

10th Special Report to the U.S. Congress on
Alcohol and Health

HIGHLIGHTS FROM CURRENT RESEARCH

From the Secretary of Health and Human Services

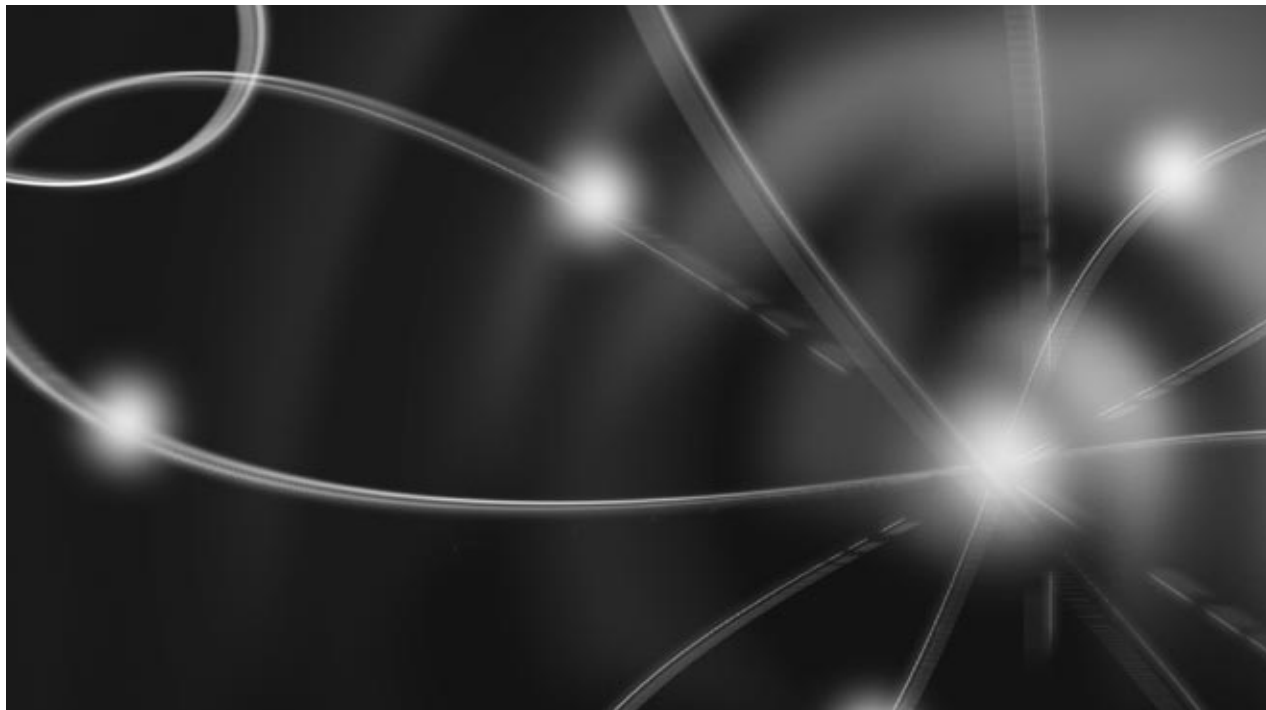
June 2000



U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
National Institutes of Health
National Institute on Alcohol Abuse and Alcoholism

10th

Special Report to the U.S. Congress on
Alcohol and Health



HIGHLIGHTS FROM CURRENT RESEARCH

From the Secretary of Health and Human Services

June 2000



U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
National Institutes of Health
National Institute on Alcohol Abuse and Alcoholism

Table of Contents

Foreword .....	.ix
Preface .....	.xi
Introduction .....	.xiii
Acknowledgments .....	.xvii
Chapter 1: Drinking Over the Life Span: Issues of Biology, Behavior, and Risk	1
Measuring the Health Risks and Benefits of Alcohol	3
Risks and Benefits of Alcohol Consumption: Physical Health	4
Psychosocial Consequences and Cognitive Effects	11
Effects on Society of Alcohol Use: Injuries and Violence	12
Assessing Risks and Benefits: Mortality, Morbidity, and Disability	13
In Closing	17
References	17
Alcohol Involvement Over the Life Course	28
Understanding the Age Progression of Alcohol Involvement in Childhood and Later Life	30
Developmental Patterns	30
Social Contexts and Drinking Behavior	37
Changes in Patterns of Drinking Behavior as a Function of Social Change	40
Development and Drinking Behavior: Dynamic Models of Stability and Change	44
In Closing	45
References	45
Alcohol and Violence	54
Individual-Level Studies: Drinking by Offenders	55
Individual-Level Studies: Drinking by Victims	58
Environmental Influences	59
Theoretical Developments	61
In Closing	63
References	63

Chapter 2: Alcohol and the Brain: Neuroscience and Neurobehavior	67
Setting the Stage: The Structure and Function of Neurons	69
Structure and Function of Neurons	70
Communication Within and Between Neurons	73
Neurotransmitters	76
In Closing	76
References	77
From Cell Membrane to Nucleus: The Effects of Alcohol on Brain Neurons	78
Alcohol's Effect on Synaptic Transmission During Acute Exposure	78
Alcohol's Effects on Protein Phosphorylation	79
Long-Term Exposure to Alcohol: Gene Expression, Protein Phosphorylation, and Protein Localization	83
In Closing	85
References	85
Acute Actions of Alcohol on the Brain	89
Measuring Alcohol's Effects	89
Alcohol and Ion Channels	90
Alcohol and Neurotransmitter Systems	98
In Closing	100
References	101
Neurobiological and Neurobehavioral Mechanisms of Chronic Alcohol Drinking	107
Reinforcement and Reward in Chronic Drinking	107
Insights Into Features of Alcoholism From Animal Models	108
Alcoholism and the Neural Structures of Reward	113
Neurochemical and Molecular Adaptations to Alcohol	115
Alcoholism: Lasting Changes in the Brain	119
References	123
The Neurotoxicity of Alcohol	134
Neuropathologic Changes	134
Morphological Changes	135
Functional Changes	138
Mechanisms of Action	138
In Closing	141
References	142
Genetic Studies of Alcohol's Actions on the Brain	147
Development of Animal Models	147
Investigation of Candidate Genes	149
Immediate Early Genes	153
References	155

Chapter 3: Genetic and Psychosocial Influences	159
Animal Genetic Studies on Alcoholism	160
Quantitative Trait Loci	160
Creating Rodent Models	161
Quantitative Trait Loci Mapping	162
In Closing	165
References	166
Recent Progress in the Genetics of Alcoholism	169
Findings From Twin/Family Studies	169
Findings From Genetic Linkage Studies	173
Findings From Genetic Association Studies	175
In Closing	177
References	177
Psychosocial Factors in Alcohol Use and Alcoholism	181
Family History of Alcoholism	181
Developmental Issues	186
Motivation To Drink	187
The Role of Cognition: Beliefs About Alcohol	189
In Closing	190
References	191
Chapter 4: Medical Consequences	197
Alcohol-Induced Liver Injury	198
Alcoholic Liver Disease	198
Preventing Liver Injury	202
Nutritional Factors	202
Other Liver Diseases	204
References	207
Alcohol and the Immune System	214
Alcohol and Diseases Related to the Immune System	214
Diseases Related to Immunodeficiency	214
Diseases Related to Autoimmunity	215
The Immune System	216
Changes in the Immune System of Alcoholics	217
Experimental Models	219
Current Directions	222
Therapeutic Measures	225
References	226

Alcohol's Effects on the Cardiovascular System .....	.240
The Heart	240
The Vascular System	244
In Closing	248
References	248
Alcohol and Women: An Overview .....	.253
Health Consequences of Alcohol for Women	253
Physiologic Mechanisms	254
Liver Injury	255
In Closing	256
References	256
Alcohol and the Skeletal System .....	.258
Research Challenges	258
Alcohol-Induced Fractures	259
Alcohol-Induced Osteopenia	260
Bone Histomorphometry	261
Potential Mechanisms of Alcohol-Induced Bone Disease	262
In Closing	266
References	266
Alcohol and Breast Cancer .....	.273
Age, Genetics, and Other Risk Factors	274
Menopausal Status and Hormones	274
Mechanisms of Alcohol-Related Breast Cancer	275
In Closing	277
References	278
Chapter 5: Prenatal Exposure to Alcohol .....	.283
Prenatal Alcohol Exposure: Effects on Brain Structure and Function .....	.285
Diagnosing the Effects of Prenatal Alcohol Exposure	285
Neuroimaging: Precise Pictures of Structural Damage to the Brain	287
Physical Measures of Altered Brain Function: Cry Patterns and EEG's	289
Effects on Cognitive and Motor Functions	290
Effects on Mental Health and Psychosocial Behavior	294
In Closing	295
References	296

Underlying Mechanisms of Alcohol-Induced Damage to the Fetus300

 Challenges to FAS Research: Multiple Mechanisms, Sites of Action, and Risk Factors301

 Candidate Mechanisms for Central Nervous System Damage302

 Candidate Mechanisms for Craniofacial Defects309

 In Closing310

 References310

Issues in Fetal Alcohol Syndrome Prevention323

 Reviews of Prevention Programs and Research323

 Methodological and Evaluation Issues325

 Reaching to All, Regardless of Risk: Universal Prevention Approaches326

 Targeting Those at Increased Risk: Selective Prevention Approaches327

 Helping Those at Highest Risk: Indicated Prevention Approaches329

 International Considerations331

 In Closing332

 References332

Chapter 6: Economic and Health Services Perspectives339

Effects of Changes in Alcohol Prices and Taxes341

 Public Policies and Alcohol Prices341

 Alcohol Prices, Taxes, and Consumption342

 Alcohol Taxes and Traffic Fatalities346

 Alcohol Demand and Marijuana Demand348

 Benefits and Costs of Taxation349

 In Closing351

 References352

Cost Research on Alcoholism Treatment355

 Past Research355

 Recent Studies356

 In Closing361

 References361

The Economic Costs of Alcohol Abuse364

 Distribution of the Burden of Costs365

 Components of the Costs of Alcohol Abuse366

 Limitations and Caveats369

 References370

Chapter 7: Prevention Research373

Reducing Alcohol-Impaired Driving375

 Recent Trends in Alcohol-Related Traffic Fatalities377

 Legislative Efforts To Reduce Alcohol-Impaired Driving378

 Enforcement of Impaired-Driving Laws386

 Comprehensive Community Programs386

 Alcohol Control Policies387

 Individual Actions389

 Safety Belt Laws390

 In Closing391

 References391

Community-Based Prevention Approaches397

 Community Prevention for Heart Disease and Health Promotion: A Precedent397

 Methodological Concerns398

 Recent Research Results399

 Commentary and Future Research Needs405

 In Closing408

 References408

Alcohol Advertising: What Are the Effects?412

 Background: The Frequency and Content of Advertising Messages413

 Does Alcohol Advertising Affect Drinking or Drinking Problems?414

 In Closing422

 References423

Chapter 8: Treatment Research 427

Screening and Brief Intervention for Alcohol Problems 429

 Screening for Alcohol Problems 429

 Brief Intervention 432

 Areas for Future Research 437

 In Closing 439

 References 439

Treatment of Alcohol Dependence With Psychological Approaches 444

 Client-Treatment Matching 444

 Professional Treatment Modeled on the 12 Steps of Alcoholics Anonymous 445

 Supportive Ancillary Services 446

 Intensity of Services 448

 In Closing 448

 References 449

Treatment of Alcohol Dependence With Medications 451

 Medications for Alcohol Dependence 452

 Medications for Patients With Both Alcoholism and Depression 457

 In Closing 458

 References 458

Subject Index 463



Foreword



I am pleased to present the *Tenth Special Report on Alcohol and Health* to the U.S. Congress, and through them to the American people.

Alcohol problems, both those of individuals and those that affect society at large, continue to impose a staggering burden on our Nation. Domestic violence, child abuse, fires and other accidents, falls, rape, and other crimes against individuals such as robbery and assault—all are linked to alcohol misuse. Alcohol misuse also is implicated in diseases such as cancer, liver disease, and heart disease. Although often not aware of it, everyone shares a portion of this burden. For example, an estimated 20 to 40 percent of patients in large urban hospitals are there because of illnesses that have been caused or made worse by their drinking. This means that out of every 100 patients in such hospitals, *almost half* may be there because of their alcohol use. Each of us shares the price of these illnesses through rising health care costs. Because one in four children under the age of 18 lives in a household with one or more family members who are alcohol dependent or who abuse alcohol, our Nation will continue to be robbed of its future. As these children grow up, they too will be at risk for continuing the cycle of alcohol abuse and dependence that has plagued too many of our citizens for too long.

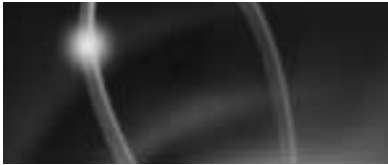
As overwhelming as these facts are, the real tragedy is that many people do not yet understand that alcohol problems can yield to scientific investigation and medical intervention in the same way as other health conditions, and in many cases more successfully.

The research findings presented in the *Tenth Special Report to the U.S. Congress on Alcohol and Health* clearly demonstrate that continued support for alcohol research, and the use of findings from research in prevention and clinical applications, offer the best hope for reducing the costs we all pay for alcohol problems. I commend it to your attention.

Donna E. Shalala
Secretary
U.S. Department of Health and Human Services



Preface



During the latter half of the twentieth century, we witnessed an unparalleled era of progress in medical science. Among other important scientific advances, we discovered the genetic code and are well on our way toward mapping the entire human genome, we began to explore how our brains work in concert with other body systems to promote or to impede health, and we developed increasingly sophisticated medical devices and technologies that allow us to look at the actual functioning of the myriad systems that make up human beings.

The *Tenth Special Report to the U.S. Congress on Alcohol and Health* presents significant new scientific findings about alcohol abuse and alcoholism since the last Special Report, issued in 1997. These findings clearly demonstrate that alcohol investigators working in fields as diverse as epidemiology, genetics, neuroscience, toxicology, prevention, and treatment are using the very latest tools and techniques of science to expand our knowledge of how to prevent, reduce, and treat alcohol problems. Because alcohol use problems exact such a personal, social, and economic toll on the American people—an estimated 100,000 lives and \$184.6 billion annually—the scientific progress described in the *Tenth Special Report* is heartening.

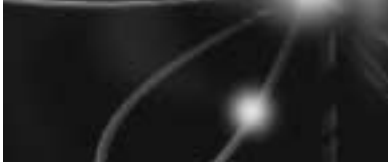
As important as this progress is for those whose lives have been affected by alcohol use, I believe that the *Tenth Special Report* serves a greater purpose. Science does not happen in a vacuum. Rather, it is a cumulative process that builds upon the knowledge developed by many scientists working in many different areas of investigation. Therefore, what is discovered about one disease or health condition may very well provide important clues about other diseases and conditions, clues that will help in the development of medications, treatments, and preventive approaches that can be widely applied. Because alcohol affects virtually all body systems and because alcohol use problems affect all levels of human interaction, the alcohol research field represents, in many respects, a microcosm of science in its entirety. Thus, the findings described in the *Tenth Special Report* about genetics, neural circuitry, the effect of the environment on gene expression, fetal development, cognition, psychological therapies, prevention and education, and treatment contribute significantly to the knowledge we need to solve not only the problems associated with alcohol abuse and alcoholism, but also the problems of human biology and behavior in general.

I would like to commend the scientists who participated in the development of the *Tenth Special Report* and the staff of the National Institute on Alcohol Abuse and Alcoholism for their efforts to bring this important information to the attention of the U.S. Congress and the American people.

Ruth Kirschstein, M.D.
Acting Director
National Institutes of Health



Introduction



The first *Special Report on Alcohol and Health* was presented to the U.S. Congress in 1971. In that report, and in each subsequent one, the National Institute on Alcohol Abuse and Alcoholism (NIAAA) summarized for the Congress—and the American people—the cumulative body of alcohol research findings in each area of investigation. For this, our 10th edition of the Special Report, we found ourselves in a pleasant, if somewhat daunting, position. The breadth and scope of alcohol research has grown so tremendously that summarizing the total body of alcohol research in one document is no longer manageable; so we have chosen to present the findings from alcohol research in a new way—to summarize what is known in a particular area and to describe in greater detail significant research findings that have been reported since the *Ninth Special Report*. And, in the best tradition of the *Special Reports on Alcohol and Health*, this 10th edition continues to provide both extensive information on alcohol use problems and ample cause for hope that we are well on the way to preventing and effectively treating them.

Alcohol is widely used in our society. Most individuals who use alcohol drink in ways that do not increase risk for alcohol use problems. Some, however, drink in ways or at times during their life course that increase risk to themselves or others. Still others who use alcohol may derive a health benefit from its use. Defining precisely who is at risk for alcohol use problems and assessing the risks versus benefits of alcohol use are the first steps toward providing accurate public health information and designing effective interventions to reduce alcohol use problems. The *Tenth Special Report* presents important new findings about biological and behavioral factors that affect the risks and benefits of drinking over the life span.

Perhaps the single greatest influence on the scope and direction of alcohol research has been the finding that a portion of the vulnerability to alcoholism is genetic. This finding, more than any other, helped to establish the biological basis of alcoholism. It also provided the basis—and justification—for much of the progress in genetics, neuroscience, and neurobehavior described in the *Tenth Special Report*. Today we know that approximately 50 to 60 percent of the risk for developing alcoholism is genetic. Genes direct the synthesis of proteins, and it is the proteins that drive and regulate critical chemical reactions throughout the human body. Genetics, therefore, affects virtually every facet of alcohol research, from neuroscience to Fetal Alcohol Syndrome. It is clear from the findings presented in the *Tenth Special Report* that although much remains to be discovered, progress has been made toward understanding how genes are involved in the etiology of alcohol use problems, including how genes interact with other genes and with the environment to produce disease.

The progress made in the neurosciences over the last two decades has been spectacular. Alcohol investigators have taken full advantage of this progress by applying neuroscience techniques to the study of alcohol use problems. As a result, our understanding of the neural processes that underlie alcohol-seeking behavior and of how alcohol's actions in the brain are related to the phenomenon of addiction has grown dramatically. Recent progress in neuroscience research described in the *Tenth Special*

Report has yielded information critical to characterizing some of the cellular and molecular processes involved in alcohol use and has helped associate these processes with the behavioral and physiologic manifestations of alcohol use and abuse. One important tool used in both genetics and neurobehavioral research is the animal model. Alcohol scientists have applied molecular biology techniques to develop a number of important animal models that allow the study of the genes associated with traits that might influence alcohol-related behaviors. Findings from studies using both vertebrate and nonvertebrate animal models and other study results concerning the etiology of alcohol use problems are discussed in the *Tenth Special Report*.

Although the toxicology of alcohol—how alcohol damages the body—was one of the first areas in alcohol research to be studied, the acceptance of the biological foundations of alcoholism and the subsequent increase in alcohol-related biological research helped to focus scientific attention on the mechanisms by which this damage occurs. As described in several chapters of the *Tenth Special Report*, alcohol research scientists have uncovered new information about the kinds of damage that alcohol exposure can cause to the brain, both during prenatal development and later in life, and to other major body organs. More important, there is a very good accounting of the progress that alcohol scientists have made toward understanding how this damage occurs. It is knowing the “how” that has the potential to produce therapeutic interventions to limit or ameliorate many of the alcohol-related health consequences.

Limited in the past, research on prevention is coming into its own. The findings from prevention research applied to various public policies already have been shown to save lives. New approaches to school-based and community prevention are demonstrating that well-planned prevention programs based on rigorously studied and validated models can reduce the magnitude and extent of our Nation’s alcohol-related problems. Prevention research is also examining the

role that advertising plays with respect to alcohol use and abuse.

The main goal of alcoholism treatment is to help alcoholics maintain sobriety. The *Tenth Special Report* highlights the progress that has been made toward developing both behavioral strategies and medications to help achieve this goal. Some of the most compelling questions about treatment have to do with factors that help to make treatment services effective. Some studies have shown significant reductions in drinking following treatment with extensively tested and refined behavioral therapies. Other strategies, involving brief interventions in primary care settings, have proved to be effective in reducing alcohol consumption in persons drinking at levels associated with negative health consequences. Because many individuals continue to experience problems with alcohol after treatment, there is a need to further improve treatment efficacy.

One of the principal payoffs of biological research in genetics and neuroscience is the potential for developing medications to treat a variety of alcohol use problems. Neuroscience research already has provided the groundwork for new medications for treating alcoholism. Researchers now are looking for new medications that target the mechanisms of the addiction itself, such as drugs that interfere with the reward properties of alcohol or craving, which are thought to be major factors in relapse. It is likely that no one medication will be effective for everyone nor that there will be the proverbial “silver bullet” of pharmacotherapies for alcoholism. Just as there are different types of medications with different mechanisms of action to treat complex diseases like diabetes, it is likely that there will be a range of medications, coupled with verbal therapies, available to clinicians.

Last, like everyone else during this ending of one century and beginning of a new century, I would like to share my thoughts on where we are heading in alcohol research. Finding the genes for alcoholism is probably one of the most important goals in alcohol research. However, it is the

beginning of the story rather than the end. For this information to be of practical use, we must understand how biology and behavior interact to produce disease. There is a welcome trend in the alcohol field toward reciprocal work between the biological and behavioral sciences. The potential success of this type of collaboration has been well demonstrated by major research efforts such as the Collaborative Study on the Genetics of Alcoholism, which involved both biological and behavioral science and scientific principles. Other examples of this type of work can be found in research on the effects of alcohol on the fetus, where there are excellent behavioral studies of children with Fetal Alcohol Syndrome and other alcohol-related birth defects as well as detailed information from imaging studies about the tremendous structural changes in the brains of children exposed to alcohol in the womb. We also are learning about the proper connectivity among neurons. In this work it appears that alcohol actually prevents the appropriate expression of certain genes.

The trend toward studying the whole human animal, not just its genetic or neural parts, will


continue to be advanced, I believe, by a rejection of the “reductionist” view, which seeks to define humankind in terms of its genes, and acceptance of the tenet that genes are not (or even mostly) destiny, just as humankind is not just the sum of its neurons and circuits.

That we are continuing to expand our knowledge of alcohol use problems is clear from the material presented in this Special Report. The scientists, and the NIAAA staff who have worked so diligently to present the *Tenth Special Report* to the Congress, have my thanks for their efforts. The task now for each of us who is concerned about the impact of alcohol abuse and alcoholism on our society is to accelerate the pace of research that has enabled us to come this far to ensure that the new millennium brings new successes.

Enoch Gordis, M.D.
Director
National Institute on
Alcohol Abuse and Alcoholism

Acknowledgments

Contributors



Mary Jane Ashley, M.D.
Department of Public Health Sciences
Faculty of Medicine
University of Toronto
Addiction Research Foundation
Mental Health Services Corporation
of Ontario
Toronto, Ontario, Canada

Gregory Bloss, M.A.
Division of Biometry and Epidemiology
National Institute on Alcohol Abuse
and Alcoholism
Bethesda, Maryland

Susan J. Bondy, Ph.D.
Department of Public Health Sciences
Faculty of Medicine
University of Toronto
Addiction Research Foundation
Mental Health Services Corporation
of Ontario
Toronto, Ontario, Canada

Laurie A. Chassin, Ph.D.
Department of Psychology
Arizona State University
Tempe, Arizona

Robert T. Cook, M.D., Ph.D.
Pathology and Laboratory Medicine
VA Medical Center and University
of Iowa
Iowa City, Iowa

John Crabbe, Ph.D.
Portland Alcohol Research Center
Department of Behavioral Neuroscience
Oregon Health Sciences University
Portland, Oregon

Fulton T. Crews, Ph.D.
Center for Alcohol Studies
University of North Carolina School
of Medicine
Chapel Hill, North Carolina

Vincent M. Figueredo, M.D.
Division of Cardiology
Lovelace Medical Center
Albuquerque, New Mexico

Michael F. Fleming, M.D., M.P.H.
Center for Addiction Research
and Education
University of Wisconsin
Madison, Wisconsin

Michael T. French, Ph.D.
Health Services Research Center and
Department of Economics
University of Miami
Miami, Florida

Charles R. Goodlett, Ph.D.
Department of Psychology
Indiana University-Purdue University
at Indianapolis
Indianapolis, Indiana

Joel W. Grube, Ph.D.
Prevention Research Center
Berkeley, California

Henrick J. Harwood
The Lewin Group
Falls Church, Virginia

Brenda Hewitt
Office of the Director
National Institute on Alcohol Abuse
and Alcoholism
Bethesda, Maryland

Michael E. Hilton, Ph.D.
Health Services Research Program
Division of Clinical and Prevention
Research
National Institute on Alcohol Abuse
and Alcoholism
Bethesda, Maryland

Ralph Hingson, Sc.D.
Social and Behavioral Sciences
Department
Boston University School of Public Health
Boston, Massachusetts

Constance Horgan, Ph.D.
Institute for Health Policy
Heller School
Brandeis University
Waltham, Massachusetts

Jan M. Howard, Ph.D.

Prevention Research Branch
Division of Clinical and Prevention Research
National Institute on Alcohol Abuse and Alcoholism
Bethesda, Maryland

Thomas E. Johnson, Ph.D.

Institute for Behavioral Genetics
University of Colorado at Boulder
Boulder, Colorado

Robert W. Karp, Ph.D.

Genetics, Neuroscience, and Behavior
Research Branch
Division of Basic Research
National Institute on Alcohol Abuse and Alcoholism
Bethesda, Maryland

Donald S. Kenkel, Ph.D.

Department of Policy Analysis and Management
Cornell University
Ithaca, New York

Robert F. Klein, M.D.

Endocrinology and Metabolism Section
VA Medical Center
Portland, Oregon

George Koob, Ph.D.

Department of Neuropharmacology
The Scripps Research Institute
La Jolla, California

Mary Jo Larson, Ph.D.

New England Research Institutes, Inc.
Watertown, Massachusetts

David M. Lovinger, Ph.D.

Departments of Molecular Physiology and
Biophysics and of Pharmacology
Vanderbilt University School of Medicine
Nashville, Tennessee

Susan E. Martin, Ph.D.

Violence, Trauma, and Unintentional Injury
Prevention Research Branch
Division of Clinical and Prevention Research
National Institute on Alcohol Abuse and Alcoholism
Bethesda, Maryland

Barbara J. Mason, Ph.D.

Department of Psychiatry and Behavioral Sciences
University of Miami School of Medicine
Miami, Florida

Sarah N. Mattson, Ph.D.

Center for Behavioral Teratology
San Diego State University
San Diego, California

Philip A. May, Ph.D.

Center on Alcoholism, Substance Abuse
and Addictions
University of New Mexico
Albuquerque, New Mexico

Craig J. McClain, M.D.

Clinical Research Center
Division of Digestive Diseases and Nutrition
University of Kentucky Medical Center and
Lexington VA Medical Center
Lexington, Kentucky

Esteban Mezey, M.D.

Division of Gastroenterology
Department of Medicine
The Johns Hopkins University
Baltimore, Maryland

Robert Nash Parker, Ph.D.

Robert Presley Center for Crime and Justice Studies
Department of Sociology
University of California
Riverside, California

Jurgen T. Rehm, Ph.D.

Fachhochschule Hamburg
Hamburg, Germany
Addiction Research Foundation
Mental Health Services Corporation of Ontario
Toronto, Ontario, Canada

Robert G. Rychtarik, Ph.D.

Research Institute on Addictions
Buffalo, New York

Robert F. Saltz, Ph.D.

Prevention Research Center
Berkeley, California

Keith W. Singletary, Ph.D.

Department of Food Science and Human Nutrition
University of Illinois, Urbana-Champaign
Urbana, Illinois

Barbara Smothers, Ph.D.

Epidemiology Branch
Division of Biometry and Epidemiology
National Institute on Alcohol Abuse and Alcoholism
Bethesda, Maryland

Ellen Stewart, B.A.
New England Research Institutes, Inc.
Watertown, Massachusetts

John J. Woodward, Ph.D.
Department of Pharmacology and Toxicology
Medical College of Virginia Campus
Virginia Commonwealth University
Richmond, Virginia

Robert A. Zucker, Ph.D.
Department of Psychiatry and Psychology
Alcohol Research Center and Substance
Abuse Division
University of Michigan
Ann Arbor, Michigan

Editorial Advisory Board

James D. Beard, Ph.D.
Department of Physiology
College of Medicine
The University of Tennessee-Memphis
Memphis, Tennessee

Howard T. Blane, Ph.D.
Research Institute on Addictions
Buffalo, New York

Gregory Bloss, M.A.
Division of Biometry and Epidemiology
National Institute on Alcohol Abuse and Alcoholism
Bethesda, Maryland

Ann May Diehl, M.D.
School of Medicine
Johns Hopkins University
Baltimore, Maryland

Bruce C. Dudek, Ph.D.
Department of Psychology
University of Albany, State University of New York
Albany, New York

Constance Horgan, Ph.D.
Institute for Health Policy
Heller School
Brandeis University
Waltham, Massachusetts

Stephanie S. O'Malley, Ph.D.
Department of Psychiatry
Substance Abuse Treatment Unit
Yale University School of Medicine
New Haven, Connecticut

Edward P. Riley, Ph.D.
Center for Behavioral Teratology
Department of Psychology
San Diego State University
San Diego, California

Kenneth J. Sher, Ph.D.
Department of Psychology
University of Missouri
Columbia, Missouri

Boris Tabakoff, Ph.D.
Department of Pharmacology
University of Colorado School of Medicine
Denver, Colorado

Sharon C. Wilsnack, Ph.D.
Department of Neuroscience
University of North Dakota
Grand Forks, North Dakota

Peer Reviewers

Bryon H. Adinoff, M.D.
VA Medical Center
Dallas, Texas

Efrain Azmitia, Ph.D.
Biology Department
New York University
New York, New York

Thomas Babor, Ph.D.
Department of Psychiatry
University of Connecticut Health Center
Farmington, Connecticut

Monte Bissell, M.D.
Division of Gastroenterology
University of California at San Francisco
San Francisco, California

Raul Caetano, M.D., Ph.D.

Alcohol Research Group
Berkeley, California

Frank J. Chaloupka, Ph.D.

Department of Economics
University of Illinois at Chicago
Chicago, Illinois

Michael C. Costanza, Ph.D.

Medical Biostatistics
University of Vermont
Burlington, Vermont

Nancy L. Day, Ph.D.

Western Psychiatric Institute and Clinic
Pittsburgh, Pennsylvania

Robert Foss, Ph.D.

Highway Safety Research Center
University of North Carolina
Chapel Hill, North Carolina

Susan Gapstur, Ph.D.

Department of Preventive Medicine
Northwestern University Medical School
Chicago, Illinois

Louis Gliksman, Ph.D.

Addiction Research Foundation
Toronto, Ontario, Canada

Rueben A. Gonzales, Ph.D.

Division of Pharmacology
College of Pharmacy
University of Texas
Austin, Texas

Stanley S. Greenberg, Ph.D.

Section of Cardiopulmonary Research
Louisiana State University Medical Center
New Orleans, Louisiana

Janet R. Hankin, Ph.D.

Department of Sociology
Wayne State University
Detroit, Michigan

R. Adron Harris, Ph.D.

Department of Pharmacology
University of Colorado Health Sciences Center
Denver, Colorado

Andrew C. Heath, D.Phil.

Department of Psychiatry
Washington University School of Medicine
St. Louis, Missouri

Robert J. Hitzemann, Ph.D.

Department of Psychiatry
State University of New York at Stony Brook
Stony Brook, New York

Harold D. Holder, Ph.D.

Prevention Research Center
Berkeley, California

Yedy Israel, Ph.D.

Department of Pathology
Jefferson Medical College
Philadelphia, Pennsylvania

Joseph L. Jacobson, Ph.D.

Department of Psychology
Wayne State University
Detroit, Michigan

Glenda Kaufman Kantor, Ph.D.

Family Research Laboratory
University of New Hampshire
Durham, New Hampshire

Lee Ann Kaskutas, Dr.P.H.

Alcohol Research Group
Berkeley, California

Karen Kopera-Frye, Ph.D.

Department of Psychology
University of Akron
Canton, Ohio

George Kunos, M.D., Ph.D.

Department of Pharmacology and Toxicology
Medical College of Virginia
Virginia Commonwealth University
Richmond, Virginia

Francine E. Lancaster, Ph.D.

Biology Department
Texas Woman's University
Denton, Texas

Richard Longabaugh, Ed.D.

Center for Alcohol and Addiction Studies
Brown University
Providence, Rhode Island

Bryan Luce, Ph.D., M.B.A.

MEDTAP International, Inc.
Bethesda, Maryland

David MacKinnon, Ph.D.

Department of Psychology
Arizona State University
Tempe, Arizona

Stephen A. Maisto, Ph.D.

Department of Psychology
Syracuse University
Syracuse, New York

William J. McBride, Ph.D.

Department of Psychiatry
Indiana University School of Medicine
Institute of Psychiatric Research
Indianapolis, Indiana

Matthew McGue, Ph.D.

Department of Psychology
University of Minnesota
Minneapolis, Minnesota

Gary G. Meadows, Ph.D.

Department of Pharmaceutical Sciences
College of Pharmacy
Washington State University
Pullman, Washington

Lorraine Midanik, Ph.D.

School of Social Welfare
University of California at Berkeley
Berkeley, California

Brenda A. Miller, Ph.D.

Research Institute on Addictions
Buffalo, New York

Michael J. Moore, Ph.D.

Fuqua School of Business
Duke University
Durham, North Carolina

A. Leslie Morrow, Ph.D.

Department of Psychiatry
University of North Carolina School of Medicine
Chapel Hill, North Carolina

M. W. Perrine, Ph.D.

Vermont Alcohol Research Center
South Burlington, Vermont

Horace Mitchell Perry III, M.D.

Division of Geriatrics
St. Louis University Health Sciences Center
St. Louis, Missouri

Tamara J. Phillips, Ph.D.

Research Division
VA Medical Center
Portland, Oregon

Christopher J. Ruhm, Ph.D.

Department of Economics
University of North Carolina at Greensboro
Greensboro, North Carolina

Marcia Russell, Ph.D.

Research Institute on Addictions
Buffalo, New York

Herman H. Samson, Ph.D.

Department of Physiology and Pharmacology
Bowman Gray School of Medicine
Winston-Salem, North Carolina

Michael A. Sayette, Ph.D.

Department of Psychology
University of Pittsburgh
Pittsburgh, Pennsylvania

Edward M. Sellers, M.D., Ph.D.

Pharmacology/Dependence Research Unit
Women's College Hospital
Toronto, Ontario, Canada

Don Shepard, Ph.D.

Brandeis University
Waltham, Massachusetts

Jody L. Sindelar, Ph.D.

Department of Epidemiology and Public Health
Yale University
New Haven, Connecticut

Michael D. Slater, Ph.D.

Department of Technical Journalism
Colorado State University
Fort Collins, Colorado

Alan W. Stacy, Ph.D.

Institute for Prevention Research
University of Southern California
Los Angeles, California

Kathleen K. Sulik, Ph.D.

Department of Cell Biology and Anatomy
University of North Carolina
Chapel Hill, North Carolina

Gyongyi Szabo, M.D., Ph.D.

Department of Medicine
University of Massachusetts Medical Center
Worcester, Massachusetts

Ronald G. Thurman, Ph.D.

Laboratory of Hepatobiology and Toxicology
Department of Pharmacology
University of North Carolina School of Medicine
Chapel Hill, North Carolina

Maharaj K. Ticku, Ph.D.

Department of Pharmacology
University of Texas Health Sciences Center
San Antonio, Texas

Steven N. Treistman, Ph.D.
Department of Pharmacology
University of Massachusetts Medical Center
Worcester, Massachusetts

Russell T. Turner, Ph.D.
Department of Orthopedics
Mayo Foundation Rochester
Rochester, Minnesota

Carl Waltenbaugh, Ph.D.
Department of Microbiology/Immunology
Northwestern University Medical School
Chicago, Illinois

Friedbert Weiss, Ph.D.
Department of Neuropharmacology
Scripps Research Institute
La Jolla, California

James R. West, Ph.D.
Department of Anatomy and Neurobiology
College of Medicine
Texas A&M University Health Sciences Center

Editing, Production, and Project Management

National Institute on Alcoholism and Alcohol Abuse Staff

Office of Scientific Affairs
Charlotte Armstrong, Project Officer
Maureen B. Gardner, Project Officer
Michael Eckardt, Ph.D.
Diane W. Miller, M.P.A.
Kenneth R. Warren, Ph.D.

Contractor Staff

Palladian Partners
Cate Timmerman
Trudy Barnes
Elizabeth Hess, E.L.S.
Catherine Rankin
Peter Taylor

Market Experts
Karen McGuinness
Maureen Berg
Kristen Dill

Many NIAAA scientific staff members contributed their time and expertise to ensure the accuracy of this report. These include individuals who wrote sections of the report and are listed as contributors. In addition, the following NIAAA staff members are due particular thanks for the extent of the effort they devoted to reviewing manuscripts and providing guidance on the content: Mary Dufour, M.D., M.P.H., Kenneth R. Warren, Ph.D., Gregory Bloss, M.A., Susan Farrell, Ph.D., Laurie Foudin, Ph.D., Richard Fuller, M.D., Jan Howard, Ph.D., Robert Huebner, Ph.D., Antonio Noronha, Ph.D., Vishnudutt Purohit, Ph.D., Barbara Smothers, Ph.D., and Samir Zakhari, Ph.D.