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DEATHS
A YEAR

ASTHMA

Causes, Diagnosis, and Treatment

By Elizabeth Wade
Based on a technical paper by Emily A. DiMango, M.D.

American Council on Science and Health
1995 Broadway, 2nd Floor, New York, NY 10023-5860 www.acsh.org

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Art Director:
Crysthal Marin

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AMERICAN COUNCIL ON SCIENCE AND HEALTH
1995 Broadway, 2nd Floor, New York, NY 10023-5860
Phone: (212) 362-7044 • Fax: (212) 362-4919
URLs: http://acsh.org • http://HealthFactsAndFears.com
E-mail: acsh@acsh.org

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Kenneth Berger, MD
Assistant Professor of Medicine, Physiology, and Neuroscience
NYU School of Medicine

Nishay Chitkara, MD
Instructor in Medicine
Department of Medicine
NYU Medical Center

Michael L. Frankenthaler, MD, FCCP
Instructor of Medicine, NYU School of Medicine
Attending, Pulmonary & Critical Care Medicine, NYU-Tisch Hospital

Joseph Lowy, MD
Clinical Associate Professor
Medical Director, Palliative Care Service
Department of Medicine (Pulmonary)
NYU Medical Center

Kenneth M. Prager, MD
Clinical Professor of Medicine
Director, Clinical Ethics
Columbia College of Physicians and Surgeons

Linda Rogers, MD, FCCP
Assistant Professor of Medicine
NYU School of Medicine
Medical Director, Bellevue Hospital Chest Clinic
Assistant Director, Asthma Clinic

Marjorie L. Slankard, MD
Clinical Professor of Medicine
Columbia University College of Physicians & Surgeons

Mark J. Utell, MD
Director, Pulmonary/Critical Care and Occupational Medicine Divisions
Professor of Medicine and Environmental Medicine
University of Rochester

Miles Weinberger, MD
Professor of Pediatrics and Director, Pediatric Allergy and Pulmonary Division
University of Iowa Hospitals and Clinics

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Introduction

Asthma is a chronic condition in which a person's airways occasionally become inflamed, which causes swelling that obstructs airflow to the lungs. It is one of the most common chronic illnesses in the United States, and while prevalence varies by gender, race, and geographic region, it currently affects over 20 million people in this country alone. There was a dramatic spike in diagnoses of asthma between 1980 and the late 1990's, but the number of total cases has since been stable. Mortality has been slower to decline, however, and about 11 people still die from asthma in the US each day.

Despite advances in our understanding of the factors contributing to asthma, the cause of asthma remains unknown. There is a strong association between allergies and asthma, and some people appear to be genetically predisposed to the illness. Several hypotheses have been proposed to explain the increase in asthma prevalence in recent years. Many of these ideas focus on characteristics of lifestyles that have accompanied increasing levels of industrialization around the world. Additionally, exposure to tobacco smoke, both in utero and during early life, increases the risk of developing asthma. There is less evidence to support the idea that early exposure to viral infections, pets, air pollution, and certain diets may also cause asthma.

Asthma therapies are divided into two general groups: reliever therapy is used for immediate relief of symptoms such as wheezing and coughing, and daily controller therapy is used to treat airway inflammation and prevent symptoms from developing. Asthma control should be reassessed regularly, and therapy should be modified accordingly. The development of new asthma treatments may improve our understanding of the disease.

Definition

Asthmatic airways become inflamed in response to certain triggers, causing small airway muscles to swell and constrict, inducing the production of excess mucus, and ultimately obstructing airflow to the lungs (Figure 1).

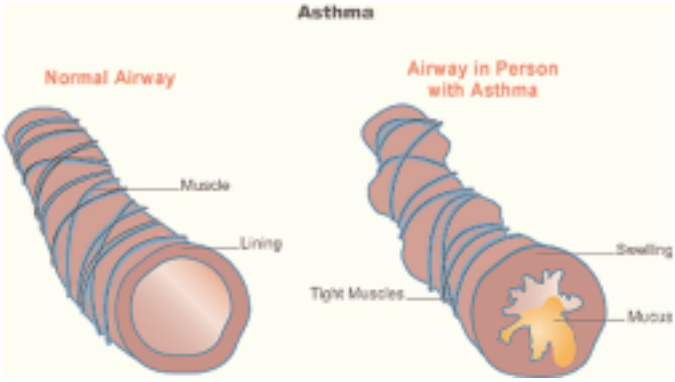

Figure1: Asthmatic airways are marked by excess mucus and constricted muscles, all contributing to obstruction of airflow. Source: http://www.nhlbi.nih.gov/guidelines/asthma

Asthma symptoms include cough, wheeze, chest tightness, and shortness of breath. Symptoms come and go and may clear up on their own or through the use of medications such as bronchodilators, which dilate some muscles in the small airways (bronchioles) in order to ease the passage of air to the lungs. While airflow obstruction due to asthma is usually reversible and temporary, some individuals with asthma develop fixed airflow obstruction and lose lung function over time.

Epidemiology

The prevalence of asthma has increased dramatically over the past 25 years in most developed countries. Globally, over 300 million people have asthma. In the United States, asthma prevalence increased sharply between the early 1980s and 1997 and has since remained fairly stable, with approximately 6 million children and 14 million adults currently affected. Asthma is the most common chronic disease in children and is more common in boys than in girls until puberty. The pattern reverses in adults, with women comprising nearly two thirds of all adults with -asthma. (http://www.cdc.gov/nchs/products/pubs/pubd/hestats/asthma/asthma.htm).

Within the US, asthma prevalence varies among different races and different geographic regions. Many factors contribute to the observed increase in asthma severity and mortality among blacks and Latinos compared to whites (Figure 2), including disparities in access to care, under-prescription and under-use of controller medications, cultural beliefs about medications, and underlying genetic differences.

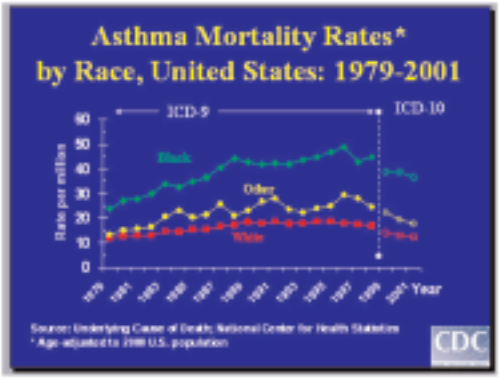

Figure 2: Mortality rates among different races in the US. Break after 1999 reflects change in coding for asthma deaths. Source: http://www.cdc.gov/nchs/products/pubs/pubd/hestats/asthma/asthma.htm

Since the rapid increase in asthma has occurred in parallel with increased industrialization in many parts of the world, some investigators have proposed that factors associated with urbanized lifestyles, such as decreased activity levels and increased obesity, may contribute to the development of asthma. This theory is difficult to substantiate scientifically.

Data on asthma prevalence in developing countries is difficult to analyze. A specific population's reported prevalence rates of asthma are heavily dependent on asthma awareness, which has generally, though not universally, increased throughout the world in recent decades. In addition, variability among countries may be due to differences in definitions of asthma.

Risk Factors for Development of Asthma

Genetics: Asthma has a strong hereditary component, but it does not follow simple inheritance patterns. Multiple genes appear to be responsible for asthma, but there is not enough evidence at this time to make firm conclusions about which ones they may be. Furthermore, genetic predisposition must be accompanied by one or more environmental exposures, as discussed below, in order to lead to asthma.

Environmental tobacco smoke: The single most consistently reported exposure risk for developing asthma is exposure to tobacco smoke. Tobacco smoke can also trigger symptoms in individuals with existing asthma. Several studies have concluded that parental smoking, including maternal smoking during pregnancy, increases the risk of asthma in children. In addition to the numerous health benefits of quitting smoking, it is strongly advised that pregnant women and parents do not smoke in order to reduce the risk of their children developing asthma and to avoid exacerbating existing breathing difficulties.

Environmental allergens: General exposure to both indoor and outdoor environmental allergens may also contribute to asthma. Environmental exposures as a cause of asthma may be important even while a child is in utero, since recent studies suggest that fetal immune systems can respond to allergens inhaled or consumed by their mothers.

Air pollution: Exposure to air pollutants has also been implicated as a risk factor for asthma. The effects of specific irritants are difficult to study, however, since exposure to each one rarely occurs in isolation. Diesel exhaust, for example, interacts with other allergens to worsen asthma. While air pollution can certainly trigger asthma symptoms, its role in the initial development of asthma has not been clearly established.

Pets: Pet exposure is known t-o trigger or worsen allergy and asthma symptoms for some patients, but there are conflicting theories as to whether early exposure to pets can affect a child's risk of developing either condition. The idea of having a "protective pet" in the household to build up a child's immunity to allergens has not been proven to be effective.

Obesity: Obesity itself does not necessarily cause asthma, but abnormally high body mass index is associated with increased prevalence of the disease in both children and adults. There are several potential explanations for the association of obesity and asthma, including a common genetic predisposition to both conditions, changes in lifestyle and diet predisposing to both conditions, and physical inactivity as a cause of both conditions.

Diet: Dietary studies relating to asthma are exceedingly difficult to interpret, since dietary components are complex and difficult to measure. Breastfeeding as a preventive strategy has been an area of great interest, but results from numerous studies are conflicting. While breastfeeding may offer several health advantages, it is difficult to draw any conclusions at this time about the risks or benefits of breastfeeding as it relates to development of asthma.

Hygiene hypothesis: One of the many hypotheses that have been advanced as potential explanations for the increase in asthma prevalence in developed nations is the hygiene hypothesis. Decreased exposure to microbes during early life may impair the immune system, predisposing an individual to asthma or allergies. Children who are exposed to many microbes, either by being attending daycare, having multiple older siblings, or being in the presence of farm animals, are less likely to develop asthma, a finding that supports the hygiene hypothesis.

Viral and bacterial infections: The question of whether viral infections early in life cause chronic asthma remains widely debated. The majority of children with asthma experience their first episode of wheezing in the course of a viral infection; however, younger children are particularly prone to wheezing because their airways are small and easily obstructed. It is therefore difficult to predict if recurrent wheezing in childhood is due to early asthma or an unrelated viral infection. Certain types of bacterial infections have also been linked to increased risk of developing asthma, but it is unclear if the relationship is cause and effect.

Occupational asthma: Occupational asthma refers to newly diagnosed cases of asthma that are due to exposures in the workplace. Ten to fifteen percent of adult-onset asthma cases can be attributed to occupational exposure to respiratory irritants. Several occupations are associated with an increased risk of developing asthma, especially farming, painting, cleaning, and nursing. Classically, symptoms are present at work and improve or disappear when the patient is away from work, although some patients with occupational asthma do not recover, even after several years away from the exposure.

Understanding the complex risk factors for asthma may eventually lead to prevention strategies and new treatments of the disease.

Asthma Triggers

In contrast to the uncertainty about risk factors for developing asthma, many factors are known to worsen asthma symptoms in individuals who have already been diagnosed with the disease.

Allergens: The majority of individuals with asthma are allergic to at least one allergen, and exposure to them often triggers asthmatic symptoms. Exposure may be seasonal, as with pollens such as ragweed, or year-round, as with dust mites and pets. Efforts to avoid allergens, such as using mattress covers to reduce dust mite exposure or keeping windows closed during pollen season, have been shown to reduce asthma symptoms.

Infections: In patients with established asthma, viral upper respiratory tract infections frequently trigger severe asthma attacks. Rhinovirus, which causes the common cold, is the most frequent asthma trigger. Influenza virus is also a common trigger, so doctors recommend that patients with asthma receive a flu shot every year. Researchers are currently examining whether certain chronic bacterial infections common in the lungs of people with asthma have the ability to induce asthma attacks. Rhinitis, or inflammation of the nasal passages causing congestion and a runny nose, and sinusitis, an infection or inflammation of the sinuses, are associated with worsening of asthma.

Exercise: Exercise-induced asthma symptoms commonly start during exercise and are usually most intense immediately after the person stops exercising. Outdoor exercise when specific environmental allergens like pollen or ragweed are present in high amounts can lead to worsened symptoms and should be avoided during allergy seasons. Exercising in cold or humid weather is also associated with an increased risk of an asthma attack.

Gastroesophageal reflux: Gastroesopageal reflux disease (GERD), a condition characterized by changes in the barrier between the esophagus and the stomach, is more common among asthmatics than the general population. It is estimated to be present in up to 65% of asthmatics, many of whom have no symptoms of GERD. Studies are underway to determine if asthma and GERD simply commonly co-exist, or if GERD can actually worsen asthma symptoms by allowing acidic stomach contents to irritate the esophagus and trachea, triggering a sudden constriction of the small airway muscles and inducing an asthma attack.

Aspirin-like drugs: Five to ten percent of individuals with asthma are sensitive to aspirin and aspirin-like products and develop acute, sometimes severe, asthma symptoms shortly after ingesting them. Such patients are advised to avoid all aspirin products, including ibuprofen (Motrin, Advil) and naproxen (Aleve). On the other hand, acetaminophen (Tylenol) is not associated with worsening asthma symptoms.

Asthma Treatment

TThe goals of asthma therapy are to reduce symptoms, improve lung function, and minimize impairment of normal activity and sleep from asthma. In 2002, 60% of asthma patients experienced an asthma attack, suggesting that asthma continues to be under-treated.

Education: Education is the cornerstone of asthma therapy, and involves teaching patients how to assess their level of asthma control and be aware of signs of worsening asthma. Patients can do this either by monitoring their symptoms or by using a peak flow meter, a device that can help detect airway obstruction even before the patient notices asthma symptoms. Use of a written asthma action plan is recommended to help patients with both daily management and asthma attacks. Medical providers should appreciate the potential role a patient's cultural beliefs and practices play in asthma management. For example, a cultural belief in the effectiveness of herbal remedies to treat asthma may lead a patient to stop using her or his other medications—a situation which should be addressed by a doctor immediately.

Self-management: Some patients can successfully manage their asthma by avoiding allergens and irritants, such as strong odors and environmental tobacco smoke. In most cases, however, asthma patients are sensitive to more than one allergen, so multifaceted approaches to reducing exposures are necessary.

Medications: When prescribed and used appropriately, the medications currently available to treat asthma are very effective in controlling symptoms in most patients. Asthma medications are divided into two categories: reliever medicines for the rapid relief of symptoms and controller medicines for daily control of asthma and prevention of symptoms.

Reliever medications: Fast-acting bronchodilators, which relax the muscles surrounding the airways, are used to relieve asthma attacks. They are typically inhaled and take effect within minutes. The effects usually last for four to six hours, so if the individual is no longer exposed to the attack's trigger after that time, a single dose of treatment may be enough. If asthma symptoms are brought on by continuous exposure to such triggers as viral infections or seasonal allergies, however, daily controller therapy may be needed to prevent symptoms from recurring.

Albuterol is the most commonly prescribed fast-acting bronchodilator in the US, with about 52 million prescriptions filled annually. Until recently, all albuterol was available as inexpensive generic products containing chlorofluorocarbon (CFC) propellants. But because CFCs have been shown to damage the ozone layer, the FDA has

required all inhalers to be switched from CFC propellants to the more environmentally sound, but also more expensive, hydrofluoroalkane (HFA) propellants by 2008. The switch will result in a significant increase in cost and might even encourage patients who pay for albuterol out of pocket to turn to less expensive and less safe over-the-counter alternatives. Some pharmaceutical companies have established programs to supply the newer HFA inhalers to patients who cannot afford them.

Controller medications: Individuals who require fast-acting bronchodilators more than twice per week should also use a daily controller medicine to treat airway inflammation, which will help to reduce the frequency of asthma attacks. Controller medications do not offer immediate relief like fast-acting bronchodilators do; rather, they work over time to reduce inflammation in the lungs and airways, improve lung function, and reduce the number of asthma attacks a patient experiences.

Steroid hormones called glucocorticoids and corticosteroids are often used to control asthma because of their anti-inflammatory effects. Inhaled corticosteroids are generally the most effective controller therapy, but they may be combined with other medications depending on the patient's needs.

Biologics are substances engineered specifically to prevent irritants from affecting the airways of individuals with asthma. A particular kind of antibody (IgE) is known to participate in the immune response the can provoke asthma attacks. A new biological agent approved for treating asthma (omalizumab, marketed under the name Xolair) interferes with IgE to disrupt the immune response, thereby preventing asthma attacks. Omalizumab is only recommended for asthma cases that cannot be controlled through other means. It is given as an injection once or twice per month and can cost as much as $10,000 per year.

Long-acting bronchodilators function similarly to short-acting bronchodilators but can control asthma symptoms for up to 12 hours. There is some concern about the safety of these medications, especially since they can mask worsening asthma by providing relatively short-term relief of symptoms. Long-acting bronchodilators currently carry a Black Box warning from the FDA. Patients now have access to safer combinations of long-acting bronchodilators and inhaled corticosteroids in a single inhaler device, such as Advair and Symbicort; the bronchodilators relieve symptoms and the corticosteroids combat inflammation and reduce the likelihood of asthma attacks.

Immunotherapy: Immunotherapy, which involves injecting small amounts of allergens under the patient's skin in order desensitize her or him to their effects, has been studied as a therapy for allergic asthma. While immunotherapy has proved to be helpful for patients whose asthma is clearly linked to exposure to specific allergens, the treatment may actually induce asthma attacks in highly sensitive individuals, so careful testing is imperative.

"Alternative medicine": Approximately half of asthma patients use some form of unconventional therapy—such as acupuncture, air ionizers, and chiropractic treatments—to manage their illness. There is too little evidence on the topic to either support or refute alternative medicine treatments of asthma, although patients who use herbal treatments should be cautioned about the potential for allergic reactions and interactions with conventional asthma medications, and should be warned not to skip their prescribed medications.

Conclusion

Asthma rates dramatically increased in the US from 1980 through 1997, and have since stabilized at a relatively high rate. Death rates from the disease remain unacceptably high. While great strides have been made in medical management of asthma, there has not been significant progress in the understanding of risk factors for developing it, making prevention extremely difficult. Future asthma treatments may be tailored to individual patients' genetic make-ups, or biologically designed to interfere with specific irritants in the airways. Studying these treatments further may help to elucidate the causes of this complex disease.

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Michael P. Elston, M.D., M.S.
Western Health

William N. Elwood, Ph.D.
NIH/Center for Scientific Review

Edward A. Emken, Ph.D.
Midwest Research Consultants

Nicki J. Engeseth, Ph.D.
University of Illinois

Stephen K. Epstein, M.D., M.P.P., FACEP
Beth Israel Deaconess Medical Center

Myron E. Essex, D.V.M., Ph.D.
Harvard School of Public Health

Terry D. Etherton, Ph.D.
Pennsylvania State University

R. Gregory Evans, Ph.D., M.P.H.
St. Louis University Center for the Study of Bioterrorism and Emerging Infections

William Evans, Ph.D.
University of Alabama

Daniel F. Farkas, Ph.D., M.S., P.E.
Oregon State University

Richard S. Fawcett, Ph.D.
Huxley, IA

Owen R. Fennema, Ph.D.
University of Wisconsin, Madison

Frederick L. Ferris, III, M.D.
National Eye Institute

David N. Ferro, Ph.D.
University of Massachusetts

Madelon L. Finkel, Ph.D.
Weill Medical College of Cornell University

Kenneth D. Fisher, Ph.D.
Office of Dietary Supplements

Leonard T. Flynn, Ph.D., M.B.A.
Morganville, NJ

William H. Foege, M.D., M.P.H.
Seattle, WA

Ralph W. Fogleman, D.V.M.
Savannah, GA

Christopher H. Foreman, Jr., Ph.D.
University of Maryland

F. J. Francis, Ph.D.
University of Massachusetts

Glenn W. Froning, Ph.D.
University of Nebraska, Lincoln

Vincent A. Fulginiti, M.D.
Tucson, AZ

Robert S. Gable, Ed.D., Ph.D., J.D.
Claremont Graduate University

Shayne C. Gad, Ph.D., D.A.B.T., A.T.S.
Gad Consulting Services

William G. Gaines, Jr., M.D., M.P.H.
College Station, TX

Charles O. Gallina, Ph.D.
Professional Nuclear Associates

Raymond Gambino, M.D.
Quest Diagnostics Incorporated

Randy R. Gaugler, Ph.D.
Rutgers University

J. Bernard L. Gee, M.D.
Yale University School of Medicine

K. H. Ginzel, M.D.
University of Arkansas for Medical Science

William Paul Glezen, M.D.
Baylor College of Medicine

Jay A. Gold, M.D., J.D., M.P.H.
Medical College of Wisconsin

Roger E. Gold, Ph.D.
Texas A&M University

Reneé M. Goodrich, Ph.D.
University of Florida

Frederick K. Goodwin, M.D.
The George Washington University Medical Center

Timothy N. Gorski, M.D., F.A.C.O.G.
University of North Texas

Ronald E. Gots, M.D., Ph.D.
International Center for Toxicology and Medicine

Henry G. Grabowski, Ph.D.
Duke University

James Ian Gray, Ph.D.
Michigan State University

William W. Greaves, M.D., M.S.P.H.
Medical College of Wisconsin

Kenneth Green, D.Env.
American Interprise Institute

Laura C. Green, Ph.D., D.A.B.T.
Cambridge Environmental, Inc.

Richard A. Greenberg, Ph.D.
Hinsdale, IL

Sander Greenland, Dr.P.H., M.S., M.A.
UCLA School of Public Health

Gordon W. Gribble, Ph.D.
Dartmouth College

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University of Florida

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Harvard Medical School

F. Peter Guengerich, Ph.D.
Vanderbilt University School of Medicine

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Advance, NC

Philip S. Guzelian, M.D.
University of Colorado

Terryl J. Hartman, Ph.D., M.P.H., R.D.
The Pennsylvania State University

Clare M. Hasler, Ph.D.
The Robert Mondavi Institute of Wine and Food Science, University of California, Davis

Virgil W. Hays, Ph.D.
University of Kentucky

Cheryl G. Healton, Dr.PH.
Mailman School of Public Health of Columbia University

Clark W. Heath, Jr., M.D.
American Cancer Society

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McLean Hospital/Harvard Medical School

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Williamstown, MA

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Joslin Diabetes Center/Harvard Medical School

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University of Alberta

Clifford A. Hudis, M.D.
Memorial Sloan-Kettering Cancer Center

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Covington & Burling, LLP

Susanne L. Huttner, Ph.D.
University of California, Berkeley

Lucien R. Jacobs, M.D.
University of California, Los Angeles

Alejandro R. Jadad, M.D., D.Phil., F.R.C.P.C.
University of Toronto

Rudolph J. Jaeger, Ph.D.
Environmental Medicine, Inc.

William T. Jarvis, Ph.D.
Loma Linda University

Elizabeth H. Jeffery, Ph.D.
University of Illinois, Urbana

Geoffrey C. Kabat, Ph.D., M.S.
Albert Einstein College of Medicine

Michael Kamrin, Ph.D.
Michigan State University

John B. Kaneene, D.V.M., M.P.H., Ph.D.
Michigan State University

P. Andrew Karam, Ph.D., CHP
MJW Corporation

Kathryn E. Kelly, Dr.P.H.
Delta Toxicology

George R. Kerr, M.D.
University of Texas, Houston

George A. Keyworth II, Ph.D.
Progress and Freedom Foundation

F. Scott Kieff, J.D.
Washington University School of Law

Michael Kirsch, M.D.
Highland Heights, OH

John C. Kirschman, Ph.D.
Allentown, PA

William M. P. Klein, Ph.D.
University of Pittsburgh

Ronald E. Kleinman, M.D.
Massachusetts General Hospital/ Harvard Medical School

Leslie M. Klevay, M.D., S.D. in Hyg.
University of North Dakota School of Medicine and Health Sciences

David M. Klurfeld, Ph.D.
U.S. Department of Agriculture

Kathryn M. Kolasa, Ph.D., R.D.
East Carolina University

James S. Koopman, M.D, M.P.H.
University of Michigan School of Public Health

Alan R. Kristal, Dr.P.H.
Fred Hutchinson Cancer Research Center

Stephen B. Kritchevsky, Ph.D.
Wake Forest University Baptist Medical Center

Mitzi R. Krockover, M.D.
SSB Solutions

Manfred Kroger, Ph.D.
Pennsylvania State University

Sandford F. Kuvin, M.D.
University of Miami School of Medicine/ Hebrew University of Jerusalem

Carolyn J. Lackey, Ph.D., R.D.
North Carolina State University

J. Clayburn LaForce, Ph.D.
University of California, Los Angeles

Robert G. Lahita, M.D., Ph.D.
Mount Sinai School of Medicine

James C. Lamb, IV, Ph.D., J.D., D.A.B.T.
The Weinberg Group

Lawrence E. Lamb, M.D.
San Antonio, TX

William E. M. Lands, Ph.D.
College Park, MD

Lillian Langseth, Dr.P.H.
Lyda Associates, Inc.

Brian A. Larkins, Ph.D.
University of Arizona

Larry Laudan, Ph.D.
National Autonomous University of Mexico

Tom B. Leamon, Ph.D.
Liberty Mutual Insurance Company

Jay H. Lehr, PH.D.
Environmental Education Enterprises, Inc.

Brian C. Lentle, MD., FRCPC, DMRD
University of British Columbia

Scott O. Lilienfeld, Ph.D.
Emory University

Floy Lilley, J.D.
Fernandina Beach, FL

Paul J. Lioy, Ph.D.
UMDNJ-Robert Wood Johnson Medical School

William M. London, Ed.D., M.P.H.
California State University, Los Angeles

Frank C. Lu, M.D., BCFE
Miami, FL

William M. Lunch, Ph.D.
Oregon State University

Daryl B. Lund, Ph.D.
University of Wisconsin-Madison

John R. Lupien, M.Sc.
University of Massachusetts

Howard D. Maccabee, Ph.D., M.D.
Alamo, CA

Janet E. Macheledt, M.D., M.S., M.P.H.
Houston, TX

Henry G. Manne, J.S.D.
George Mason University Law School

Karl Maramorosch, Ph.D.
Rutgers University, Cook College

Judith A. Marlett, Ph.D., R.D.
University of Wisconsin, Madison

Lawrence J. Marnett, Ph.D.
Vanderbilt University

James R. Marshall, Ph.D.
Roswell Park Cancer Institute

Roger O. McClellan, D.V.M., M.M.S., DABT, DABVT, FATS
Toxicology and Risk Analysis

Mary H. McGrath, M.D., M.P.H.
University of California, San Francisco

Alan G. McHughen, D.Phil.
University of California, Riverside

James D. McKean, D.V.M., J.D.
Iowa State University

Joseph P. McMenamin, M.D., J.D.
McGuireWoods, LLP

Patrick J. Michaels, Ph.D.
University of Virginia

Thomas H. Milby, M.D., M.P.H.
Walnut Creek, CA

Joseph M. Miller, M.D., M.P.H.
Durham, NH

Richard A. Miller, M.D.
Pharmacyclics, Inc.

Richard K. Miller, Ph.D.
University of Rochester

William J. Miller, Ph.D.
University of Georgia

Grace P. Monaco, J.D.
Medical Care Ombudsman Program