blood pressure control programs in approximately 13 towns in the Commonwealth. These programs served a relatively small number of people and, thus, their impact on high blood pressure associated mortality in the State has been minimal. Statewide health education efforts on smoking, diet, and physical inactivity have been even more limited. Efforts to reduce exposures to environmental toxic substances have been incomprehensive.

New Disease Prevention Initiatives

The Massachusetts Department of Public Health has concluded that the evidence is compelling that many deaths from heart disease, cancer, and cerebrovascular disease can be prevented. We believe that a systematic effort to prevent such deaths should be among the highest priorities of public health agencies and health care providers throughout the country.

Recognizing that new initiatives in disease prevention were required for this effort to be successful in Massachusetts, the department recently established the Center for Health Promotion and Environmental Disease Prevention, which reports directly to the Commissioner's Office. Funding for the center is derived from a combination of State appropriations and Federal block grant monies, in a ratio of approximately 1.5 to 1. The center's three divisions work closely together; this ensures both that lifestyle and environmental risk reduction efforts are appropriately integrated and that all center activities and research have rigorous evaluation components built into their design.

The center has a multidisciplinary staff, which includes persons with expertise in chronic disease epidemiology and prevention, health education, behavioral sciences, communications, research and evaluation, environmental toxicology, risk assessment, and occupational health. The center has a scientific advisory committee consisting of experts in health promotion and environmental disease prevention from the fields of public health and medicine. The leading public health and medical schools in the State are heavily represented on this committee.

The center is currently implementing an aggressive statewide program aimed at reducing deaths and disability from heart disease, cancer, and cerebrovascular disease. Because these three causes of death have so many risk factors in common, it is

most efficient to target efforts on all three diseases simultaneously. The statewide program focuses on both lifestyle and environmental risk factors for these three causes of death.

The goals of the program for all Massachusetts residents:

- to become nonsmokers,
- for their serum cholesterols to be less than 200 mg/dl with a population mean of 160 mg/dl, and for the percentage of calories they derive from fat to be less than 30 percent,
- for their blood pressures to be less than 140 mmHg systolic and 90 mmHg diastolic,
- for them to exercise vigorously for 20 minutes three or more times per week, and
- to minimize their exposure to environmental and occupational toxic substances.

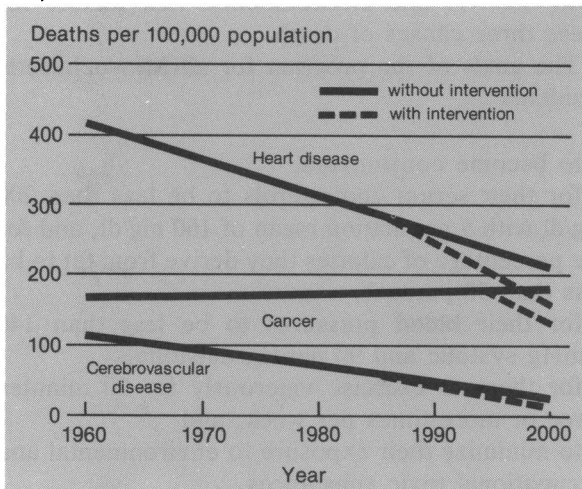
Although these goals are extremely ambitious, they are both appropriate and reasonable based on the epidemiologic and intervention studies cited. The goals are also consistent with those set by the Federal Government in recent years (53,54).

The center has set quantified objectives for the annual reduction in the prevalence of risk factors to enable Massachusetts to meet these goals. Several goals, such as those relating to smoking and diet, will take 15 to 20 years to approximate; others, such as the goal relating to high blood pressure, should be largely attained within 10 years. Progress towards meeting these goals and objectives will be assessed through annual statewide surveys of risk factor prevalence.

We predict that the statewide program will lead to a decline in age-adjusted mortality rates for heart disease of at least 3.7 percent annually as compared to a current decline of 1.7 percent annually. Simultaneously, there will be at least a 7 percent annual decrease in age-adjusted mortality rates for cerebrovascular disease as compared to the current annual decrease of 3.6 percent. Age-adjusted mortality rates for cancer will not change substantially for about 10 years, after which they will decline by at least 5 percent per year. The net effect of these declines in mortality rates will be a savings of at least 500 lives annually within 2 years, 2,000 lives annually within 5 years, and 4,400 lives annually within 10 years. Figure 1 shows the projected age-adjusted mortality rates for heart disease, cancer, and cerebrovascular disease through the year 2000 that will result from this program.

Programmatic efforts target the entire population of Massachusetts, since almost all residents of the

Age-adjusted mortality rates for heart disease, cancer, and cerebrovascular disease, Massachusetts. (1970 standard million.)



Commonwealth are at risk. Special attention is given to those who are most vulnerable—the poor, the less educated, and minorities.

The center has included numerous elements in its statewide program. Its diverse components, which are described subsequently, incorporate the critical elements of successful disease prevention programs that have been conducted elsewhere. Because the three diseases targeted by our program are the most common chronic diseases throughout the United States, the design and strategies of our program should have direct relevance for those who work in either public health or health care delivery outside Massachusetts.

Health Promotion Program Elements

The use of mass media is a key component of the center's statewide efforts to inform the public of the elements of a healthy lifestyle. Several polls have shown that fewer than 1 percent of the public can name the three major risk factors for heart disease (55). Television, radio, and newspapers are being used throughout Massachusetts to disseminate information on the relationship between lifestyle behaviors and health.

A staff of health promotion regional coordinators from the center is working in each of Massachusetts' six Health Service Areas (HSAs) on improving the control of high blood pressure. They assist at worksites, hospitals, neighborhood health centers, senior centers, and other community sites in setting up high blood pressure control activities. These efforts include screening, education, and referral for persons with elevated blood pressures. Nonpharmacologic approaches to the control of high blood pressure are strongly promoted as the first line of

therapy for most individuals with high blood pressure.

Nutrition programs include both practical education and modifications in food preparation and selection. Although many people have some knowledge of the importance of reducing their dietary intake of fat and salt, few know how best to achieve this. Statewide educational efforts are intended to change this situation. These efforts are being reinforced through the work of the regional coordinators at hospitals, other worksites, schools, and restaurants to include healthier food selections in their menus and to cook without adding salt. Educational materials on fat and salt are being compiled for distribution at these sites, as well as in supermarkets. In selected sites, food items will be labeled as being high or low in fat.

The campaign to reduce smoking has several components. There are repeated legislative efforts at both the State and local levels to reduce smoking in public places, especially restaurants, hospitals and other health care facilities, worksites, and schools. The department is seeking restrictions on the advertising and free distribution of cigarettes. We are encouraging insurance companies to lower health and life insurance premiums for nonsmokers. In addition, smoking prevention and cessation programs are being developed at worksites and in schools through the work of the regional coordinators.

Massachusetts residents are encouraged to participate in regular, vigorous physical activity. The center is working with schools to emphasize the importance and advantages for future health of lifetime, cardio-respiratory fitness activities and to focus their physical education classes on such activities. Worksite and community physical fitness programs are being developed with the assistance of the regional coordinators.

The department is also funding community-based projects aimed at reducing the major lifestyle risk factors for the three leading causes of death. These projects differ from previous efforts, however, in that they aim at much larger target groups and focus on multiple risk factors and diseases rather than on a single risk factor and disease. In addition, the design and evaluation of the projects are far more rigorous than was the case for previous projects.

The center is initiating training programs in lifestyle risk reduction for local health departments throughout the Commonwealth and encouraging them to initiate health education activities among the populations they serve. We anticipate that at least several such departments will begin commu-

nity-based risk factor reduction programs with partial funding from the center. In addition, several of these departments have already been enthusiastic, successful proponents of local ordinances to restrict smoking.

The center is enlisting the active participation of physicians and other health care providers in efforts to eliminate or significantly reduce lifestyle risk factors among their clientele. Such professionals can play a major role in minimizing these risk factors by screening, counseling, educating, and where appropriate, treating the population they serve for these risk factors.

For example, findings in a recent study showed that when physicians recommended their patients quit smoking and gave them written instructions about how to quit, the average 1-year cessation rate rose from 0.3 percent to 5.1 percent (56). Similarly, many physicians have significantly improved the level of control of high blood pressure among their patients. Since the vast majority of individuals see their physicians at least once a year, the medical profession has an enormous potential to reduce lifestyle risk factors in large numbers of people.

Environmental Disease Prevention

The center has a multi-faceted program to reduce environmental and occupational exposures that may be carcinogenic. Center staff work closely with staff from the department's Cancer Registry, now in its third year of operation. Town- and region-specific analyses of incidence data for different cancer sites provide an early warning of areas which may be experiencing elevated cancer rates due to environmental exposures. Elevations in certain types of cancer in several towns have already led to studies to determine if there are any causal environmental toxic exposures and also led to reductions in some of these exposures.

The capacity for computer mapping of environmental exposure data and cancer incidence data is being developed. Analyses of spatial and temporal correlations of these data will be performed in order to determine if increased rates of cancer are associated with such exposures. Such analyses will facilitate the setting of priorities for the elimination or reduction of toxic hazards. They may also lead to additional indepth studies to assess whether locally elevated cancer rates are indeed caused by exposures to those environmental toxic substances.

In cooperation with the Massachusetts Departments of Environmental Quality Engineering, Labor and Industries, and Food and Agriculture, our department is currently finalizing an official

State cancer policy. This policy addresses issues such as the relevance of animal carcinogenicity studies for humans, setting levels of acceptable risk for human exposure to carcinogens, and establishing scientific criteria for deciding when to conduct an investigation of a cancer cluster.

Another element in the center's environmental disease prevention program addresses the problem of contamination of water by carcinogenic substances. Center staff assess the health risks from the level of such substances currently present in Massachusetts water supplies and make recommendations for tolerance levels for these substances which will minimize the public's risk of developing cancer from water. They also suggest which substances and other water supplies should be given highest priority for action.

Center staff also make recommendations on exposure limits for carcinogens present in foods. For example, center staff members participated in the recent review of the risks of exposure to ethylene dibromide (EDB) in food. Because EDB is a potentially potent human carcinogen, the center recommended that the department set strict tolerance levels for this substance to minimize exposure and subsequent risk.

The center is also focusing on the problem of occupational toxic exposures. In 1983, the Massachusetts Legislature passed right-to-know legislation with the active support of the department. This legislation calls on the department to develop a list of potentially toxic substances to which workers may be exposed. Employers must label substances on the list to which their employees are exposed and provide information to them on the toxicity and safe handling of those substances. This law is an important preventive health measure, because it can result in increased employee and employer awareness of the dangers of exposure to various toxic substances and the safeguards which can be taken. This heightened awareness will be an important step in bringing about a reduction in future exposure to such substances.

Finally, the center is conducting training programs for local health department professionals and primary care physicians in environmental-occupational epidemiology and toxicology. This training will create a strong local infrastructure to help our health department prevent cancers due to toxic exposures. In addition, these professionals will be able to send early warning signals to our agency about potential problems from environmental and occupational exposures which require remedial action or further study.

Conclusion

The Massachusetts Department of Public Health is now implementing programs to reduce lifestyle and environmental risk factors for the leading causes of death in Massachusetts. The integration of the two sets of activities in an aggressive statewide effort appears to be unique in the United States today. Given our current understanding of the etiology of heart disease, cancer, and cerebrovascular disease, however, its applicability is widespread. Other States, individual practitioners, and health care institutions can all undertake programs to reduce population risk factors like those described here. Nationwide efforts similar to those planned for Massachusetts would result in the saving of many thousands of lives annually.

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Hypertension-Related Mortality in California

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Synopsis

Death rates in California for hypertension-related diseases during 1969-71 and 1979-81 are compared. During both periods, age-standardized rates for a composite hypertension-related mortality category are highest for blacks, followed by whites, and lowest for Asians and Pacific Islanders. Filipinos who have high prevalence rates of hypertension record low rates of hypertension-related mortality. After adjusting for the comparability ratio, the age-standardized hypertension-related death rate declined by more than 28 percent between 1969-71 and 1979-81. The decrease was greatest at age 15-44 years. Of all major hypertension-related diseases, cerebrovascular diseases registered consistently large percentage declines in mortality for all age and race groupings examined.