The National Heart, Lung, and Blood Institute (NHLBI) has a longstanding appreciation of the value of behavioral research. From the earliest days, when the concept of “coronary prone” behavior was introduced, to the growing recognition of the need for strategies to encourage health-promoting behaviors and lifestyles, to more recent efforts to incorporate health-related quality of life measures into our clinical studies, behavioral research has contributed much to our understanding of cardiovascular disease (CVD). Although still in its infancy, the application of this discipline to lung and blood diseases, sleep disorders, and transfusion medicine issues clearly offers much promise for advances in treatment and prevention.

Acknowledging that many opportunities lie in biobehavioral research, in November 1995 the NHLBI convened the Task Force on Behavioral Research in Cardiovascular, Lung, and Blood Health and Disease to chart a course for future research efforts. Composed of national experts, it was charged to review the state of knowledge in biobehavioral research in cardiovascular, lung, and blood diseases and sleep disorders over the past 5 years; identify research opportunities; and develop a comprehensive plan, including scientific priorities, for NHLBI support of research on health and behavior for the next several years.

During a series of meetings that spanned nearly 2 years, the task force worked to develop a report of its findings and conclusions. The report provides a detailed summary of accomplishments to date, highlights new scientific opportunities, and identifies specific recommendations for future research. The full text, with graphics, is available on the NHLBI Web site at http://www.nhlbi.nih.gov/nhlbi/sciinf/taskforc.htm.

The synopsis that follows was excerpted from the executive summary of the task force report.

The Institute is very pleased to have this task force report to guide its activities with respect to research on health and behavior. We are grateful to the task force chair, Dr Stephen Manuck; the subgroup chairs, Drs David Krantz and Margaret Chesney; and the task force members for their valuable contribution to this important and timely endeavor.

Overview of Behavioral Research
Behavior contributes significantly to health, well-being, and longevity. Indeed, clinical and epidemiological research supports numerous behavioral guidelines for the prevention of disease. These guidelines include regular physical activity and maintenance of appropriate weight; avoidance of tobacco products; dietary intake of fruits, vegetables, and fiber, coupled with a low consumption of fat; moderate use of alcohol; and the ability to cope effectively with stress. Among persons who suffer from disease, behavior is also often critical to achieving treatment objectives. For example, patients must frequently comply with complex and lengthy treatment regimens, as well as assume significant personal responsibility for managing their symptoms and monitoring their health status.

If we can aspire to greater health through prudent behavior, reality abundantly reflects our frequent failure to do so. Many examples may be cited. Cigarette smoking remains prevalent in American society and is currently increasing in some segments of the teenage population. Only a quarter of Americans engage in regular physical exercise, and although fat consumption has decreased somewhat in recent years, rates of obesity have risen appreciably over the same period. It is also estimated that 5 of every 10 patients fail to adhere fully to prescribed therapies.

Hence, behavior’s role in health and disease encompasses both promise and challenge—the promise of a reduced risk for illness and better disease management and the challenge of promoting actions that will contribute significantly to this goal. Behavioral research seeks to inform both of these objectives. Two of its primary aims are to elucidate the nature, origins, and effects of health-related behaviors and to apply behavioral principles to modify individuals’ health-imparing behaviors and lifestyles.

For many decades, clinicians and scientists have also speculated on the role that emotional stress and personality traits play in the pathogenesis and clinical expression of various disorders, including coronary heart disease (CHD), essential hypertension, and asthma. The rigorous study of such concepts was long hampered by imprecise definitions of stress and personality and by the absence of reliable methods of assessing these variables. In recent years, however, this research has progressed significantly because of the availability of new measurement techniques and advances in biobehavioral science methodologies. Consequently, the increased risk for disease conferred by psychosocial factors and, with respect to CVD, the biological processes underlying these associations are much better understood than they were a decade ago.

Beyond the causes and treatment of disease is the individual’s experience of illness itself. Disease is often accompanied by pain, apprehension, restricted mobility, and other
functional impairments; difficulties fulfilling personal, family, and financial responsibilities; and, occasionally, impaired cognitive function. Diagnostic procedures and medical interventions may affect behavior in a variety of ways, sometimes eroding (and at other times enhancing) patients’ overall quality of life, even while improving medical outcomes. Behavioral scientists are currently studying these effects and defining the dimensions of quality of life for both ill and healthy individuals.

It is now widely acknowledged that medicine’s concerns extend beyond the biological end points of disease to encompass a wider spectrum of patients’ experiences, including their emotional, cognitive, and interpersonal functioning. Because heart, lung, and blood diseases are responsible for a substantial portion of all morbidity and mortality in the United States, the behavioral and social sequelae of these diseases and their treatments have become increasingly important areas of behavioral science research.

With an aging population in the United States, the prevention and management of chronic illnesses is becoming a topic of significant concern. Here, behavioral research is enhancing understanding of the ways patients cope with serious illness and the efficacy of psychosocial and other environmental interventions to ease patients’ adjustment to illness, promote their recovery, and prevent the recurrence of disease.

The scope of behavioral research is therefore wide-ranging. For cardiovascular, pulmonary, and blood diseases and sleep disorders, it includes 3 main areas:

- Effects of behaviors, stress, and psychosocial factors on individuals’ risk for disease
- Behavioral aspects of illness and of treatments for disease
- Psychosocial and behavioral factors in the management of chronic disease

The term “behavior” is used here in its broadest sense. It denotes both the external actions of individuals and the more subjective qualities of individuals’ experiences. These subjective experiences are represented “internally” by feelings, moods, attitudes, perceptions, and psychological dispositions (eg, personality traits).

The term “environment” also is defined broadly and includes both psychosocial and physical environments. Psychosocial environmental factors, such as socioeconomic status, social isolation, and networks of social affiliation and support figure prominently in behavioral research. Other pertinent psychosocial factors include ethnicity, culture, and occupational and social stress. Physical environmental factors include geographic areas of residence, quality of habitat, and substances (eg, allergens) to which individuals may be exposed in occupational and residential settings.

Behavioral variables affect disease in the context of genetic and biological predispositions. Thus, genetic variability among individuals, often in interaction with environmental variables, can affect both behavior and disease-relevant physiology.

To the extent that some behavioral factors conspire to increase risk for disease, it also follows that their modification might diminish risk or aid in the management of disease. Psychological interventions therefore seek to alter the behaviors of individuals in beneficial ways, by changing certain aspects of the environment, reinforcing preferred behaviors, or modifying patients’ motivational states, thoughts, or feelings.

Two Broad Conclusions

The task force reached 2 broad conclusions based on its review of the state of the science of behavioral research on heart, lung, and blood diseases and sleep disorders:

- Behavioral research has contributed significantly to the understanding of disease risk and the progression and clinical manifestations of disease
- Effective modification of individuals’ behavior and/or psychosocial environments can potentially reduce disease risk, ameliorate the burdens of illness, and promote recovery and rehabilitation

Overview of the Report

In Part I, Behavioral Antecedents of Disease, the task force addressed 2 main topics: the extent to which behavioral factors increase risk for cardiovascular and lung diseases, and the influences of these factors on the pathophysiology of disease and the expression of symptoms. Three types of behavioral variables are implicated in individuals’ risk for disease:

- Lifestyle factors, such as cigarette smoking, physical inactivity, adverse diet, obesity, and consumption of alcohol
- Individual characteristics, including psychological traits (eg, anger, hostility, depression), personality, and physiological responsiveness to stress
- Social and environmental variables, such as socioeconomic status, ethnicity, lack of social support, and occupational stress

Part I also includes a review of experimental and clinical research on physiological processes that link behavior with disease. For example, there is increasing evidence that behavioral factors exacerbate atherosclerosis, promote hypertension and related alterations in cardiac structure and function, induce myocardial ischemia in persons with coronary artery disease, affect processes involved in hemostasis and thrombosis, and trigger cardiac arrhythmias.

Many of the lifestyle factors that increase risk for CVD also appear to aggregate in relation to abnormalities of insulin and glucose metabolism. In addition, sleep disorders can profoundly affect cardiovascular and pulmonary conditions. Studies of individuals with asthma indicate that psychological factors may also affect airway obstruction and that individual differences in the ability to perceive diminished airflow in asthma may be related to the exacerbation of symptoms.

In Part II, Behavioral Interventions: Prevention and Management of Disease, the report focuses on applied behavioral research. Interventions to reduce the risk of disease or improve disease management may be targeted to individuals, groups, or communities and may range from health education...
to behavior-modification programs, “skills” training, and some forms of psychotherapy.

The objectives of interventions to modify risk factors for disease include prevention and cessation of smoking, promotion of regular exercise and increased physical activity (including physical rehabilitation of cardiac patients), modification of diet, weight loss, and control of alcohol use and abuse.

Addressing the behavioral aspects of disease management, the task force focused on chronic diseases. Topics include prevention of the progression or recurrence of CVD; behavioral management of chronic lung diseases (asthma, chronic obstructive pulmonary disease, cystic fibrosis, and tuberculosis); treatment of sleep disorders; adjustment to the debilitating symptoms of sickle cell disease, thalassemia disorders, and hemophilia; and behavioral aspects of blood donation and transfusion medicine.

Part II of the report also discusses 2 key issues for improving health outcomes: ensuring adequate adherence to treatment regimens that frequently are complex, inconvenient, or painful and evaluating the effect of disease and medical treatments on patients’ quality of life. These cross-cutting issues are highly pertinent to the management of all cardiovascular, pulmonary, and blood diseases and sleep disorders.

Recommendations for Future Research

The task force identified more than 100 areas of significant opportunity for behavioral research. These topics range from risk factor associations and risk reduction to pathophysiology, expression of symptoms, and the clinical management of disease. The many specific recommendations for new research are listed in the report for each of the research areas addressed by the task force.

Many of the recommendations in the report reflect similar research concerns, as applied to different diseases and clinical care issues, and therefore may be expressed as thematic objectives for behavioral investigation. These objectives, which are viewed by the task force as representing areas of highest priority for behavioral research, are summarized below.

1. Foster Interdisciplinary Research and Research Teams

The scientific accomplishments summarized in the report illustrate that research on the behavioral dimensions of disease and its clinical management progresses most vigorously when conducted by interdisciplinary research teams. For example, the best evidence that psychosocial factors contribute to risk for CVD comes from population studies joining the expertise of both behavioral scientists and epidemiologists. Similarly, the experimental and clinical evidence that behavior influences the pathophysiology of CHD, including atherosclerosis, myocardial ischemia, and cardiac rhythmia, results from extensive research collaborations among many experts, including psychologists, neurobiologists, cardiologists, and comparative pathologists.

Because the application of behavioral science to the problems of heart, lung, and blood diseases and sleep disorders involves interdisciplinary investigation, the collaborative arrangements necessary for conducting such research must continue to be fostered.

2. Encourage Research on Behavioral Factors in Lung and Blood Diseases

Research on the behavioral aspects of lung and blood diseases must be expanded. Behavioral scientists have given relatively little attention to these 2 areas even though lung and blood diseases are prevalent, disproportionately affect children, and present numerous challenges for patients’ psychosocial adjustment and long-term clinical management.

Contemporary treatments significantly extend the life expectancy of patients with diseases such as cystic fibrosis, sickle cell disease, thalassemia, and hemophilia, but they also create new difficulties for these patients and their families. These difficulties include adhering to treatment regimens, which are often painful and complex, and handling the effects of debilitating symptoms on patients’ social and emotional development, as well as on overall family functioning.

For most of these diseases, even the scope of relevant behavioral issues remains to be elucidated—such as the cognitive and emotional sequelae of disease, the determinants of symptom exacerbation, patients’ perceived quality of life, level of treatment adherence, and problems in disease self-management. Progress in these areas, however, could lead to significant improvements in clinical care and treatment, as the barriers to optimal adjustment and disease management are identified and subjected to targeted behavioral intervention.

3. Promote Investigation of Previously Understudied Populations

Like other biomedical research, most of the evidence on behavioral predictors of disease is based on studies of middle-aged white men. The prevalence of lifestyle and psychosocial risk factors, however, often varies across different demographic groups. For example, tobacco use and physical activity vary according to race, gender, and socioeconomic status. Understanding these differences may assist in reaching underserved populations and designing interventions that will have the greatest benefit.

The nature and strength of associations between risk factors and disease outcomes may also differ among population groups. For example, some evidence suggests that behavioral factors predict CVD more strongly in men than in women. However, such findings are difficult to evaluate because of a dearth of investigations in this area and the methodological deficiencies of existing studies. Thus, reported gender differences in behavior-disease associations may be erroneous, resulting from reliance on psychosocial measures that are validated only for men or, possibly, from inadequate statistical power due to the lower incidence of cardiac events in middle-aged women. Another possibility is that behavioral factors are equally important among women and men, but the specific variables that predispose to disease in women may differ from those that are predictive in men.

Similar issues may also pertain to studies of minority populations. Behavioral risk factors may vary in these popu-
lations because of different cultural and learning experiences, exposure to different environments, and different genetic backgrounds. Current understanding of the behavioral aspects of disease across all segments of the population must be increased.

4. **Incorporate Behavioral Science into Existing Epidemiological and Clinical Studies**

The effect of behavioral factors on risk for disease must be better understood. However, establishing associations between putative risk factors and subsequent development of new or recurrent disease usually requires large-scale investigations, often involving population sampling or extensive recruitment of patients and repeated observations over several years. Incorporation of behavioral measurements into existing studies offers a cost-effective means of evaluating the disease relevance of newly hypothesized risk factors and the usefulness of new techniques or instruments to measure specific variables of interest.

For example, research indicates that enhanced cardiovascular responsiveness to stress may increase an individual’s risk for CHD and essential hypertension. To clarify this possible association, the NHLBI recently supported development of a psychophysiological test battery that has high reliability and may be applied in population-based epidemiological investigations. Incorporating such instruments into ongoing, prospective studies of risk factors for CVD is now appropriate. Similarly, inclusion of ambulatory blood pressure monitoring in longitudinal studies can enhance understanding of behaviorally evoked variations of blood pressure and the influence of this variability on the development of hypertension and its end-organ effects.

In addition, behavioral research should be integrated into studies of the occurrence of CHD events. Such work can help illuminate the onset, triggers, and course of myocardial infarction, myocardial ischemia, and malignant arrhythmias. Psychological measures could also be included usefully in studies identifying precipitants of clinical asthma. Also, other instruments for assessing psychosocial risk factors, such as socioeconomic status, should now be incorporated routinely in epidemiological investigations, as should measures of treatment adherence and health-related quality of life in studies of patient populations and major clinical trials.

5. **Identify Further the Biological Mechanisms that Underlie Behavior-Disease Associations**

Recent research has linked individuals’ behavior not only to the incidence of disease, but also to important pathophysiological processes, especially those related to CHD. This research must now be followed by more intensive investigations of the biological mechanisms that mediate behavioral influences on clinical disease.

Recent research efforts point to potentially promising areas of study. For example, experiments on nonhuman primates have identified some of the neuroendocrine factors that promote atherosclerosis. This work should lead to more detailed studies of pathophysiology and mechanisms, focusing on such disease-relevant events as early changes in the function of arterial endothelium; the proliferation of cells in the intima of the artery; and processes involved in plaque formation, complication and rupture.

Both clinical research and experimental research are also needed to establish the hemodynamic, neuroendocrine, hemostatic, and neural mechanisms for behavioral influences on acute cardiac events, including infarction, coronary thrombosis, myocardial ischemia, ventricular fibrillation, and sudden death in susceptible individuals, as well as the development of behaviorally induced hypertension. Studies of sleep-disordered patients should similarly seek to determine how sleep apnea affects myocardial perfusion and cardiac electrical stability; in addition, they should look to clarify the circadian mechanisms that may underlie diurnal variations in morbidity and mortality from cardiovascular and pulmonary disease.

Also, preliminary evidence that psychological stress can exacerbate the symptoms of asthma should prompt research aimed at identifying immunological and autonomic–neuroendocrine mechanisms by which behavioral and emotional states might influence inflammatory and bronchomotor processes in clinical asthma.

6. **Identify Psychological Factors Responsible for the Aggregation of Behavioral Risk Factors**

Many behavioral risk factors for disease often aggregate within individuals. That is, people who have one lifestyle risk factor such as smoking, obesity, physical inactivity, or high alcohol consumption, are also likely to have other health-imparing habits. Also, psychosocial risk factors for CVD often occur together. Hostile individuals, for example, are more likely to have symptoms of depression and fewer sources of social support than nonhostile persons.

This clustering of disease-predictive attributes suggests that a more limited set of psychological variables may underlie the diversity of behavioral risk factors documented in epidemiological research. Attempts to identify these variables may yield a more parsimonious understanding of the behavioral origins of disease risk and suggest new directions for designing preventive and therapeutic programs for risk reduction.

7. ** Develop Interventions to Promote Sustained Improvements in Lifestyle Risk Factors**

Behavioral researchers have made substantial progress in developing and evaluating interventions to modify lifestyle risk factors. These interventions include programs for smoking cessation, weight loss, physical exercise, and diet modification. However, individuals’ initial successes in altering their high-risk behaviors are commonly followed by relapse or failure to maintain the lifestyle changes achieved during the intervention.

A related problem is the lack of empirical guidelines for selecting appropriate treatment goals. For example, the amount, duration, and intensity of exercise needed to best protect against CVD is not clear. In the case of obesity, even a modest reduction in weight will improve other risk factors, but whether this benefit also reduces an individual’s risk for
morbidity and mortality is not known. These examples illustrate the importance of establishing the relationship between degrees of risk factor change and relevant health outcomes, in addition to encouraging long-lasting changes, in efforts to improve the health of individuals and populations.

8. Develop Interventions to Improve Patients’ Adherence to Treatment

In addition to maintaining long-term changes in lifestyle risk factors, patients who are being treated for cardiovascular, lung, and blood diseases often have difficulty adhering to the treatments prescribed. Failures in adherence are ubiquitous, affecting nearly all categories of treatment and thereby undermining much of the therapeutic enterprise. Although many interventions have been developed to promote improved adherence (some of generic design and others tailored to specific treatment modalities), the efficacy of these approaches needs to be established in controlled clinical studies and randomized trials. In addition, ways to enhance patients’ adherence within managed care settings and to improve the adherence-counseling skills of primary care physicians, nurses, and paraprofessionals need to be developed and evaluated.

9. Develop Efficient Preventive Interventions for Reducing Risk for Disease

Trial programs to prevent smoking and to help individuals develop healthful dietary and activity patterns have been somewhat successful. However, recent trends such as increased smoking among some adolescent groups and population-wide increases in obesity underscore the deleterious effects that larger cultural influences can have on individuals’ adoption of healthful behaviors.

The effect of the broader environment (e.g., mass-media messages, popular role models) on children’s and adolescents’ adoption of dietary patterns, physical activity, and use of alcohol and tobacco needs to be better understood. This knowledge should be used to develop more effective policies and interventions for primary prevention, making use of existing social institutions and medical resources.

10. Foster Development of New Research Methodologies and Measurement Techniques

Like all areas of science, behavioral research is constrained by the methodologies and measurement tools available. As new research methods and techniques become available, behavioral science will advance more rapidly. Some of the methodologies of the future may come from other sciences but will nonetheless benefit behavioral research.

Examples of recent technological developments include ultrasound techniques for noninvasively evaluating extracranial carotid artery disease and various imaging techniques for assessing changes in cardiac function and myocardial perfusion. The first of these techniques is now being used to evaluate behavioral influences on the development and progression of atherosclerosis; imaging techniques have already figured prominently in the study myocardial ischemia induced by mental stress.

In other areas, there is a need to improve or expand the measurement of disease-relevant psychosocial and behavioral variables. For example, validated instruments are needed to assess individuals’ functional health status and perceived well-being, 2 important aspects of health-related quality of life. Similarly, the availability of improved, cost-effective methods for measuring visceral obesity and consumption of fat and other dietary components would enhance studies of obesity and diet modification.

Researchers who are studying the psychosocial and socioenvironmental predictors of disease would benefit from the availability of scales having established validity in demographically heterogeneous populations. This research would also be enhanced by the availability of multidimensional instruments capable of capturing the diverse features of such broadly defined concepts as socioeconomic status, social integration, and psychological stress.

In addition, ambulatory techniques for “real-time” assessment of behavioral and psychological states in natural environments need to be further refined. Such techniques promise to assist in understanding the behavioral triggers for episodic symptoms and events related to pulmonary and cardiovascular diseases. Finally, documenting treatment compliance would be improved substantially by the development of adherence measures that are objective, valid, practical for use in customary clinical settings, and applicable to a variety of patient and research populations.

11. Integrate Behavioral and Pharmacological Approaches to the Reduction of Risk Factors

Medications to redress lifestyle risk factors such as smoking, obesity, and unhealthy dietary preferences, are emerging as important components of risk management. For example, nicotine replacement therapies are a new and effective means for promoting and maintaining smoking cessation, and new drugs to suppress appetite and reduce food intake are now widely used to help individuals lose weight and control obesity. These medications, however, do not offer sufficient benefit to justify their use as the only means of treatment. This is not surprising given the important role that environmental, social, and learning factors play in the initiation and maintenance of health-imparing behaviors. Indeed, preliminary evidence suggests that medication may be most effective when it is prescribed in conjunction with a broader program of behavioral modification and counseling.

12. Incorporate Genetic Research Strategies into Behavioral Research on Heart, Lung, and Blood Diseases

In addition to abundant evidence that genetic differences among individuals account for a substantial portion of population variability in many disease risk factors, it is now well established that most complex behavioral traits result from a combination of genetic and environmental influences. Therefore, both the independent and interactive effects of genes and environments must be identified to fully understand the development of behavioral risk factors for disease.

It is already known that many of the behavioral variables implicated in CVD have significant heritability. These vari-
ables include patterns of physical activity, smoking, obesity, diet-induced weight gain, certain dietary preferences, physiological responsiveness to stress, hostile personality characteristics, and depression. Quantitative genetic studies also enable researchers to estimate environmental influences on individual differences in behavior and to distinguish between those environmental effects (eg, shared family environments) which cause related persons to be either similar or different. Future behavioral genetics research should be directed toward clarifying the nature of genetic and environmental influences on the development of behavioral risk factors and, possibly, elucidating the common origins of risk factors that often tend to cluster within individuals.

Recent advances in the molecular genetics of disease and disease risk can also be incorporated fruitfully into behavioral research. The identification of major genes regulating lipid metabolism and body weight, for instance, provides specific markers of genetic vulnerability, in the context of which behavioral interventions (such as diet modification or weight loss programs) should be evaluated. Studies of this type may identify who would be expected to benefit from a particular form of treatment and to what degree.

Genetic technologies also are producing new animal models that may be useful in behavioral research on the pathogenesis of disease. For example, the creation of transgenic and “knockout” mouse strains that are susceptible to human-like atherosclerosis offers the opportunity for studying social effects on atherogenesis using an animal model that is much less expensive, and therefore more feasible, than nonhuman primates. Such models may also lead to a better understanding of the physiological mechanisms that underlie effects of behavioral risk factors on disease.
Task Force on Behavioral Research in Cardiovascular, Lung, and Blood Health and Disease
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