

# Prevention in Perspective: History, Concepts, and Issues

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Much like a mirage, the goal of prevention has long allured the medical profession. Although the effectiveness of many ancient preventive measures is today discounted from our biomedical perspective, the idea of prevention has been extolled from the earliest times as the highest goal of medicine. Then, as now, however, the effective practice of prevention has remained elusive.

After a brief historical sketch and a spate of definitions, this article will explore important contemporary issues relating to preventive medicine, illustrated with a number of examples. The goal is to develop a broad view of prevention in the context of the family physician's office, the medical profession, the community, and society as a whole. In the end, this analysis will support an optimistic perspective on prevention, underscoring the diversity of settings for family physician involvement.

## History

Any chauvinism about the modern view of prevention can be effectively dispatched with the following quotation from the Yellow Emperor, written 4,500 years ago:

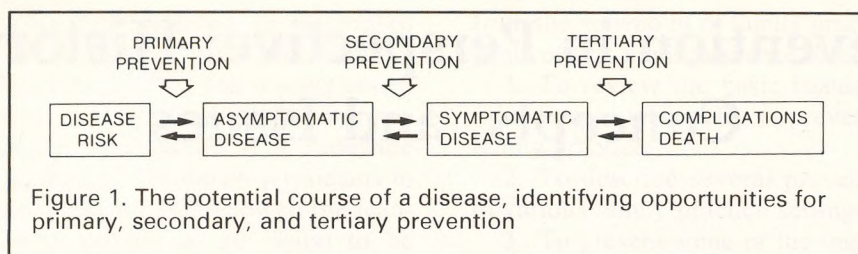
Hence the sages did not treat those who were already ill; they instructed those who were not yet ill. To administer medicines to diseases which have already developed and to suppress revolts which have already developed is comparable to the behavior of those who begin to dig a well after they have become thirsty, and of those who begin to cast weapons after they have already engaged in battle.<sup>1</sup>

One wonders what sort of marvelous preventive measures were available to justify so strong a statement as this. The Yellow Emperor's comments, however, are not anomalous; many physicians and medical critics have glorified the benefits of prevention and deplored the exclusive attention to established disease, among them Sir Thomas More, Thomas Adams, Karl Marx, Oliver Wendell Holmes, Louis Pasteur, Charles Dickens, and George Bernard Shaw.<sup>2</sup>

In the 19th century, interest in prevention centered around major public health issues, such as water supply, sewage disposal, working conditions, and living arrangements. Even without comprehensive understanding of causation, officials were able to prevent or contain diseases by paying attention to the cleanliness of drinking water, crowded living and working conditions, and adequate nutrition in the population. The well-documented decline in mortality and increase in life expectancy occurring shortly after the turn of the century almost certainly resulted from these more general measures, preceding the development of most specific medical therapies (eg, antibiotics, many immunizations) by several decades.<sup>3,4</sup> Unfortunately, increased public affluence which delivered us from the major infectious diseases has delivered us into the hands of others—

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cardiovascular disease, cancer, and automobile accidents to name the most prominent.

Accompanying the changes in mortality patterns and public health measures, a shift in emphasis in medical practice itself occurred in the 1920s. No longer content to leave prevention and "hygiene" to the public health physicians, the mainstream of the medical profession moved into the promotion of the periodic health examination as a virtual panacea for the population's health problems. The concept of the periodic health examination was first articulated by Dobell in 1861, was not recognizably instituted in the United States until 1915, but, with little opposition, became widespread by the late 1920s and 1930s.<sup>5</sup> The euphoric optimism accompanying the "annual physical" approach is characteristic in Eugene Lyman Fisk's textbook on the subject and in a periodical entitled, appropriately enough, *How to Live, a Monthly Journal of Health and Hygiene*, published until 1934.<sup>6</sup> Physicians not supporting periodic health examinations were often castigated in lay and professional publications as "reactionary" and "anti-progressive."

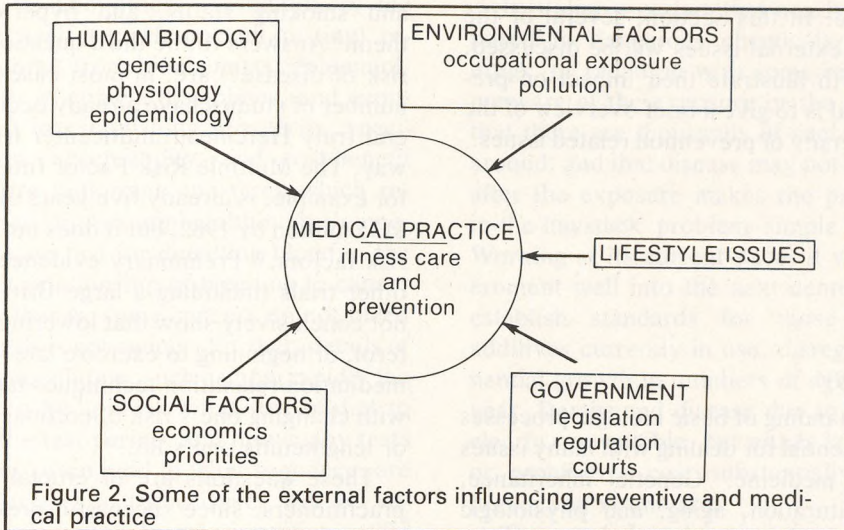
Promotion of the periodic health examination was the first in a series of recommendations made by organized medicine aimed at the "well" population, moving away from exclusive interest in disease and toward the maintenance of health. After some initial reluctance, the public has embraced the shift in emphasis wholeheartedly, so much so that the medical profession is now held accountable for any number of ills formerly in the social and

political domains. This "medicalization" of society has been highlighted in several recent publications, and is broadly relevant to the discussion which follows.<sup>7</sup> The fact that the medical profession is currently unable to meet many of these broader expectations has certainly contributed to growing disaffection among physicians toward preventive medicine, and among the public toward the medical profession.

Today the desire for effective prevention is intense, but the enthusiasm is tempered by demonstration of the ineffectiveness of some time honored procedures, by life-style issues, by occupational, environmental, and governmental factors, by the lack of solid scientific information, and by the sheer enormity of the problems when multiplied by the size of the population.

## Definitions

In a sense, all that physicians do in practice is preventive medicine, whether giving immunizations, managing cardiac risk factors, or treating diabetes to avoid complications. Medical and surgical therapy can be viewed as always preventing something. Such a definition, although perhaps useful philosophy for practice, is insufficient for detailed discussions in prevention, since it fails to



differentiate among the various settings in which preventive care may occur.

A more descriptive definition subdivides prevention into primary, secondary, and tertiary, as illustrated in Figure 1. *Primary prevention* is the prevention of any clinical manifestations of disease. Examples would be immunizations for childhood infections, genetic counseling for heritable birth defects, and the avoidance of smoking for lung cancer and emphysema. *Secondary prevention* is the early detection and treatment of established, but asymptomatic disease. Cervical cytology and stool testing for occult blood are good examples. *Tertiary prevention* is the avoidance of complications, and rehabilitation and palliation for symptomatic disease, including most of medical and surgical therapy. This discussion focuses only on primary and secondary prevention.

The typology of primary, secondary, and tertiary prevention can be applied longitudinally to a single condition. For example, primary prevention would discourage smoking at the outset; secondary prevention would offer screening and treatment

programs for early, asymptomatic smoking-related diseases; and tertiary prevention would provide treatment and palliation for those with symptomatic lung or other organ impairment due to smoking.

### Factors Influencing Prevention

Prevention is inextricably linked with medical practice. It is difficult to imagine prevention without expertise from the medical sciences; conversely, it is difficult to imagine medical practice without prevention. In family practice, particularly, the "preventive attitude" should be very much in evidence across all three levels of prevention.<sup>8</sup>

As Figure 2 illustrates, preventive medicine, as a segment of medical practice, is subject to modification by the same external factors and issues that affect medical practice overall. The effects of these factors on the practice of prevention, how-

ever, are unique. In this section, several of the more important external issues will be discussed, using examples to illustrate their impact on prevention. The goal is to give a brief overview of the breadth and diversity of prevention related issues.

### *Human Biology*

Some understanding of basic biologic processes in humans is essential for dealing with many issues in preventive medicine. Genetic inheritance, growth and maturation, aging, and physiologic processes are, of course, frequently involved in human diseases, and their elucidation becomes of obvious importance in planning preventive strategies. The impact of basic science disciplines on prevention could be extensively illustrated, but here only two examples will be used, one each in primary and secondary prevention.

Cardiovascular disease ranks at the top of conditions causing death in the United States, and trying to prevent it before clinical manifestations occur is a good example of primary prevention. Successful primary prevention is dependent on affirmative answers to three questions: (1) are the risk factors known? (2) can the risk factors be changed? and (3) does changing the risk factors alter the risk of disease?

Answers to the first question are derived primarily from epidemiologic studies of coronary heart disease in the population. Careful retrospective studies of groups with disease (case-control approach), and prospective studies of groups with possible risk factors (cohort approach) have amply shown the relationships of age, sex, family history, smoking, hypertension, and elevated serum lipids to the development of coronary heart disease, with lack of exercise and personality type still very much under evaluation. Answering the second question (can the risk factors be changed?) requires the study of underlying mechanisms and trials of programs attempting to change the risk factors. Biochemistry, physiology, genetics, behavioral science, and epidemiology all play important roles. It appears that some risk factors can indeed be changed, cholesterol levels, exercise

and smoking status, and hypertension among them.<sup>9</sup> Answers to the third question (does it alter risk of disease?) are, in most cases, still open. A number of studies have already occurred, and several truly Herculean multicenter trials are underway. The Multiple Risk Factor Intervention Trial, for example, is already five years old and will cost \$135 million by 1982, but it does not address all the risk factors.<sup>10</sup> Preliminary evidence from this and other trials (including a large British study) does not conclusively show that lowering serum cholesterol, or beginning to exercise late in life, or using meditation/relaxation techniques have much to do with changing one's risk of coronary heart disease or lengthening one's life.<sup>11</sup>

These questions are of crucial importance to practitioners, since successful prevention cannot occur without the basic scientific information at hand. Recommendations often must be made to patients using the best, but admittedly incomplete, evidence.

The criteria for evaluating procedures in secondary prevention have a different focus from those used in primary prevention. Several authors have proposed evaluation schemes.<sup>12-13</sup> The six criteria used by Frame and Carlson are representative: (1) the disease must have a significant effect on quality or quantity of life; (2) acceptable methods of treatment must be available; (3) the disease must have an asymptomatic period during which detection and treatment significantly reduce morbidity and/or mortality; (4) treatment in the asymptomatic phase must yield a therapeutic result superior to that obtained by delaying treatment until symptoms appear; (5) tests must be available at reasonable cost to detect the condition in the asymptomatic period; and (6) the incidence of the condition must be sufficient to justify the cost of screening.<sup>14</sup> In addition to these criteria, the screening test itself must be validated with attention to sensitivity, specificity, accuracy, and precision.<sup>15</sup>

The example of testing stool specimens for occult blood readily illustrates the enormous number of disciplines and resources necessary to validate the procedure as a screening tool for colorectal cancer. Certainly colorectal cancer has a high incidence and significant morbidity and mortality; there is a significant asymptomatic period; acceptable treatment exists. It also appears that early treatment gives a better result than late, although the relationship of treatment to outcome is less

secure for those lesions specifically detected by screening methods. These few statements reflect the condensation of a great deal of work done by epidemiologists, statisticians, radiologists, surgeons, internists, and others. Validation of the screening test itself (ie, Hemocult testing) requires further input from biochemists, epidemiologists, a variety of clinical disciplines, and economists to assist in establishing sensitivity, specificity, precision, acceptability, and cost/benefit ratios. There are important questions which remain unanswered. For example, although Hemocult is an adequate test for detecting blood in the stool, the exact relationship of bleeding to cancer is not known—that is, some cancers do not bleed and all that bleeds is not cancer. Further, details of use of the Hemocult test, such as how rapidly the reagent needs to be applied, what sort of diet to follow during the test period, and how many tests to perform, how often, and in what sequence, are not known. Answers to these issues will yet require extensive evaluation by a variety of scientific disciplines.

These two examples of primary and secondary prevention illustrate our extensive dependence on basic medical science in order to define effective preventive programs. The number of scientific disciplines has broadened beyond biochemistry and physiology to include wider applications of epidemiology, statistics, and the behavioral sciences.

### *Environmental Factors*

Although the threat of eco-catastrophe assails us daily from newspapers and television, the documented impact of environmental factors on health, at least to date, has been somewhat less than catastrophic in the United States. In fact, the good health enjoyed by much of the population is attributable to control of environmental factors which a century ago caused endless misery and poor health, such as contaminated water and food, inadequate waste disposal, and disease vector control.<sup>16</sup> Yet several of these environmental problems still occur in the general population with dis-

comfiting frequency, and new problems have been added, such as excess deaths during periods of heavy air pollution and accidents with toxic chemicals resulting in deaths and disability.

It is almost certain that nearly all of us are exposed to dangerous chemicals, food additives, drugs, or radiation with some regularity, but are unaware of the exposure or the hazard. The fact that there are thousands of such potential agents around, and that disease may not occur until years after the exposure makes the proverbial needle-in-the-haystack problem simple by comparison. Working at its current pace, it will take the government well into the next century to study and establish standards for those chemicals and additives currently in use, disregarding the exponential growth in numbers of agents from year to year. Deaths and disease due to these agents are clearly preventable, but either lack of knowledge or prohibitive cost substantially limit effective prevention in this area.

Those employed in industry suffer excessive risks from accidents and chemical exposures causing short and long-term disability, and death. Eula Bingham, current head of the Occupational Safety and Health Administration (OSHA), estimates deaths due to occupational causes at over 100,000 per year. Further, one in four workers may be exposed to an OSHA regulated substance which causes death or disease, and up to 50 million Americans have already been exposed to OSHA regulated carcinogens during their working lifetimes.<sup>17</sup> These are grim numbers, indeed, but there is room for optimism since, by definition, all such occupation-related disability and death is preventable.

The exact dimensions of adverse environmental effects on health are not known, but they are likely to be substantial. Some authorities believe that virtually all cancers, for example, are environmentally determined.<sup>18</sup>

### *Life-style*

Few readers will need reminding of the enormous impact of life-style issues on health. As with

environmental factors, death and disease due to life-style should, by definition, be preventable.

A few statistics will help to bring the issue into quick focus. Lung cancer, accounting for 20 percent of all cancer deaths, is related to cigarette smoking in 85 percent of cases, or about 50,000 deaths yearly. Our biggest killer, cardiovascular disease, is associated (though perhaps not causally) with a number of life-style issues, especially diet, exercise, personality, and stress. Alcohol is a factor in at least half of the 50,000 automobile fatalities yearly. Looking at mortality alone, correction of life-style problems (certainly a utopian dream) could eliminate as many as 30 percent of all deaths, and increase average life expectancy by as much as 15 years. Changes in life-style thought to be actually achievable, however, would result in far less significant increases in life expectancy.<sup>19,20</sup>

The prodigious effect of life-style on health, and the consequent potential for prevention, raises immediate questions regarding responsibility: who is to blame for the current state of affairs? It is fashionable to blame the individual, since surely the medical profession cannot be held responsible, especially since medicine's attempts at programs in weight reduction, stop smoking clinics, diet counseling, and exercise advocacy have been marginally successful, if at all. Life-style issues, however, are evidence of deeper social and cultural phenomena, so that our societal construction of rewards must shoulder some of the responsibility for individual behavior. Our heavy investments in the tobacco industry, fast automobiles, alcohol, guns, and junk food certainly present an array of acceptable pastimes to the population which have negative health effects. Solutions to the problem are likely to be social, then, as well as individual and medical.

### Government

Aside from its increasing role in reimbursement for health services, the government, through legislation, regulation, and the judiciary, has a great deal to say about health issues. More specifically, evidence shows that it can have a substantial impact on prevention.

Automobile and motorcycle accidents are the leading cause of death in young adults in the United States. Through legislation and regulation, cars and highways have been redesigned, speed limits reduced, and considerable reductions in annual fatalities achieved.<sup>21</sup> Experience with mandatory seat belt laws in certain Canadian provinces shows, in more rigorous fashion, that such legislation can save lives.<sup>22</sup> The on-again, off-again motorcycle helmet laws in many states offer further persuasive evidence that government intervention through the mandated use of helmets can reduce fatalities.<sup>23</sup>

Protests about loss of individual freedom limit extensive use of the legislation/regulation approach. It is important to note, however, that individual indiscretion in not using seat belts, or motorcycle helmets, or whatever, affects not only the injured individual, but all of us through higher taxes and insurance premiums to cover the resulting injury costs.

Independent of the other branches of government, the judiciary has had much to say about the practice of medicine in recent years. Malpractice issues have contributed to the controversy about practicing defensive medicine, a particularly sticky problem when it comes to procedures and tests designed to prevent, rather than treat, some condition.

Can a physician be held accountable for not performing some screening or preventive procedures, when doing so may have changed the eventual outcome? The Washington State Supreme Court has said "yes" in a case where a young woman's eye symptoms went undiagnosed as glaucoma until permanent visual impairment had resulted. The court ruled that, notwithstanding unanimous expert medical testimony to the contrary, tonometry should be performed routinely on patients under 40 years of age.<sup>24</sup> The implications of this decision are far reaching, establishing the precedent of a standard of care being determined outside the medical profession. As might be expected, there has followed a great deal of negative editorial comment from the medical community.<sup>25</sup> The courts have the power to exercise increasing influence over medical standards in those cases where adverse outcomes result in litigation, and may decide issues in defiance of available medical evidence. The overall effect of judicial influences on preventive practice is not yet known.

## Society

Medical and preventive practice does not occur in a vacuum, but in the context of society as a whole. The medical profession is no longer assured unlimited resources, financial or otherwise, to prevent and treat illness. Society cannot afford to provide every state-of-the-art procedure or technology for any and all who might benefit. Decisions must be made and priorities established.<sup>26</sup>

For example, the usual way of looking at mortality is to list the most common causes of death, and assume that these would be the priorities in prevention. In the United States, the top four would be cardiovascular disease, cancer, cerebrovascular disease, and accidents. Assuming that premature deaths are more socially costly, because of lost productivity, than late deaths or deaths in the very elderly, the Canadians have instead ranked causes of death by the number of years of life lost. The top four then become automobile accidents, cardiovascular disease, other accidents, and respiratory disease—quite a different listing. From the years-of-life-lost approach, then, perhaps more money, research, education, and attention should be devoted to accident prevention than either heart disease or cancer control, a startling deviation from the traditional American view.<sup>27</sup>

An extension of the impact of broad social issues on prevention is the use of economic theory in evaluating medical programs. Cost-effectiveness and cost-benefit analyses are seen with increasing frequency in the medical literature, often in articles dealing with screening tests or other preventive procedures. The "technological imperative" (if it is available, it should be done regardless of cost) is seen as untenable. Thus, although we are technically capable of screening all newborns for a dozen or so inherited disorders of amino acid metabolism, the rarity of the conditions and the high costs of screening suggest that resources may be better used elsewhere. Critics of the American scene argue that society sets implicit dollar values on all preventive issues. For example, by radically redesigning cars and highways, lowering and enforcing speed limits, and a variety of other measures, we could virtually eliminate automobile accident fatalities. The social costs, economic and otherwise, of such a program would be astronomical, and society is willing to allow 50,000 or so fatalities to avoid those costs. Similar

arguments might be proposed in discussing such subjects as the tobacco industry and the 50,000 lung cancer deaths, and the social costs of altering an affluent and sedentary life-style to reduce heart disease. The point is that the economic view can help a great deal in analyzing the use of resources, and suggesting more efficient alternatives. It fails, however, in the setting of equitable priorities. Those issues are in the social, political, and ethical areas.

## Discussion

Prevention is a complex matter. Beyond what goes on in the family physician's office, any number of external factors are potentially important. In preventing lung cancer, for example, aside from the current scientific and educational impossibility of getting smokers to quit and nonsmokers to not start, broad political, environmental, economic, and life-style issues are at work to make the individual physician's job more difficult. In defining the role of family physicians in prevention, then, it is necessary to comment on opportunities both within and outside the traditional practice setting.

At the outset, it should be apparent that the science of prevention is still very much in flux. We do not know all there is to know about cardiac risk factors, or about altering the risk factors, or about changing the actual risk of heart disease. We do not practically know how to prevent accidents, or suicides, or overweight, or cancer, or any number of other conditions high on the lists of mortality in the United States. Worse, the answers to some important questions may never be available because of the ethics or costs of doing the necessary research.

Physicians are certainly not newcomers to making decisions in the face of uncertainty; it is a fundamental component of the art and science of medicine. It is most unsatisfying, however, to be confronted by patients' inquiries about this or that diet or exercise program, knowing that the necessary scientific information is not available; and every family physician has had the unhappy expe-

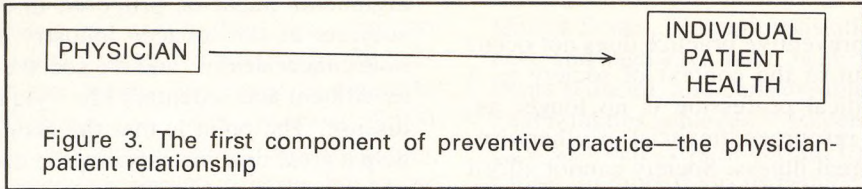


Figure 3. The first component of preventive practice—the physician-patient relationship

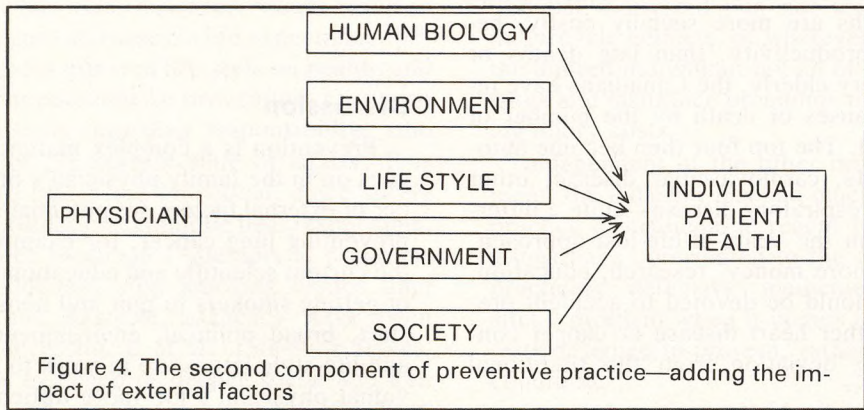


Figure 4. The second component of preventive practice—adding the impact of external factors

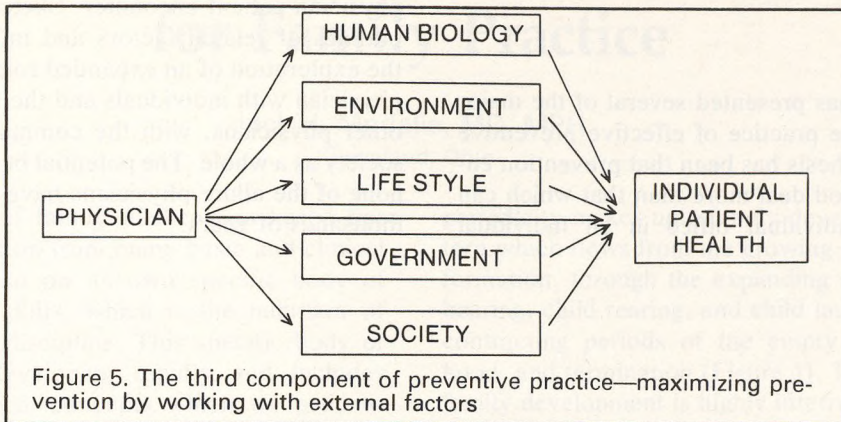
rience of declaring someone “a picture of health” one week, only to be caring for him or her in the coronary care unit the next.

Many physicians, and probably a majority of patients, feel that the science of prevention is further advanced than it actually is. One has only to examine the dogmatic pronouncements in the recent past on the benefits of low-residue diets and the value of multichannel blood screening tests to realize that preventive advice is not always well founded in the light of more rigorous study. The section on counseling in Fisk's 1928 textbook on the periodic health examination offers entertaining insights on the transience of preventive dogma.

Current advice on the hazards of eating cholesterol and the necessity of yearly pap smears may soon follow Fisk's recommendations of high fat diets, daily cold showers, and thrice-daily bowel movements.<sup>6</sup> Clearly, some humility is in order.

Figure 3 illustrates the first step in developing a model for family physicians in prevention. The direct physician-patient relationship has great potential for effective primary and secondary prevention using validated methods. Preventive protocols and schedules should be frequently reviewed to update counseling, examinations, and screening tests, using the best available evidence. The approach of Frame and Carlson is exemplary,





using specific criteria to evaluate proposed procedures and to develop a schedule of such examinations and procedures over the lifetime of a patient.<sup>14</sup> An update of their approach appears in this issue of *The Journal of Family Practice*. Patients and physicians should be comfortable with the fact that preventive advice and practices are likely to change.

The second step in developing a model for family physicians in prevention is illustrated in Figure 4, adding the external factors discussed earlier. The relative importance of each of these factors may change with the subject matter, as previously illustrated. For maximum impact on the individual's health, the physician may need to step outside the usual physician-patient relationship, and assume a role in several of these factors, as diagrammed in Figure 5. This is not as difficult as it may at first appear, and can occur at many levels.

A few examples will illustrate the involvement of physicians outside the office to maximize prevention. Alert individual physicians have been responsible for identifying a number of hazardous occupational exposures. The associations of polyvinyl chloride with angiosarcoma of the liver,<sup>28</sup> bis-chloro-methyl ether with lung cancer,<sup>29</sup> and

beryllium with chronic lung disease<sup>30</sup> were initially identified by astute single physicians. Careful work histories and knowledge of the major industries in his or her area would assure that more such discoveries will continue to be made by the primary care physician.

At the community level, physicians have the option of a much stronger role, involving some degree of advocacy for issues affecting the health of their patients. Locally, programs in childhood accident prevention,<sup>31,32</sup> poisoning prevention, water fluoridation,<sup>33</sup> and patient education<sup>34</sup> have been successfully lead by small groups with physician participants. At the state and federal levels, individual physicians have had major roles in consumer product safety<sup>35</sup> (eg, flame-resistant infant sleepwear, dangerous toys), malpractice law, and automobile and motorcycle safety legislation, to name a few.

On the scientific and research fronts, there is much more room for interested family physicians to raise the appropriate questions, to participate in multi-physician trials of new approaches, or to independently perform pilot studies and substantive research. Several examples are presented in this issue of *The Journal of Family Practice*.

**Conclusion**

This article has presented several of the major issues facing the practice of effective preventive medicine. The thesis has been that prevention encompasses a good deal more than that which can occur in an individual office in an individual

physician-patient encounter. Sketching the broad outlines of related factors and influences allows the exploration of an expanded role for the family physician with individuals and their families, with other physicians, with the community, and with society as a whole. The potential benefits have lost none of the allure physicians have recognized for thousands of years.

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