Natural gas extraction from shale rock formations, which includes hydraulic fracturing (commonly referred to as “hydrofracking”), is increasingly in the news as the deployment of the technologies has expanded, rural communities have been transformed overnight, public awareness has increased, and regulations are developed. The expanding use of shale gas extraction across the United States occurs in a context in which there are demands to reduce greenhouse gas emissions, desires to decrease dependency on foreign energy, controversies over other energy sources like offshore drilling, nuclear energy, biofuels and the proposed Keystone pipeline, and slower advancements of renewables like wind and solar energy technologies. Public health was not brought into discussions about shale gas extraction at earlier stages; in consequence, the health system finds itself lacking critical information about environmental public health impacts of the technologies and able to address concerns by regulators at the federal and state levels, communities, and workers employed in the shale gas extraction industry.

Shale gas extraction in the United States is an opportunity because of the existence of thermogenic methane reservoirs in geologic formations such as the Marcellus and Utica shale formations. Formerly inaccessible, the higher cost of petroleum based fuels has motivated efforts to extract and market this methane at depths up to 7,000 feet. Because of the geology of the shale—at depths of at least 100 ft and with gas stored within natural fractures or joints rather than in large pools—conventional gas extraction techniques are not effective. Hydrofracturing utilizes technological advances in horizontal drilling and fracturing techniques. It differs from conventional gas extraction techniques in that it involves: higher volume of fracking fluids (millions of gallons of fluid versus less than 100,000 gallons of fluid) to stimulate gas release; directional drilling to access more natural joints; the use of “slickwater” to allow for pumping over 1.5 to 2.0 miles of horizontal pipe; and multi-well pads. Combining these technologies has made gas extraction from organic-rich shale formations economically feasible in the last 15 years.

In many states, the number of permits issued for fracking has increased exponentially in the last few years. Other states, such as New York, have required an individual, site-specific environmental review while the state formulates its own guidance or even, in the case of
Maryland, issued a moratorium on permits until such approaches can be developed. Generally regulators have focused on the potential hazards with the fracturing fluid (“slickwater”), which is water with chemicals added to reduce the friction of the water in underground channels. Hydrofracking chemicals include those designed to keep fracture channels opened (proppants and biocides), gelling agents (to increase the viscosity), anti-corrosives, friction reducers, and acids. Regulators also have been concerned about how the expansion of shale gas extraction activities increases noise, air, and light pollution in an area, and the potential for accidental releases of hazardous material into the air and groundwater. Also, these activities have been known to create local seismic activity. In public health, there is an increasing awareness of the importance of a “health in all policy” approach to protecting human health while ensuring economic growth. Central to this is the use of health impact assessments to inform decisions by providing a structured process that uses scientific data, professional expertise, and stakeholder input to identify and evaluate the public health consequences of proposals. In 2011 the NRC published a report “Improving Health in the United States: The Role of Health Impact Assessment” that provides recommendations for how properly-conducted health impact assessments can help minimize adverse health effects and optimize beneficial ones. If anything, the pressures that have led to the rapid deployment of hydrofracturing for shale gas extraction—high costs of energy, economic pressures, and the need to reduce greenhouse gas emissions—will only grow more acute with time. The advancement of new technologies for energy production requires a holistic approach to sustainable economic growth that fully considers health impacts.

This workshop will focus on shale gas extraction to explore the health impacts of emerging energy technologies and the use of health impact assessments to assess and identify ways to mitigate potential health impacts. Through presentations and discussions, it is expected that Roundtable members, scientists, decision makers and other participants will become better informed on the potential health impacts of fracking; learn lessons from ongoing health impacts assessments, and be better positioned to consider safeguards to protect the public’s health from emerging energy and other technologies.

This workshop is one in a series of workshops sponsored by the Roundtable on Environmental Health Sciences, Research, and Medicine. The Roundtable was established in 1998 to provide a mechanism for parties from the academic, industrial, and federal research perspectives to meet and discuss sensitive and difficult environmental health issues in a neutral scientific setting. The purpose is to foster dialogue and is not intended to provide recommendations.

Registration for this workshop is free. For registration, the updated agenda, or more information, visit www.iom.edu/frackingHIA.
WORKSHOP ON THE HEALTH IMPACT ASSESSMENT OF NEW ENERGY SOURCES: SHALE GAS EXTRACTION. SPEAKER BIOSKETCHES

John Adgate, Ph.D., M.S.P.H., is the chair to the Department of Environmental & Occupational Health at the Colorado School of Public Health. His research focuses on improving exposure assessment in epidemiologic studies – studying the factors that affect the health and illness of entire populations – by documenting the magnitude and variability of human exposure to air pollutants, pesticides, metals and allergens. Some of his research projects have included evaluating methods that might help to reduce lead poisoning in the home, outcomes of long-term exposure to indoor and outdoor air pollutants, and a controlled trial to test an allergen reduction intervention in inner city residences. Dr. Adgate has a Ph.D. in Environmental Health from the University of Medicine and Dentistry of New Jersey - Robert Wood Johnson Medical School and Rutgers University, a Master of Science in Public Health from the University of North Carolina at Chapel Hill School, and a Bachelor of Science in Biology from Calvin College.

John M. Balbus, M.D., M.P.H., serves as senior advisor for public at the National Institute of Environmental Health Sciences (NIEHS). He also leads NIEHS efforts on climate change and human health. In this capacity he serves as Department of Health and Human Services principal to the U.S. Global Change Research Program, for which he also co-chairs the Interagency Cross-Cutting Group on Climate Change and Human Health. Dr. Balbus has authored studies and lectures on global climate change and health, transportation-related air pollution, the toxic effects of chemicals, and regulatory approaches to protecting susceptible subpopulations. Before joining NIEHS, Dr. Balbus was Chief Health Scientist for the non-governmental organization Environmental Defense Fund. He served on the faculty of The George Washington University, where he was founding Director of the Center for Risk Science and Public Health, founding co-Director of the Mid-Atlantic Center for Children's Health and the Environment, and Acting Chairman of the Department of Environmental and Occupational Health. He maintains an adjunct faculty appointment at the Johns Hopkins Bloomberg School of Public Health.

Dr. Balbus received his A.B. degree in Biochemistry from Harvard University, his M.D. from the University of Pennsylvania, and his M.P.H. from the Johns Hopkins School of Public Health. In addition to current membership on the Institute of Medicine Roundtable on Environmental Health Sciences, Research and Medicine, Dr. Balbus has also served as a member of the EPA Science Advisory Board, the National Research Council's Board on Environmental Studies and Toxicology and the EPA Children's Health Protection Advisory Committee. He is a member of the American College of Physicians, the American Public Health Association, and the Society of Toxicology.

Jamie Bartram, Ph.D., is a professor of environmental sciences and engineering in the Gillings School of Global Public Health of the University of North Carolina (UNC) at Chapel Hill and founding director of the Water Institute at UNC. He has worked in diverse areas of public health and disease prevention, especially in relation to environment and health and water supply and sanitation. From 1998 to 2009, he worked at the World Health Organization’s Headquarters, leading the Water, Sanitation, Hygiene, and Health Unit and the Unit for Assessing and
Managing Environmental Risks to Health. Jamie was awarded the IWA (International Water Association) Grand Award in 2004 for international leadership in development and application of evidence based policy and good practice. He is an Honorary Professor at the University of Wales at Aberystwyth and a Visiting Professor at the Universities of Bristol and Surrey, UK. Jamie is an author of more than 60 academic papers and more than 40 book chapters, and editor of around 25 books including aspects of global monitoring, water supply, sanitation, and pollution. He received a Ph.D. in environmental and public health and a B.Sc. in microbiology from the University of Surrey.

David J. Carey, Ph.D., is Associate Chief Research Officer, Director, and Senior Scientist of the Sigfried and Janet Weis Center for Research at the Geisinger Health System. Dr. Carey has extensive research experience in the areas of cellular and molecular biology, and is now extensively engaged in genomics research on vascular disease and other areas. He has served as a key player in the development of translational genomics research at Geisinger since 2004. Dr. Carey received his Ph.D. from St. Louis University.

David Cole, M.S., is Regional Discipline Leader for Production Technology for Shell’s Upstream Americas Business Unit. In this role, he oversees the activities of Shell’s 200 production engineers in the Americas. David joined Shell in 1981 as a Production Engineer. He spent the next 10 years being responsible for conventional and unconventional fields in Shell’s Onshore and Offshore businesses. David then moved to Shell’s Bellaire Research Center where he was a member of a team positioning Shell for its entrance into the Deepwater. In 1993, David transferred back to a production engineering technical specialist before becoming a superintendent with engineering and operations responsibilities for drilling, completions, and well interventions. Following the creation of the Americas Region in 2003, David became completion and wells services engineering manager for the region. Moving back into the technology arena, he then headed up the region’s Technology Planning and Implementation team, with responsibility for developing new capabilities for the region. Prior to his current assignment, David was operations manager with responsibility for three of Shell’s platforms in the Gulf of Mexico. David has a bachelor’s degree in mechanical engineering from Mississippi State University and a master’s degree in petroleum engineering from Louisiana State University.

Rob Donnelly, MBChB, MFOM, grew up in Perth Scotland and studied Medicine at Edinburgh University. He joined the Royal Army Medical Corps and spent six years in a variety of roles, with the Infantry in Northern Ireland and London, Army hospitals in Hong Kong and London and finally a mobile armored field unit in the West of England. He completed training in Family Medicine before leaving the Army to train in Occupational Medicine at British Steel in South Wales. After six years in a variety of roles in the Steel Industry he moved to Shell in Aberdeen working in the offshore Exploration and Production sector. A move to Houston Texas followed where for four years he led Shell Health Services in the Americas. This involved multiple business units in 34 countries.

In March 2007 he moved the Hague Netherlands to assume his current position as Vice President Health for Royal Dutch Shell. He is accountable for 650 staff in 130 countries where Shell has operational interests. A particular area of focus is operations and the potential impact on health of a community.
SPEAKER BIOSKETCHES

His professional interests include fitness to work and environmental health. He has published a number of articles on occupational medicine and health and the workplace.

Eric Esswein, M.S.P.H., is a senior industrial hygienist with the NIOSH Western States Office in Denver, CO. He conducts field-based research in oil and gas exploration and production. Eric has been a Commissioned Officer in the U.S. Public Health Service since 1991 when he joined NIOSH as an industrial hygienist with the Hazard Evaluations and Technical Assistance Branch (HETAB) in Cincinnati before transferring to the NIOSH Denver Field Office in 1998. He earned a bachelor’s degree in environmental health and toxicology from Huxley College of the Environment at Western Washington University and a master’s degree in public health with an emphasis in industrial hygiene from the University of Utah.

Richard A. Fenske, Ph.D., M.P.H., is professor and Associate Chair of Environmental and Occupational Health Sciences at the University of Washington, and has served as Director of the NIOSH-supported Pacific Northwest Agricultural Safety and Health Center since 1996. He is a core faculty member of the NIEHS-supported Center for Ecogenetics and Environmental Health. He also served as Deputy Director of the EPA/NIEHS-supported UW Center for Child Environmental Health Risks Research from 1996-2003, and Director of the UW Field Research and Consultation Group from 1992-1996.

Dr. Fenske currently serves on several federal advisory boards and committees: the U.S. Environmental Protection Agency’s primary advisory group, the Science Advisory Board; the National Academy of Sciences/Institute of Medicine Committee to Review the Health Effects in Vietnam Veterans of Exposure to Herbicides; and the 16-member EPA Human Studies Review Board, which evaluates the science and ethics of studies involving human subjects. He is also on the editorial boards of the Journal of Agricultural Safety and Health, and the Journal of Exposure Science and Environmental Epidemiology.

Dr. Fenske teaches courses in the areas of environmental health risk assessment, environmental sampling and analysis, exposure science, and public health policy related to pesticide use. From 1984-1990 Dr. Fenske was Assistant Professor and then Associate Professor of Environmental Sciences at Rutgers University and the New Jersey Agricultural Experiment Station. He received his doctoral degree and master’s in public health from UC Berkeley in Environmental Health Sciences. He was also awarded the master’s degree in geography from UC Berkeley and a master’s degree in comparative religion from Columbia University in New York. His bachelor’s degree is in history from Stanford University.

Michael Focazio, Ph.D., received his doctorate from the University of Cincinnati in 1988 specializing in watershed modeling. After a short time as environmental scientist for the Interstate Commission on the Potomac River Basin, Mike joined the U.S. Geological Survey (USGS) as a hydrologist in the Virginia Water Science Center. He served as the program coordinator for the USGS/National Park Service Water Quality Partnership for several years and is presently the associate coordinator for the Toxic Substances Hydrology Program in the Energy, Minerals, and Environmental Health Mission Areas. Mike is an instructor in the Johns Hopkins University Advanced Academic Programs, Kreiger School of Arts and Sciences and is the past USGS Liaison to the U.S. Environmental Protection Agency's Office of Groundwater and Drinking Water. He is presenty an appointed board member for the Water and Sanitation Authority of Fauquier County, VA.
Lynn R. Goldman, M.D., M.P.H., a pediatrician and an epidemiologist, is Dean of and Professor at the School of Public Health and Health Services at George Washington University. Prior to her move to GWU, Dr. Goldman was a professor of Environmental Health Sciences at the Johns Hopkins University Bloomberg School of Public Health. Her areas of focus are children’s environmental health research, public health preparedness, and environmental health policy. She had joint appointments in the Departments of Health Policy and Management and Epidemiology and in Emergency Medicine at the Johns Hopkins School of Medicine.

From 1993-1998, Dr. Goldman served as Assistant Administrator for the EPA’s Office of Prevention, Pesticides and Toxic Substances (OPPTS). In that position she was responsible for the nation's pesticide, toxic substances and pollution prevention laws. In this job she was responsible for managing a number of complex regulatory and science issues. Her achievements included: expanding the Toxics Release Inventory, reauthorizing the nation’s pesticides laws (Food Quality Protection Act of 1996); and development of a framework for the regulation of biotechnology chemical and pesticide products. She led consensual processes that developed frameworks for testing of high volume industrial chemicals and for identification of chemicals that disrupt endocrine systems.

Between 1985-1993, Dr. Goldman served at the California Department of Health Services, most recently as head of the Division of Environmental and Occupational Disease Control. She led public health efforts to respond to emergencies such as earthquakes and unintentional releases of pesticides in communities. She conducted public health investigations on pesticides, childhood lead poisoning and other environmental hazards.

She has a B.S. from UC Berkeley, an M.P.H. from the Johns Hopkins University School of Public Health, an M.D. from UC San Francisco, and pediatric training at Children’s Hospital, Oakland, California. She has served on numerous boards and expert committees, including the Committee on Environmental Health of the American Academy of Pediatrics and the Centers for Disease Control Lead Poisoning Prevention Advisory Committee. Dr. Goldman is a member of the Institute of Medicine and vice chairman of the Institute of Medicine Roundtable on Environmental Health Sciences.

Bernard D. Goldstein, M.D., is emeritus professor of environmental and occupational health and former dean of the University of Pittsburgh Graduate School of Public Health. He is a physician, board certified in Internal Medicine, Hematology and in Toxicology. Dr Goldstein is author of over 150 publications in the peer-reviewed literature, as well as numerous reviews related to environmental health. He is an elected member of the National Academies of Science Institute of Medicine (IOM) and of the American Society for Clinical Investigation. His experience includes service as Assistant Administrator for Research and Development of the U.S. Environmental Protection Agency, 1983-1985. In 2001 he came to the University of Pittsburgh from New Jersey where he had been the founding director of the Environmental and Occupational Health Sciences Institute, a joint program of Rutgers University and Robert Wood Johnson Medical School. He has chaired more than a dozen National Research Council and IOM committees primarily related to environmental health issues. He has been president of the Society for Risk Analysis; and has chaired the NIH Toxicology Study Section, EPA’s Clean Air Scientific Advisory Committee, the National Board of Public Health Examiners, and the Research Committee of the Health Effects Institute. He has also served as a member or chairperson of numerous national and international scientific advisory committees for government, industry and environmental groups.
George Gray, Ph.D., is professor in the Department of Environmental and Occupational Health and Director of the Center for Risk Science and Public Health at The George Washington University School of Public Health and Health Services (SPHHS). In both academic and policymaking settings, Dr. Gray has long been committed to the effective use of science to inform public health choices, and emphasizes the importance of communicating those choices effectively to citizens, journalists, and lawmakers.

Prior to joining SPHHS in 2010, Dr. Gray served as assistant administrator for the EPA’s Office of Research and Development and as the agency science advisor, promoting scientific excellence in EPA research, advocating for the continuing evolution of the agency’s approach to analysis, and encouraging programs that provide academic research to support EPA’s mission. His areas of focus included nanotechnology, ecosystem research, the influence of toxicology advances on testing and risk assessment, and sustainability. From 2005 to 2009, Professor Gray was executive director of the Harvard Center for Risk Analysis, and a member of the faculty at the Harvard School of Public Health. In addition to teaching, he applied the tools of risk analysis to public health problems ranging from mad cow disease to pesticides in food to the risks and benefits of fish consumption.

Dr. Gray received his Doctor of Philosophy and Master of Science in toxicology from the University of Rochester School of Medicine and his Bachelor of Science in biology from the University of Michigan.

Dan Greenbaum, M.C.P., joined the Health Effects Institute (HEI) as its President and Chief Executive Officer in 1994. In that role, he leads HEI’s efforts, supported jointly by US EPA and industry, with additional funding from U.S. DOE, Federal Highway Administration, U.S. AID, the Asian Development Bank, and foundations, to provide public and private decision makers – in the US, Asia, Europe, and Latin America - with high quality, impartial, relevant and credible science about the health effects of air pollution to inform air quality decisions in the developed and developing world.

Greenbaum has been a member of the National Research Council (NRC) Board of Environmental Studies and Toxicology and vice chair of its Committee for Air Quality Management in the United States. He recently served on the NRC Committee on The Hidden Costs of Energy and serves currently on their Committee on Science for EPA’s Future. Greenbaum also chaired the EPA Blue Ribbon Panel on Oxygenates in Gasoline which issued the report Achieving Clean Air and Clean Water and EPA’s Clean Diesel Independent Review Panel, which reviewed technology progress in implementing the 2007 Highway Diesel Rule. In May 2010, Greenbaum received the Thomas W. Zosel Outstanding Individual Achievement Award from the U.S. EPA for his contributions to advancing clean air. Greenbaum holds Bachelor's and Master's degrees from MIT in City Planning.

Charles G. "Chip" Groat, Ph.D., holds the John A. and Katherine G. Jackson Chair in Energy and Mineral Resources in the UT Department of Geological Sciences and is Director of the Center for International Energy and Environmental Policy and the Energy and Mineral Resources Graduate Program. He joined the Department of Geological Sciences in June 2005 after serving for six-and-a-half years as Director of the U.S. Geological Survey, appointed by President Clinton and retained by President Bush. He also has faculty appointments in the LBJ School of Public Affairs and the Department of Petroleum and Geosystems Engineering. At the U.S. Geological Survey he emphasized integrated scientific approaches to understanding
complex natural systems and the use of these understandings in management decisions regarding these systems, an interest that continues at the university.

His degrees in geology are from the University of Rochester (A.B.), University of Massachusetts (M.S.), and The University of Texas at Austin (Ph.D.).

**Steven Hamburg, Ph.D.**, is Chief Scientist at the Environmental Defense Fund. He is an ecosystem ecologist specializing in biogeochemistry and the impacts of disturbance on forest structure and function. From 1994-2010 he was a tenured member of the Brown University faculty. He was founding Director of the Global Environment Program at the Watson Institute for International Studies (program disbanded). He has published more than 80 scientific papers related to ecosystem science and serves on numerous national and international science panels, including receiving explicit recognition from the IPCC for his work contributing to the awarding of the 2007 Nobel Peace Prize. He was a Bullard Fellow at Harvard University and he currently serves as Co-chair of a Royal Society's Solar Radiation Management Governance Initiative, is a member of the USDA FACA advising the Secretary of Agriculture on Research, Extension, Economics and Education. He twice received the EPA's Environmental Merit award.

**Michael Honeycutt, Ph.D.**, is the director of the Toxicology Division of the Texas Commission on Environmental Quality (TCEQ). He has been employed by the TCEQ since 1996 and has managed the division of 14 toxicologists since 2003. His responsibilities include overseeing health effects reviews of air permit applications, overseeing the review of the results of ambient air monitoring projects, and overseeing the reviews of human health risk assessments for hazardous waste sites. Dr. Honeycutt spearheaded the updating of TCEQ’s Effects Screening Levels (ESLs), or toxicity factors for chemicals. The current TCEQ ESL derivation procedure has been through two independent external scientific peer reviews and multiple rounds of public comment (http://www.tceq.texas.gov/toxicology/esl/guidelines/about.html). Dr. Honeycutt serves as a technical resource for TCEQ management and staff on issues concerning air and water quality, drinking water contamination, and soil contamination. He also serves as an expert witness in public and state legislative hearings, participates in public meetings, and has conducted hundreds of media interviews.

Dr. Honeycutt is an adjunct professor at Texas A&M University, has published numerous articles in the peer-reviewed literature, serves or has served on numerous external committees, and has provided invited testimony at Congressional hearings.

**Robert Jackson, Ph.D., M.S.**, is the Nicholas Chair of Global Environmental Change and a professor in the Biology Department and Nicholas School of the Environment and Earth Sciences at Duke University. His research examines feedbacks between people and the biosphere, including studies of the global carbon and water cycles, biosphere/atmosphere interactions, and global change. He is currently Director of Duke's Center on Global Change and Duke's Stable Isotope Mass Spectrometry Laboratory. In his quest for solutions to global warming, he also directs the new Department of Energy-funded National Institute for Climatic Change Research for the southeastern U.S. and co-directs the Climate Change Policy Partnership, working with energy and utility corporations to find practical strategies to combat climate change.

Jackson has received numerous awards, including the Murray F. Buell Award from the Ecological Society of America, a 1999 Presidential Early Career Award in Science and Engineering from the National Science Foundation, a Fellow in the American Geophysical
Richard J. Jackson, M.D., M.P.H., is a professor and chair of environmental health sciences at the University of California, Los Angeles. He has worked extensively on the impact of the environment on public health, and over the last decade much of his work has focused on how the built environment affects health. In 2004, he was co-author of Urban Sprawl and Public Health. Dr. Jackson is currently working on policy analyses of environmental impacts on health, from chemical body burdens to climate change to urban design. In addition, he is evaluating the effects of farming, education, housing, and transportation policies on health. Dr. Jackson chaired the American Academy of Pediatrics Committee on Environmental Health and recently served on the Board of Directors of the American Institute of Architects. He serves on the editorial boards of the American Journal of Industrial Medicine, Environmental Research, and Public Health Reports. He is a member of the Institute of Medicine Roundtable on Environmental Health Sciences, Research, and Medicine and of the National Research Council Committee on “Sustainable” Products and Services. Dr. Jackson earned his M.D. from the University of California, San Francisco.

Timothy Kelsey, Ph.D., is a professor of agricultural economics at The Pennsylvania State University. He conducts research on issues such as economic and community implications of Marcellus Shale, public finance and taxation, and land use change. Through Penn State Cooperative Extension, Dr. Kelsey teaches workshops statewide to local government officials, citizens, and others interested in community issues. He has been at Penn State since 1991, and began actively working on Marcellus issues in 2008.

Suzette Kimball, Ph.D., is internationally known for work in coastal processes and is the United State Geological Survey (USGS). Dr. Kimball was named Associate Director for Geology in 2008, coming to that position from being the Director of the Eastern Region since 2004. Dr. Kimball joined the USGS as Eastern Regional Executive for Biology. In that position, she built many partnerships, helped shape programs, and led the establishment of the USGS Florida Integrated Science Center. She came to the USGS from the National Park Service in Atlanta, where she was Associate Regional Director. She entered the National Park Service as a research coordinator in the Global Climate Change Program, became Southeast Regional Chief Scientist, then Associate Regional Director. She was assistant professor of environmental sciences at the University of Virginia, co-director of the Center for Coastal Management and
Policy and marine scientist at the Virginia Institute of Marine Science, and managed coastal morphology and barrier island studies in the U.S. Army Corps of Engineers.

Dr. Kimball has authored numerous publications on barrier island dynamics, coastal ecosystem science, coastal zone management and policy, and natural resource exploration, evaluation, and management. She has received the Presidential Rank Award and the Secretary of the Interior's Meritorious Service Award. Dr. Kimball has a doctorate degree in environmental sciences with a specialty in coastal processes from the University of Virginia, a master's degree in geology and geophysics from Ball State University, and a bachelor's degree in English and geology from the College of William & Mary.

Linda A. McCauley, Ph.D., R.N., FAAN, FAANOH, is the sixth dean of Emory University’s Nell Hodgson Woodruff School of Nursing. She began her appointment in May 2009 after serving as the associate dean for research at the University of Pennsylvania’s School of Nursing. Dr. McCauley holds a secondary appointment in the Rollins School of Public Health at Emory University and is internationally recognized for her scholarship in environmental and occupational health. She has devoted much of her distinguished career to identifying culturally-appropriate interventions to decrease the impact of environmental and occupational health hazards for workers and young children. McCauley is currently leading two studies in Oregon and Florida with funding from the National Institutes of Health and the Centers for Disease Control and Prevention.

McCauley is an elected member of the Institute of Medicine of the National Academies. She also is a fellow of the American Academy of Nursing and the American Academy of Occupational Health Nurses. She has been widely published in the fields of nursing and environmental health. She is a sought-after speaker and has been featured in national publications and broadcasts including Time, Business Week, the Atlanta Journal-Constitution, NPR, and the Weather Channel.

David Michaels, Ph.D., M.P.H., is an epidemiologist and a nationally recognized leader in the scientific community's efforts to protect the integrity of the science on which public health and regulatory policies are based. Before joining OSHA, he was Professor of Environmental and Occupational Health at the George Washington University School of Public Health.

From 1998 to 2001, Dr. Michaels served as Assistant Secretary of Energy for Environment, Safety and Health. In that position, he was the chief architect of the Energy Employees Occupational Illness Compensation Program, the historic initiative to compensate nuclear weapons workers who contracted occupational illnesses as a result of exposure to radiation, beryllium, and other hazards. The program has provided more than $6 billion in payments to sick workers and the families of deceased workers.

In 2006, Dr. Michaels was awarded the American Association for the Advancement of Science's Scientific Freedom and Responsibility Award, and, in 2009, the John P. McGovern Science and Society Award given by Sigma Xi, the Scientific Research Society, for his work in scientific integrity and for gaining compensation for nuclear weapons workers.

Dr. Michaels is the author of studies examining the health of construction workers, printers, bus drivers, and other occupations, as well as of numerous publications on science and regulatory policy. He is a graduate of the City College of New York, and holds a Master of Public Health and Ph.D. from Columbia University.
Jennifer Orme-Zavaleta, Ph.D., has been with EPA for 30 years, working in the areas of human health and ecological research, risk assessment, policy and regulation development, strategic planning, and program implementation. The focus of her experience includes the evaluation of risks to human and ecosystem health, and the influence of environmental change on human health in response to a variety of stressors including synthetic organic and inorganic chemicals, radionuclides, microorganisms, and vector-borne disease. She has worked in the Offices of Research and Development, Pesticides and Toxic Substances, and Water.

As interim NPD for SSWR, she lead the realignment of the former drinking water and water quality research programs to form a holistic research program that maximizes responsiveness to the rapidly changing needs of the Agency’s water program, Regional Offices, and other critical water resource partners and stakeholders.

During her career, she has been involved with the risk assessment practices within the Agency, and the national and international scientific community. As a member of EPA’s Risk Assessment Forum Technical Panel she was one of several scientists who developed the Guideline for Reproductive Risk Assessment, Guideline for Implementation of EPA’s Cancer Risk Assessment Guidelines, and Guideline for Assessing Risk from Less than Lifetime Exposures. She has also served as the manager of EPA’s Drinking Water Health Advisory Program, leading the development of over 120 health advisories (HAs) for inorganic, organic, pesticides, munitions, and microbial contaminants. These assessments have been used by the World Health Organization to develop guidelines for drinking water quality and also serve as the basis for unreasonable risk to health determinations for US public water supplies when regulatory violations occur.

Bob Perciasepe, M.Pl., M.P.A., returned to the U.S. Environmental Protection Agency to serve as Deputy Administrator—the nation’s second ranking environmental official and the agency’s chief operating officer—with his appointment by President Obama in 2009. In this role, he continues a career spanning nearly four decades as one of the nation’s leading environmental and public policy figures. An expert on environmental stewardship, advocacy, public policy, and national resource and organizational management, Perciasepe is widely respected within both the environmental and U.S. business communities.

His extensive experience includes service both inside and outside of government. He served as a top EPA official in the administration of President Bill Clinton, who appointed him, first, to serve as the nation’s top water official and later as the senior official responsible for air quality across the U.S. Prior to being named to his current position, he was chief operating officer at the National Audubon Society, one of the world’s leading environmental organizations. He has also held top positions within state and municipal government, including as Secretary of the Environment for the State of Maryland and as a senior official for the City of Baltimore.

Perciasepe holds a Bachelor of Science degree in Natural Resources from Cornell University and master's degree in planning and public administration from the Maxwell School of Syracuse University. He and his wife have two adult daughters.

Christopher J. Portier, Ph.D., joined CDC in 2010 as the Director of the National Center for Environmental Health and Agency for Toxic Substances and Disease Registry. Dr. Portier came to CDC from the National Institute of Environmental Health Sciences (NIEHS), where he was the Senior Advisor to the Director and a Principal Investigator in environmental systems biology. Formerly, Dr. Portier was Associate Director of NIEHS, Director of the Environmental Toxicology Program at the NIEHS, and Associate Director of the National Toxicology Program.
Dr. Portier is an internationally recognized expert in the design, analysis, and interpretation of environmental health data. His research efforts and interests include such diverse topics as cancer biology, risk assessment, climate change, bioinformatics, immunology, neurodevelopment, genetically modified foods, and genomics. From 2000 to 2006, he managed the NTP and developed a strategic initiative that is internationally recognized for its innovation. He has contributed to the development of cancer risk assessment guidelines for national and international agencies and has either directed or contributed significantly to numerous risk assessments. He led the U.S. evaluation of electromagnetic fields by national and international scientists, which was the first comprehensive review in this field. Dr. Portier directed efforts of the U.S. government to develop a collaborative research agenda with Vietnam on the health effects of Agent Orange in that country. He has just directed a multiagency review of research needs for the health effects of climate change for the entire U.S. government.

Dr. Portier received his B.Sc. degree (1977) in mathematics (summa cum laude) and his M.S. (1979) and Ph.D. (1981) degrees in biostatistics. He has authored more than 150 peer-reviewed publications, 30 book chapters, and 40 technical reports. In the past 5 years, he has given more than 70 invited lectures, many of them at international meetings.

Allen Robinson, Ph.D., has conducted research examining the technical and policy issues related to energy and the environment. A current focus is fine particulate matter – 50,000 Americans are estimated to die prematurely each year from fine particle pollutant and almost 70 million people in the United States live in areas that violate the National Ambient Air Quality Standard for fine particle mass. Atmospheric particles also have a controlling influence on Earth’s climate and degrade visibility.

A major thrust of Dr. Robinson’s research is characterizing fine particle emissions from combustion systems such as diesel engines. Laboratory experiments using dilution samplers and a smog chamber have revealed a dynamic new picture for primary organic aerosol emissions, in which these emissions evaporate, oxidize, and recondense over time. These findings require updated approaches to measure and simulate emissions from combustion systems. His group is working to implement this revised framework into chemical transport models to investigate its implications on our understanding of urban, regional and global air quality. This modeling has revealed a potentially important new source of regional oxidized and presumably hydrophilic organic aerosol. Work is ongoing to better understand the health consequences and climate effects of these pollutants.

Dr. Robinson joined Carnegie Mellon in 1998 after working for two years as a Postdoctoral Fellow at the Combustion Research Facility at Sandia National Laboratories. He received his Ph.D. from the University of California at Berkeley in Mechanical Engineering in 1996 and his B.S. in Civil Engineering from Stanford University in 1990. Dr. Robinson received the Ahrens Career Development Chair in Mechanical Engineering from Carnegie Mellon University in 2005 and the George Tallman Ladd Outstanding Young Faculty Award from Carnegie Mellon University in 2000.

Deborah Swackhamer, Ph.D., is an environmental chemist with an emphasis in aquatic chemistry. She manages the University of Minnesota Water Research Center’s research and
educational programs, including overseeing the Water Resources Research Institute grants program for the U.S. Geological Survey and developing research and educational opportunities for the center. She is a professor of environmental chemistry in the University of Minnesota's School of Public Health and holds the Charles M. Denny Chair of Science, Technology, and Public Policy in the University's Humphrey Institute of Public Affairs.

Dr. Swackhamer received her B.A. in chemistry from Grinnell College and her M.S. in water chemistry and Ph.D. in limnology and oceanography from the University of Wisconsin-Madison. Her research focuses on the chemical and biological processes that control the fate of toxic organic contaminants in the environment, environmental exposure, and risk assessment.

Ann Sweeney, Ph.D., M.P.H., currently serves as professor of epidemiology & biostatistics at the Texas A & M Health Science Center. Her research interests include environmental and occupational exposures to toxic agents and the relation to adverse reproductive effects, particularly infertility, early pregnancy loss, and congenital anomalies. Dr. Sweeney has had extensive experience conducting large population-based studies of cohorts exposed to endocrine active compounds, including PCBs, PBBs, dioxin, and phthalates, and their effects on pregnancy outcome. She is currently the Principal Investigator for the Longitudinal Investigation of Fertility and the Environment (LIFE) study's Texas site, funded by the Eunice Kennedy Shriver National Institute of Child Health and Human Development.

In the past, Dr. Sweeney served as a member of the Institute of Medicine's Gulf War and Health Study Committee, on the expert panel assessing the health effects of pesticides. She was also a member of the Fertility and Early Pregnancy Committee, assigned to the National Longitudinal Cohort Study Planning Committee, sponsored by the National Institute of Child Health and Human Development, the National Institute for Environmental Health Sciences, the Centers for Disease Control and Prevention, and the U.S. EPA. Dr. Sweeney served as a member of the EPA Science Advisory Board Environmental Health Committee from 2002-2008. Her service during this interval included membership on several review panels, including Perfluorooctanoic Acid Human Health Risk, Ethylene Oxide Human Health Risk, and the Acrylamide Review panels.

Dr. Sweeney received her Ph.D. from the University of Pittsburgh, Graduate School of Public Health in 1991 and her M.P.H. from the University of Pittsburgh, Graduate School of Public Health in 1988.

Aaron Wernham, M.D., the director of the Health Impact Project, a collaboration of the Robert Wood Johnson Foundation and the Pew Charitable Trusts, established to promote and support the use of Health Impact Assessment (HIA) in the United States. Dr. Wernham served on the National Research Council’s Committee on Health Impact Assessment. He has led multiple HIAs and HIA trainings, and advised state and federal agencies around the United States on implementing HIA. Previously, Dr. Wernham worked with the Alaska Native Tribal Health Consortium. In this position, he led a joint state-tribal-federal working group which developed guidance for implementing HIA in Alaska.

Dr. Wernham received his medical degree from the University of California, San Francisco, and his Masters degree in Health and Medical Sciences from University of California, Berkeley. He is board certified in family medicine, and served as clinical faculty in a University of California, Davis family practice residency program.
Roxana Zulauf Witter, M.D., M.S.P.H., M.S., is an assistant research professor in the Department of Occupational and Environmental Health at the Colorado School of Public Health. She led a Health Impact Assessment investigating potential health effects of natural gas development in a residential community in Colorado. She also led the development of a White Paper and Literature Review of Potential Exposure-Related Human Health Effects of Oil and Gas Development. Dr. Witter is Co-Program Director of the Occupational and Environmental Medicine Residency and teaches the Occupational and Environmental Toxicology course at Colorado School of Public Health. Dr. Witter is board certified in Occupational and Environmental Medicine and spent several years in clinical practice.
ROSTER OF ROUND TABLE ON ENVIRONMENTAL HEALTH SCIENCES, RESEARCH, AND MEDICINE

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NIOSH FIELD EFFORT TO ASSESS CHEMICAL EXPOSURE RISKS TO GAS AND OIL WORKERS

BACKGROUND
There is a lack of existing information regarding the variety and magnitude of chemical exposure risks to oil and gas extraction workers. To determine if risks are present, NIOSH wants to develop partnerships with the oil and gas extraction industry to identify, characterize and (if needed) control workplace chemical exposures. This work will occur as part of the NIOSH Oil and Gas Extraction Safety and Health Program, which seeks to prevent injuries and illnesses among oil and gas extraction workers. Strategic objectives include identifying possible exposures, determining risk, and preventing chemical exposures to workers involved in oil and gas extraction industry.

PURPOSE
The goals of this NIOSH field effort include: 1) identifying processes and activities where chemical exposures could occur; 2) characterizing potential exposures to vapors, gases, particulates and fumes (e.g., solvents, diesel particulate, crystalline silica, acids, metals, aldehydes, and possibly other chemicals identified during the study); 3) depending on results of the field effort, recommending safe work practices and/or proposing and evaluating exposure controls (to include engineering controls, substitution, and personal protective equipment).

WHO CAN PARTICIPATE

Workers, managers, supervisors, and health and safety professionals involved in oil and gas drilling and servicing operations are encouraged to participate in the field effort.

BENEFITS OF PARTICIPATION

Companies can leverage the industrial hygiene expertise of a NIOSH field research team to help identify if chemical exposure risks are present or absent, and based on results of field studies, prioritize and control potential workplace chemical exposures at their worksites. Data and results collected by NIOSH in the field effort will be communicated to the company in letter format. Become involved with NIOSH and be seen as a leader in occupational safety and health in the gas and oil industry.

NOTE: This Field Research Effort will be fully funded by NIOSH; there is no cost to participate. NIOSH is a part of the Centers for Disease Control and Prevention (CDC). NIOSH is a federal agency responsible for conducting research and providing guidance related to occupational health and safety. NIOSH is not a regulatory agency. Federal regulations provide for trade secret protection for participating companies.

HOW TO BECOME INVOLVED

To learn more about the Field Effort to Characterize Chemical Exposures in Oil and Gas Extraction Workers, contact Eric Esswein, CIH, at (303) 236–5946, or submit inquiries electronically or by mail to: eje1@cdc.gov or Eric Esswein, NIOSH, Denver Federal Center, P.O. Box 25226 Denver, CO. 80225
IMPROVING HEALTH IN THE UNITED STATES

The Role of Health Impact Assessment

Committee on Health Impact Assessment
Board on Environmental Studies and Toxicology
Division on Earth and Life Studies
National Research Council

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Summary

Many Americans believe that the United States has one of the best health-care systems in the world and that consequently Americans enjoy better health than most of the world’s populations. The data, however, do not support that belief. In fact, the United States is ranked 32nd in the world in life expectancy even though it is ranked third in total expenditures on health care as a percentage of gross domestic product (GDP). Clearly, good health is determined by more than money spent on the health-care system. In fact, a growing body of research indicates that living conditions—including such factors as housing quality, exposure to pollution, and access to healthy and affordable foods and safe places to exercise—have a greater effect on health. That research highlights the importance of considering health in developing policies, programs, plans, and projects, including ones that may not appear at first to have an obvious relationship to health.

Health impact assessment (HIA) has arisen as an especially promising way to factor health considerations into the decision-making process. It has been defined in various ways but essentially is a structured process that uses scientific data, professional expertise, and stakeholder input to identify and evaluate public-health consequences of proposals and suggests actions that could be taken to minimize adverse health impacts and optimize beneficial ones. HIA has been used throughout the world to evaluate the potential health consequences of a wide array of proposals that span many sectors and levels of government. International organizations, such as the World Health Organization and multilateral development banks, have also contributed to the development and evolution of HIA, and countries and organizations have both developed their own guidance on conducting HIA.

Although HIA has not been used widely by decision-makers in the United States, its use has steadily increased over the last 10 years. Local, state, and tribal health departments have conducted HIAs to inform decision-making in other agencies; community-based organizations have conducted HIAs with input from public-health experts to inform officials who are deliberating on legislative or administrative proposals; planning and transportation departments have conducted HIAs to inform their own decisions; and private consultants have con-
ducted HIAs for industry to determine the potential health consequences of various projects. Given the potential health benefits of HIA, the Robert Wood Johnson Foundation, the National Institute of Environmental Health Sciences, the California Endowment, and the Centers for Disease Control and Prevention asked the National Research Council (NRC) to develop a framework, terminology, and guidance for conducting HIA of proposed policies, programs, and projects at the federal, state, tribal, and local levels, including the private sector. As a result of that request, NRC convened the Committee on Health Impact Assessment, which prepared this report.

THE NEED FOR HEALTH-INFORMED DECISION-MAKING

The U.S. population clearly has not reached its full health potential despite major medical advances and large expenditures on health care. Almost 50% of adults suffer from at least one chronic illness, and obesity, which contributes to many health conditions, has grown to epidemic proportions in children and adults. Poor health has implications not only for the quality and duration of life but for the economy. Health-care spending accounted for 7% of U.S. GDP in 1970, accounted for 16% of GDP in 2008, and is projected to account for almost 20% by 2019. Poor health also results in reduced participation in and productivity of the labor force. Thus, the consequences of chronic illness are huge in suffering and monetary and business costs.

Many scientists, policy-makers, and others recognize that health is determined by multiple factors, including factors that shape the conditions in which people are born, grow, live, work, and age. Policies and programs that have historically not been recognized as related to health are now known or thought to have important health consequences. For example, public health has been linked to housing policies that determine the quality and location of housing developments, to transportation policies that affect the availability of public transportation, to urban planning policies that determine land use and street connectivity, to agricultural policies that influence the availability of various types of food, and to economic-development policies that affect the location of businesses and industry. The recognition that health is shaped by a broad array of factors emphasizes the importance of understanding the possible health consequences of decision-making. In fact, it can be argued that major improvements in public health cannot be achieved without considering the root causes of ill health. Indeed, it has been argued that major health problems, such as the obesity epidemic and its associated health and monetary costs, are essentially unintended consequences of various social and policy factors related, for example, to the mass production and distribution of energy-dense foods and the engineering of physical activity out of daily life through changes in how transportation is organized and how neighborhoods are designed and built.

Accordingly, systematic assessment of the health consequences of policies, programs, plans, and projects is critically important for protecting and
Summary

promoting public health; as indicated, lack of assessment can have many unexpected adverse health (and economic) consequences. One striking example is development of the transportation infrastructure in the United States. In 1956, Congress passed the Interstate Highway Act, which resulted in a transportation infrastructure focused on road-building and private automobile use and has shaped land-use patterns throughout the country. The emphasis on motorized transportation has been associated with more driving, less physical activity, higher rates of obesity, higher rates of air pollution, and transportation injuries and fatalities. A partial accounting of the costs of health outcomes wholly or partly associated with transportation indicates that the costs could be as great as $400 billion annually. No one can know how much the costs could have been reduced if health had been integrated into the decision-making. Without a systematic assessment, the health-related effects and their costs to individuals and society are hidden or invisible products of transportation-related decisions.

Several approaches, methods, or tools could be used to incorporate aspects of health into decision-making, but HIA holds particular promise because of its applicability to a broad array of policies, programs, plans, and projects; its consideration of adverse and beneficial health effects; its ability to consider and incorporate various types of evidence; and its engagement of communities and stakeholders in a deliberative process. The following sections define and describe the elements of HIA, the challenges to its practice, and the approaches to advancing it and integrating it into today’s decision-making processes.

**DEFINING HEALTH IMPACT ASSESSMENT AND ITS ELEMENTS**

On the basis of its review of HIA definitions, practice, published guidance, and peer-reviewed literature, the committee recommends the following technical definition of HIA, which is adapted from the definition of the International Association for Impact Assessment:

HIA is a systematic process that uses an array of data sources and analytic methods and considers input from stakeholders to determine the potential effects of a proposed policy, plan, program, or project on the health of a population and the distribution of those effects within the population. HIA provides recommendations on monitoring and managing those effects.

The committee emphasizes that HIA is conducted to inform a decision-making process and is intended to be concluded and communicated in advance of a decision so that the information that it yields can be used to shape a final proposal in such a way that adverse effects are minimized and beneficial ones are optimized. The committee acknowledges that other assessment methods may share some features with HIA, but they do not meet the definition and description of HIA that the committee provides in the present report.
The committee found remarkable consistency regarding the basic elements that are generally included in descriptions of HIA, although they may be organized differently in the stages or steps that are outlined. The committee recommends a six-step framework as the clearest way to organize and describe the elements of HIA. The steps and their outputs are illustrated in Figure S-1; the committee’s conclusions regarding each step are provided below.

**Screening** establishes the need for and value of conducting an HIA and is essential for high-quality HIA practice. The committee concludes that the following factors are the most important to consider in determining whether to conduct an HIA: the potential for substantial adverse or beneficial health effects or irreversible or catastrophic effects, even if the effects have a low likelihood; the ability of information from the HIA to alter a decision or help a decision-maker to discriminate among options; the possibility that a disproportionate burden of the health effects is placed on vulnerable populations; the existence of public concern or controversy regarding health effects of a proposal; the opportunity to incorporate health information into a decision-making process that may not otherwise include such information; and the ability of the HIA team to complete the assessment within the time and with the resources available.

**Scoping** identifies the populations that might be affected, determines which health effects will be evaluated in the HIA, identifies research questions and develops plans to address them, identifies the data and methods to be used and alternatives to be assessed, and establishes the HIA team and a plan for stakeholder participation throughout the HIA process. The credibility of an HIA and its relevance to the decision-making process rest on a systematic evaluation of the full array of potential effects—risks, benefits, and tradeoffs—rather than on a narrow consideration of a subset of issues predetermined by a team’s research interests or regulatory requirements. However, to ensure judicious use of resources, the HIA should ultimately focus on the health effects of greatest potential importance. The committee notes that it is appropriate to include issues that are the subject of community concern even if they appear unlikely to be substantiated by further analysis; such an analysis can provide reassurance to communities even if the eventual conclusions do not support their concerns.

**Assessment** is a process that involves describing the baseline health status of the affected populations and then characterizing the expected effects on health (and its determinants) of the proposal and each alternative under consideration relative to the baseline and each other. In light of the various policies, programs, plans, and projects that are the subject of HIAs, a broad array of data and analytic methods are used to evaluate the potential effects. Often, complete information is not available, and expert judgment plays an important role in the HIA. Whatever approach is taken, an explicit statement of data sources, methods, assumptions, and uncertainty is essential. The committee notes that uncertainty does not negate the value of information. Even when the evidence of an effect is uncertain, describing the potential causal pathways that are based on a
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reasonable interpretation of available data and expert judgment can help to establish a framework for monitoring and managing any impacts that might occur as the proposal is implemented.

**FIGURE S-1** Framework for HIA, illustrating steps and outputs.
Recommendations identify alternatives to the proposal or specific actions that could be taken to avoid, minimize, or mitigate adverse effects or to take advantage of opportunities for a proposal to improve health. Relatively little attention has been paid to the formulation of effective, actionable recommendations, and the committee offers three points for consideration. First, community input is essential for proposals that could have localized effects because it helps to ensure that specific aspects of living conditions and community design that may not be obvious to outside researchers are considered, and it maximizes the probability that the affected community will accept the conclusions and recommendations of the assessment. Second, recommendations are effective only if they are adopted by a decision-maker and implemented. The chances that the recommendations are adopted and implemented will increase if measures are drafted to address identified public-health risks; recognize feasibility issues, practical challenges, and other concerns possibly raised by the decision-maker during the HIA process; and fulfill the requirements of the legal and policy framework governing the decision. Third, recommendations should include the elements of a health-management plan that identifies appropriate indicators for monitoring, an entity with authority or ability to implement each measure, and a mechanism for verifying implementation and compliance. In practice, the HIA team will be asking a decision-maker to consider the findings and recommendations; ultimately, the decision-maker must balance health considerations with the many other technical, social, political, and economic concerns that bear on the proposal.

Reporting is the communication of findings and recommendations to decision-makers, the public, and other stakeholders. At present, there is little uniformity in the content of an HIA report. The committee recommends that, at a minimum, the written HIA report describe the proposed action or policy and alternatives that are the subject of the HIA, document the data sources and analytic methods used, identify the people consulted during the HIA process, and provide a clear, concise, and easily understood description of the process, findings, and recommendations. Furthermore, the reports should be made publicly available. A well-designed dissemination strategy is critical for the success of an HIA, and continuing efforts to inform decision-makers and stakeholders of the findings and recommendations are essential. However, efforts to support health-based recommendations must be carefully distinguished from biased efforts to promote a specific alternative on the basis of a skewed comparison of favorable and unfavorable aspects of a proposal or a predetermined political agenda. Undue bias in an HIA will likely compromise its credibility and efficacy.

Monitoring and evaluation can be characterized by several activities. Monitoring can consist of tracking the adoption and implementation of HIA recommendations or tracking changes in health indicators (health outcomes or health determinants) as a new policy, program, plan, or project is implemented. Evaluation can be process evaluation (evaluation of whether the HIA was conducted according to its plan of action and applicable standards), impact evaluation (evaluation of whether the HIA influenced the decision-making process), or
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outcome evaluation (evaluation of whether implementation of the proposal changes health outcomes or health determinants). Few HIA evaluation data have been published in the United States or elsewhere, and it is not reasonable to expect that decision-makers will adopt HIA widely in the absence of evidence of its effectiveness and value. Consequently, the committee concludes that the lack of attention to evaluation is a barrier that will need to be overcome if HIA is to be advanced in the United States and notes that unbiased evaluation of its effectiveness and value will require participation of evaluators independent of the HIA team, stakeholders, decision-makers, and fiscal sponsors.

The committee emphasizes that the definitions and criteria recommended here should not be considered rigid requirements but rather reflect an ideal of practice. Given the broad array of applications and the resources and time available for HIA, deviations are expected, but they should be justified by a clear and well-articulated rationale. The committee also notes that HIA should not be assumed to be the best approach to every health-policy question but should be seen as part of a spectrum of public-health and policy-oriented approaches; the most appropriate will depend on the situation and decision-making context.

CHALLENGES AHEAD FOR HEALTH IMPACT ASSESSMENT

The committee identified several challenges for the successful emergence, development, and practice of HIA. Many are related to various aspects of HIA practice and are noted below with the committee’s suggestions for possible resolutions.

Defining health and the boundaries for HIA. As noted above, there is a growing consensus that individual health and public health are shaped by genetic, behavioral, social, economic, and environmental factors. Therefore, the committee concludes that HIA practice should not be restricted by a narrow definition of health or restricted to any particular policy sector (for example, education, urban planning, or finance), level of government (federal, state, tribal, or local), type of proposal (policy, program, project, or plan), or specific health outcome or issue (for example, asthma or obesity). There is no evidence to suggest that HIA is more important, appropriate, or effective in any particular decision context. On the contrary, HIA may be useful in a broad array of decision contexts, including many decision types to which it has not yet been applied. Accordingly, HIA should be focused on applications that present the greatest opportunity to protect or promote health and to raise awareness of the health consequences of decision-making. Because there are few legal mandates for HIA in the United States, it is most often conducted as a voluntary practice. As such, it will be difficult to ensure that decisions that could have the greatest impact on health are selected for evaluation. Thus, the current ad hoc approach to conducting HIA may result in less useful applications. The committee concludes that any future policies, standards, or regulations for HIA should include explicit criteria for identifying and screening candidate decisions and rules for providing
oversight for the HIA process; such criteria and rules would promote the utility, validity, and sustainability of HIA practice.

Balancing the need to provide timely, valid information with the realities of varying data quality. HIA must provide evidence-based findings and recommendations within the practical realities and timelines of the decision-making process; however, HIA practitioners often face substantial challenges regarding data availability and quality. The committee offers three strategies to maximize the validity of findings and recommendations in light of data constraints. First, one should consider diverse types of evidence and use expertise from multiple disciplines. Second, one should critically evaluate the data quality and select the evidence and analytic methods that are the strongest from among those available for a particular decision and context. There are no uniform standards for evaluating all potential evidence used in HIA, given the diverse applications and heterogeneity of data; in the future, criteria for data quality could be developed to characterize the relative strength of evidence and the nature and magnitude of uncertainties. Third, a strategy for assessing, acknowledging, and managing uncertainties is essential for ensuring the credibility of HIA findings and recommendations.

Producing quantitative estimates of health effects. Many expect HIA to produce quantitative estimates of health effects. Quantitative estimates of health effects have a number of desirable properties: they provide an indication of the magnitude of health effects, they can be easily compared with existing numerical criteria or thresholds that define the significance of particular effects, they allow one to make more direct comparisons among alternatives, and they provide inputs for economic valuation. They can be produced when there has been sufficient empirical research on relationships between particular determinants and health outcomes. Relying exclusively on quantitative estimation in HIA, however, presents some drawbacks. First, quantification has high information requirements. Given the breadth of health effects potentially considered in HIA, the sparse data available to support quantitative approaches, and the variability in practitioner capacity, it would be challenging or impossible for all HIAs to predict all potentially important health effects quantitatively. Second, because quantification can be resource-intensive, it may require more time than is practical, given the timeline for decision-making. Third, quantitative estimates may create an unwarranted impression of objectivity, precision, and importance and lead a reader to give credence to quantified results even if assumptions used in the analysis were based on subjective choices. Overall, however, quantitative estimates of health effects have value and should be provided when the data and resources allow and when they are responsive to decision-makers’ and stakeholders’ information needs.

Synthesizing conclusions on dissimilar health effects. Given that HIA analyzes multiple health effects, a practical challenge is synthesizing and presenting results on dissimilar health effects in a manner that is intelligible and useful to

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1In this report, the term HIA practitioners refers to the people conducting the HIA.
Summary
decision-makers and stakeholders. Although summary measures have not been commonly used in HIA practice, they can be used to translate estimated effects on disparate health outcomes into a single comparable unit, such as quality-adjusted life years, disability-adjusted life years, and healthy-years equivalent. Calculating summary measures, however, requires assumptions and weighting schemes that need to be recognized and explained, and summary measures may not allow the integration of all health effects. Therefore, if summary measures are used, the committee recommends that effects—including those excluded from the summary measure—be described and characterized separately with regard to magnitude and significance in a way that allows users to judge their cumulative nature. The relative value of dissimilar health effects can then be considered explicitly or implicitly in the decision-making process.

Ensuring stakeholder participation. Ensuring that stakeholders are able to participate effectively in the HIA process is widely described as an essential element of practice, although stakeholders often are not engaged or are only minimally engaged in the process. That discrepancy can be attributed to several factors, including the time and resources available; the methods, guidance, and standards used to conduct HIA; the importance that the practitioner or sponsor places on stakeholder participation; and a view that stakeholder participation may interfere with or impede progress. However, stakeholder participation is critical for the quality and effectiveness of the HIA. It helps to identify important issues; focus the HIA scope; highlight local conditions, health issues, and potential effects that may not be obvious to practitioners from outside the community; and ensure that recommendations are realistic and practical. Thus, whenever possible, strategies for stakeholder participation should extend beyond some minimal effort and address barriers and challenges to participation.

Ensuring the quality and credibility of HIA. Although HIA is different from primary scientific research, the committee concludes that several aspects of the HIA process could benefit from peer review. Peer review could highlight overlooked issues, identify opportunities to improve data or methods, and increase the legitimacy of conclusions and their acceptance and utility in the decision-making process. A formal peer-review process would need to overcome several obstacles, such as the possible difficulties in assembling the multidisciplinary team that would be needed to perform the review, the substantial delays that could occur in the process, and the current lack of agreed-on evaluation criteria. However, HIA is often conducted on proposals that are contested among polarized and disparate interests and stakeholders, and accusations of bias can arise. Independent peer review could help to ensure that the process by which HIA is conducted and the conclusions and recommendations produced are as impartial, credible, and scientifically valid as possible. The committee notes, however, that some flexibility in the peer-review process would be necessary particularly for cases in which an HIA must be completed rapidly to be relevant to the decision that it is intended to inform.

Managing expectations. HIA clearly is intended to inform decisions and ultimately to shape policy, programs, plans, and projects so that adverse health
effects are minimized and potential health benefits are optimized. The hope is that identifying valid information on a decision’s harms or benefits to health will motivate decision-makers to take protective actions. However, health typically is only one factor in the decision-making process; practical factors—such as cost, feasibility, and regulatory authority—also play a prominent role. And improved knowledge alone cannot necessarily change the ideology, interests, and attitudes of decision-makers. Thus, it is not reasonable to consider HIA successful only if it changes decisions. Furthermore, looking at HIA only as a mechanism for advocacy will compromise the support for and legitimacy of the practice.

Integrating HIA into environmental impact assessment (EIA). The U.S. National Environmental Policy Act (NEPA) and some related state laws explicitly require the identification and analysis of health effects when EIA is conducted. EIA, however, has traditionally included at most only a cursory analysis of health effects. Some argue that health analysis should be integrated into EIA because NEPA and related state laws provide a mechanism for achieving the same substantive goals as HIA. Others contend that EIA has become too rigid to accommodate a comprehensive health analysis and that attention should be focused on the independent practice of HIA. The committee emphasizes that the appropriate assessment of direct, indirect, and cumulative health effects in EIA under NEPA is a matter of law and not discretion, and recent efforts have successfully integrated the HIA framework into EIA. Thus, where legal standards under NEPA or applicable state EIA laws require an integrated analysis of health effects, one should be conducted with the same procedures that would be used to assess any other required factor. Because the steps and approaches of HIA and EIA are compatible, HIA offers an appropriate way to meet the requirement for health analysis under NEPA and related state laws. Although there are some substantive challenges to overcome, the committee concludes that improving the integration of health into EIA practice under NEPA and related state laws is needed and would advance the goal of improving public health.

ADVANCING HEALTH IMPACT ASSESSMENT

Substantial improvements in public health will require a focused effort to recognize and address the health consequences of decisions made at all levels and in all sectors of government. As noted, HIA is a particularly promising approach for integrating health implications into decision-making. International experience and the limited (but growing) experience in the United States provide important clues as to what is needed most to advance HIA.

Societal awareness of and education in HIA. First, the common belief that our health depends only on genetic predisposition, health care, and personal choice is impeding the improvement of public health. Policy-makers and the public need to be educated in the many factors that can affect health, the importance of considering them in all decision-making, and the role that HIA can play in the decision-making process. An education campaign will be necessary to
Summary

secure the resources that will be needed for the development of HIA practice. Second, few U.S. academic institutions offer formal education in HIA. Consequently, there are few professionally trained HIA practitioners in the country, and there is little agreement among them as to what constitutes good practice. High-quality education and training will be vital for the advancement of HIA in the United States. Third, continuing education of HIA professionals, policymakers, and the public will be important for improving the quality of HIA practice in this country. The committee notes that a professional association or society could facilitate continuing education and develop, monitor, and facilitate standards of professional education and practice in HIA.

Structures and policies to support HIA. First, substantial interagency collaboration at the local, state, and federal levels is necessary to conduct HIA of policies, programs, plans, and projects, especially those emanating from non-health sectors, such as transportation, finance, urban planning, education, and agriculture. Such collaboration is essential, given the resource-constrained environments in which makers of public policy and other officials often work. The committee offers several suggestions for promoting interagency collaboration in the present report. Second, systematic use of HIA ultimately will depend on the adoption of policies and legal mandates to integrate health considerations into decision-making. As noted above, NEPA requires the analysis of health effects when EIA is conducted, but the spirit of the requirement needs to be reinvigorated and strengthened. Explicit guidance demonstrating how health considerations could be incorporated into NEPA would be beneficial. The committee emphasizes that policies and legislation outside the context of NEPA will most likely be needed to facilitate the use of HIA.

Research on and scholarship in HIA. First, few evaluations of HIA effectiveness have been conducted in the United States, especially because it has emerged so recently. Because conducting HIA will probably require the investment of substantial public and private resources, research is needed to document HIA practices and their effectiveness in influencing decision-making processes and promoting public health. Second, the quality of HIA could be substantially improved if there were better evidence on the relationship of “distal” factors to health outcomes. For example, research on how health is affected by federal, state, and local policies and actions traditionally considered to be unrelated to health—such as transportation, agriculture, education, housing, financial, and immigration policies—would be extremely beneficial.

The recognition that health is affected by much more than medical care, personal choice and behavior, and genetic predisposition is fundamental for the development and implementation of strategies to improve public health. However, the mere promulgation of a legal requirement to consider health would most likely not result in the health improvements that the United States needs. A tool, method, or approach is needed to facilitate the integration of health into decision-making. HIA is particularly promising in light of its broad applicability, its focus on adverse and beneficial health effects, its ability to incorporate various types of evidence, and its emphasis on stakeholder participation.