Homeland and Health Security:

Understanding Today's Necessities, Tomorrow's Needs

The RTI Fellows Symposium Abstracts and Presenter Biographies

November 6-7, 2003

NC Biotechnology Center
15 Alexander Drive
Research Triangle Park, North Carolina

The RTI Fellow Program

Designed to recognize and integrate the best technical talent at RTI into our business strategy, the Fellow Program provides professional opportunities for exceptionally talented staff who are committed to science in support of RTI's mission. RTI Fellows are active in research projects and serve as consultants in key areas of scientific accomplishment. RTI relies on the Fellows to provide scientific leadership to their colleagues, to their research programs, and to the Institute at large. The Fellow program fosters scientific originality and innovation. In this way, RTI Fellows not only influence the future of RTI, but also enhance the impact of our research on society.

Current members of the RTI Fellow Program are as follows:

Distinguished Fellows

Dr. Paul P. Biemer
Dr. F. Ivy Carroll
Dr. Kathleen N. Lohr

Fellows

Dr. Derick W. Brinkerhoff
Dr. Jerry Cromwell
Dr. David S. Ensor
Dr. F. Reed Johnson
Dr. Joshua M. Wiener
Blake S. Wilson

Session Leader Biographies

Paul Biemer, PhD
RTI International

Paul Biemer is an RTI Distinguished Fellow and holds a joint appointment with the University of North Carolina at Chapel Hill. Dr. Biemer has been associated with RTI since 1991, when he took the position of principal scientist and director of the Survey Methods Program.

Dr. Biemer received his Ph.D. in Statistics from Texas A&M University in 1978. His Ph.D. dissertation examined nonsampling errors in surveys, which has continued to be his major research interest. He is the author of a book, with Lars Lyberg, *Introduction to Survey Quality* (New York: John Wiley, 2003) and is the lead editor of *Measurement Error in Surveys* (New York: John Wiley, 1991).

Upon completing his graduate work, Dr. Biemer joined the U.S. Census Bureau as a mathematical statistician where he led major quality improvement projects for the 1980 Decennial Census and the current surveys program. He advanced to the position of assistant division chief of the Statistical Research Division. Dr. Biemer left the Census Bureau in 1986 to take an associate professor position at New Mexico State University. At NMSU, Dr. Biemer assumed the positions of head of the Department of Experimental Statistics and director of the University Statistics Center. He continued his research on nonsampling errors with funding from the Census Bureau and the National Agricultural Statistics Service.

Kerrie E. Boyle, DrPH
RTI International

Kerrie E. Boyle, director of RTI International's Statistics Research Division, has been with RTI since 1985. During her 25 years in statistics research, she has conducted a wide range of epidemiologic investigations and has specialized in the design and analysis of studies of the impact of exposure to potentially hazardous exposure on humans. Dr. Boyle directs all programs in statistics within RTI that include sampling and survey statistics, and medical and epidemiological studies as well as international health research. She provides overall leadership and management of RTI's statistical staff numbering more than 175. Her doctoral degree in biostatistics is from the University of North Carolina at Chapel Hill.

Michael Bryan
RTI International

Michael Bryan is a homeland security analyst in RTI International's Center for Strategic Initiatives. He is part of the RTI team establishing the Agriculture Disaster Research Institute, and is providing support to the U.S. Department of Agriculture in several areas, including identification of advanced technologies to aid in disaster preparedness. He is involved in RTI strategic initiatives related to homeland security, including the North Carolina Partnership, a collaboration between N.C. public and private universities and RTI. His background at RTI includes development of research programs in the environmental sciences, including hazardous waste remediation, brownfields and economic development.

Jerry Cromwell, PhD
RTI International

Jerry Cromwell is currently a Fellow at RTI International. He received his PhD in economics from Harvard University in 1974 before developing a career in health economics research. He has led many technical and evaluation projects for federal agencies that focused on cost containment and disparities in access to health care. He founded Health Economics Research in 1978 (recently acquired by RTI), building a core of interdisciplinary researchers studying hospital and physician payment issues and the cost effectiveness of clinical interventions and new regulatory and payment policies. He has testified on health issues in Congress and sat on scientific review boards evaluating new technologies. Dr. Cromwell has published widely on health economics issues and taught health economics courses at Tufts and Brandeis Universities.

David S. Ensor, PhD
RTI International

David S. Ensor is the director for the Center for Aerosol Technology and is an RTI Fellow. Dr. Ensor received his PhD in engineering at the University of Washington. For over 30 years Dr. Ensor has conducted contamination control, aerosol, and indoor air quality research. He is a founding editor of *Aerosol Science and Technology.* He has served as President of the American Association for Aerosol Research and the International Aerosol Research Assembly. He is the convenor of ISO Working Group 14744-7 (glove boxes, minienvironments, isolators and clean hoods). His current research activities include immune buildings, homeland security technology verification for air cleaning, electrospraying/electrospinning and bioaerosol sampling. Dr. Ensor is a Fellow of the Institute of Environmental Science and Technology and American Society of Heating, Refrigerating and Air-Conditioning Engineers.

Sam Field, MBA
RTI International

Sam Field serves as the director of RTI International's (RTI's) Technology Assisted Learning Division. He has been with RTI since 1997. Mr. Field has developed defense training and simulation systems and applications for 15 years, and has been managing complex hardware and software design and production contracts for over 13 years. His business unit is currently engaged in several training projects, including distance learning materials and Web-delivered training simulations for the Government as well as commercial clients. Mr. Field's education includes a BS in Electrical Engineering, MBA with concentration in Finance, and graduate studies in adult education and technology applied to Instructional Design. In addition to his years in defense contracting and contract research, he participated in the start-up of a truck safety appliance company.

Jun Liu, PhD
RTI International

Jun Liu is a senior research statistician and manager of technical operations for the Statistics Research Division at RTI International. His main research interests are in study design, estimation, and modeling for both cross-sectional and longitudinal complex multistage surveys. He is also interested in design and analysis issues of randomized and non-randomized experiments. Dr. Jun Liu graduated from Carleton University in Canada with a PhD in Statistics. He has been with RTI for more than 10 years.

Kathleen N. Lohr, PhD, MPhil, MA
RTI International

Kathleen N. Lohr is a Distinguished Fellow at RTI International (RTI), where she directs the RTI-University of North Carolina (UNC) Evidence-based Practice Center, developing systematic reviews and evidence reports on a wide array of clinical and health policy topics. Between 1996 and 2003, she directed a program of research in health services and health policy and served as chief scientist (Health, Social, and Economic Research). Dr. Lohr is also research professor at the UNC School of Public Health, a Senior Research Fellow at the Cecil G. Sheps Center for Health Services Research, senior investigator for UNC's Program on Health Outcomes, and a co-investigator on UNC's Center for Education and Research in Therapeutics.

Dr. Lohr spent 9 years at the Institute of Medicine (IOM), National Academy of Sciences. As director of the Division of Health Care Services, she had responsibility for administrative, personnel, and substantive tasks for studies in health care delivery, organization, financing, quality of care and clinical evaluation, practice guidelines, health workforce, and public health. During her 12 years at the RAND Corporation before joining the IOM, she served as lead analyst, co-principal investigator or project leader, and author or senior editor on numerous health care projects for the Department of Health and Human Services (particularly the RAND Health Insurance Experiment), Department of Defense, and Office of Technology Assessment.

Dr. Lohr serves on various advisory boards for federally sponsored projects and professional institutions and is widely published in quality of care, evidence-based practice, and health status assessment.

Joshua M. Wiener, PhD
RTI International

Joshua M. Wiener is a Fellow and program director for aging, disability and long-term care at RTI International. He is the author or editor of eight books and over 100 articles on health care for older people, long-term care, Medicaid, health reform, health care rationing, and maternal and child health. Prior to coming to RTI International, Dr. Wiener did policy analysis and research for the Urban Institute, the Brookings Institution, the Health Care Financing Administration, the Massachusetts Department of Public Health, the Congressional Budget Office, the New York State Moreland Act Commission on Nursing Homes and Residential Facilities, and the New York City Department of Health. He received his BA from the University of Chicago and his PhD from Harvard University.

Plenary Session

RTI International

RTI International seeks to improve the human condition through objective, innovative, multidisciplinary research, development, and technical services and to set the standard for scientific and professional excellence. In furtherance of that mission, the RTI Fellow Program is the home for exceptionally talented RTI staff to be active in science and research projects, to serve as RTI-wide consultants in key areas of scientific accomplishment, and to provide strategic technical and scientific leadership to RTI. Since 2001, this country has redoubled its efforts to address issues of terrorism, and, in planning this first Fellows Symposium, the Fellows identified "Homeland and Health Security: Understanding Today's Necessities, Tomorrow's Needs" as a critical national issue central to RTI's mission and work. The symposium will foster transdisciplinary work within RTI and with outside partners, including not only the founding universities — University of North Carolina, Duke University, and North Carolina State — but also universities and institutes with which we already collaborate in relevant areas such as bioterrorism preparedness. Especially important areas for future research and policymaking to be examined at the symposium include medicine and public health, statistical issues in bioterrorism and surveillance, technical approaches to monitoring and detection, economic impacts of terrorism, safety of agriculture and the food supply, and innovative approaches to training for emergency preparedness.

Victoria Franchetti Haynes, PhD
RTI International

Victoria Haynes is president and chief executive officer of RTI International (RTI). Her career of more than 26 years has focused on technology leadership, management, and new business development. Before joining RTI in 1999, she was vice president of the Advanced Technology Group and chief technical officer at BF Goodrich Company. She also held managerial roles at Monsanto Corporation.

Dr. Haynes is a member of several corporate and nonprofit boards, including the board of directors for Lubrizol Corporation, Nucor Corporation, Ziptronix, Inc., and MCNC Research and Development Institute. She also serves on advisory boards and committees for a number of universities and the Federal government. Her doctoral and masters degrees are from Boston University, and her undergraduate degree in chemistry is from the University of California, Berkeley.

Strategic Medical Intelligence
Michael Allswede

The Strategic Medical Intelligence (SMI) section of the Federal Bureau of Investigation, Pittsburgh Office, is directed at detection, first-case determination, and investigation assistance for bioterrorism. The fundamental structure is a novel organization incorporating physicians, public health officials, and law enforcement to project high-level consultation to the local level. SMI doctors are security-cleared individuals skilled at creating action plans to mitigate the constantly evolving bioterrorism threat.

Michael P. Allswede, DO
University of Pittsburgh Medical Center, Pittsburgh, PA

Michael Allswede's career spans 40 years, with a focus on emergency medicine. He has practiced medicine on three continents, and in settings as disparate as third world tent cities and university medical centers, most recently at the University of Pittsburgh Medical Center, where he directs the UPMC Health System's bioterrorism preparedness efforts. His academic career has included postings as an associate residency director for the University of Michigan's Program in Emergency Medicine, Director of the Governmental Emergency Medical Security Services at Allegheny General Hospital in Pittsburgh, and as the medical toxicologist and chief of the Special Emergency Response Section at the Department of Emergency Medicine, University of Pittsburgh. He has also served as a military unit commander, State Police SERT Tactical Emergency medicine director, SWAT team member for the Federal Bureau of Investigation and member of the Joint Terrorism Task Force at the Pittsburgh FBI, a member of the U.S. Secret Service, and as a national policy consultant for the U.S. Department of Justice (DOJ). He created a prototype state-level management system for weapons of mass destruction (the *RaPiD-T Program*) for DOJ that includes educational programming and a multi-disciplinary approach to crisis management organization. Dr. Allswede has also served as an instructor for the U.S. Department of Defense, Domestic Preparedness Program and has trained Metropolitan Medical Strike Team members in several U.S. cities. In 2000, he was named to the State and Local Advisory Group of the DOJ National Domestic Preparedness Office, and he serves the Biomedical Security Institute of Pittsburgh as a co-investigator in a syndromic detection and bio-surveillance project.

Public Health Preparedness: A Systems Approach

Edward Baker, Jr.

Assuring public health preparedness requires a systems approach to rebuild our nation's weak public health system. The system must be strong enough to respond not just to biological and chemical terrorism but also to a range of man-made and natural threats. Since day-to-day challenges require the same systems to be in place that are used for response to rare events, improvements in the infrastructure needed to protect against a terrorist attack have a "dual use" — benefiting daily operations of public health agencies. The three major elements of system capacity — workforce, information systems and organization — are now being strengthened through unprecedented investments in the public health infrastructure. Workforce improvements have focused on improving leadership and management skills, enhancing technical knowledge, and building a network of Centers for Public Health Preparedness. Information system development has included the creation of the Health Alert Network, a national system that has built a public information infrastructure providing a platform to alert the health community to threats such as anthrax, West Nile Virus, and Smallpox. Organizational capacity building has centered on creation of public health performance standards leading to organizational accreditation and certificate of competency of public health workers.

We, as a nation, have made meaningful progress in improving public health preparedness since September 11; workforce, information systems, and organizational capacity have been improved. Nevertheless, much needs to be done if we are to realize the vision of "Every health agency prepared, every community fully protected."

Edward L. Baker, Jr., MD, MPH, MSc
The North Carolina Institute for Public Health
UNC School of Public Health

Edward Baker currently serves as director of the North Carolina Institute for Public Health, the outreach and service unit of the University of North Carolina School of Public Health. He also holds the position of research professor in the Department of Health Policy and Administration. Prior to taking these positions in May 2003, he served as assistant surgeon general in the U.S. Public Health Service and Director of the Center for Disease Control and Prevention's (CDC) Public Heath Practice Program Office since 1990. In that role, he led national initiatives to strengthen the public health infrastructure by improving workforce competency, enhancing information systems, improving access to practice-relevant knowledge, assuring organizational capacity, and supporting extramural prevention research. Initiatives developed or enhanced under his leadership include the Public Health Leadership Institutes, the Information Network for Public Health Officials, the Public Health Training Network, the Sustainable Management Development Program, the Health Alert Network, the National Public Health Performance Standards Program, the National Laboratory Training Network, the National Laboratory System, and the Management Academy for Public Health. Previously, he served as deputy director of the National Institute for Occupational Safety and Health and on the faculty of Harvard School of Public Health's Occupational Health Program. Dr. Baker trained in medicine at Baylor College of Medicine, in public health and occupational health at Harvard, and in preventive medicine and epidemiology (through the Epidemic Intelligence Service) at CDC. He has received numerous awards and published over 100 papers in peer-reviewed journals.

USDA APHIS Agriculture Security Overview

John L. Williams

American agriculture is vulnerable to asymmetric threats that range from new and re-emerging animal and plant diseases to the possibility of a deliberate assault upon segments of our food production system. These threats to agriculture literally span from the farm to the fork.

An attack against America's food production commodities market could be felt in every home in the nation, with effects ranging from higher food prices, drastic food shortages, and possibly significant increase, in food borne illnesses.

The U.S. Department of Agriculture (USDA) is the executive agency responsible for ensuring the safety of the nation's food production pathway. Within the USDA, the Animal Plant Health Inspection Service (APHIS) is responsible for ensuring the safety of all animal and plant products from the farm to the production centers located around the country. As such, APHIS has recognized the evolving threat to the nation's food biosecurity and has embarked upon an extensive program to enhance the nation's readiness to detect, deter, and respond to terrorist events involving plant or animal pathogens.

This presentation discusses threats to and vulnerabilities of America's agricultural assets, and will describe programs, activities, and research interests at USDA APHIS designed to respond to these challenges.

John L. Williams, DVM
U.S. Department of Agriculture

John L. Williams is senior APHIS scientific advisor to the administrator of the Animal and Plant Health Inspection Service (APHIS) for the U.S. Department of Agriculture (USDA). He provides leadership and policy guidance to the agency's Homeland Security, and other special initiative programs. Dr. Williams was also appointed assistant to the deputy secretary of agriculture as an additional duty. As a member of a small "core group" he serves as a primary representative and coordinator for issues and programs concerning USDA policy and actions, research, and intelligence matters related to homeland security, and other threats. He also serves as USDA representative and senior agricultural technical advisor to numerous national level groups.

From 1997 until joining the administrator's office in 1999, Dr. Williams was the associate director of Animal Health Programs of Veterinary Services (VS). In this position, he provided leadership and guidance to the VS operational staff. Dr. Williams also served as chief of emergency operations for VS. He provided leadership and guidance to the national program for the detection, control, and eradication of exotic animal disease and/or pest incursions. He has worked in numerous staff and field positions, including national and international assignments, and has acquired a broad and quite unique knowledge and experience base which he brings to his current position.

Dr. Williams completed more than 24 years as a veterinary medical officer (Veterinary Corps) of the U.S. Army Reserves. He received the Bronze Star (1991) for accomplishments in Desert Storm. As a result of his exemplary and distinguished service, upon his retirement from the Reserves, he was awarded the Legion of Merit.

Dr. Williams is a native of Florida, where he grew up on a farm. He obtained his Doctor of Veterinary Medicine degree from Tuskegee University.

Challenges for Statisticians in Counterterrorism

David Banks

An enormous amount of federal effort is being directed towards counterterrorism. These efforts often entail novel applications of statistics and fresh scope for theory. This talk reviews ways in which the statistics profession can contribute to counterterrorism and discusses applications and issues in profiling, record linkage, biometric identification, risk analysis, mathematical epidemiology, contaminant sampling, and related topics. We also describe some of the institutional changes that are being made within the statistics profession and in federal statistical agencies.

David Banks, PhD
Duke University

David Banks is a professor of the practice of statistics at the Institute of Statistics and Decision Sciences at Duke University. Before that he was a federal statistician, working at the U.S. Food and Drug Administration, the U.S. Department of Transportation, and the National Institute of Standards and Technology. His current research focuses upon data mining and counterterrorism. He received his doctoral degree from Virginia Polytechnic Institute.

Agriculture and Food Safety

National Research Roadmap for Agriculture Disaster Prevention, Response, and Recovery

Robert Helms

RTI, along with other founding organizations including the University of Tennessee, Auburn University, Kansas State University, North Carolina State University, and Michigan State Universities, has been leading the formation of the Agriculture Disaster Research Institute (AgDRI). AgDRI, formed as a 501(c)(3) organization, is a partnership among academia, government, and industry dedicated to the prevention of, response to, and recovery from agriculture disasters, whether intentional, accidental, or natural.

AgDRI is developing a roadmap for agriculture disaster preparedness. The roadmap structure focuses on defining existing capabilities, and recommending incremental improvements to existing capabilities as well as leap-ahead research and development needs. The U.S. Department of Agriculture (USDA) is a partner in development of the roadmap, which will inform USDA's national research agenda. The USDA sponsor of AgDRI is John Williams, who will be giving a plenary presentation at RTI's Fellows Symposium.

AgDRI will hold a roundtable October 26-28, 2003, at Auburn University to present the draft roadmap to stakeholders including members of the agriculture industry and government. RTI is the primary coordinator and integrator of the roadmap. Given RTI's role and the scheduled date shortly before the RTI Fellows Symposium, the proposed presentation will describe the roadmap and the response and input received from industry and government stakeholders at the roundtable.

The structure of the roadmap aligns with the theme of the RTI Fellows Symposium, "Today's necessities, tomorrow's needs." This presentation will provide information on the roadmap and on research and development priorities of public and private agriculture stakeholders, including the USDA.

Robert F. Helms II, PhD
RTI International

Robert Helms is director of RTI International's (RTI's) Center for Strategic Initiatives, and acting executive director of the Agriculture Disaster Research Institute (AgDRI), an independent not-for-profit partnership of industry, academia, and government to improve agriculture disaster preparedness in the United States. He has also provided senior leadership to define and establish capability requirements for RTI lifelong learning.

Dr. Helms provides the RTI lead on research applications for masterplans integrating advanced learning environments of leading edge education and training technologies and tools with educational methodologies and evaluations to provide better learning at less cost. Examples of these applications and masterplans include the University of Mounted Warfare, the University of Information Technology, and the U.S Army's Lifelong Learning Implementation Plan.

Dr. Helms is leading several strategic initiatives in homeland security, including the AgDRI, the North Carolina Partnership, University-Based Center for Homeland Security, Homeland Security Institute, and Disaster Medicine Research Institute. He also owns and operates a cattle and quarter horse ranch in Lee County, NC.

Agricultural Security and the Role of the First Responder

Tim Moore

This presentation will describe a strategic new program providing agriculture disaster preparedness training to first responders. It will also include an overview of the value of the American agricultural sector and the importance of protecting it in light of the new trans-national threats of terrorism following 9/11, as well as protecting agriculture during natural or accidental events.

RTI has established a new office in Anniston, AL at the U.S. Department of Homeland Security's Center for Domestic Preparedness. This office is acting as a liaison on behalf of the U.S. Department of Agriculture's Animal Plant Health Inspection Service, responsible for introducing agriculture disaster preparedness into the training of first responders such as firefighters, emergency medical technicians, and police, as well as mayors, city/county council members, and individuals from a wide variety of jobs in the federal government. It will also work to increase disaster training for students in veterinary schools.

The Center for Domestic Preparedness (CDP) trains approximately 20,000 students per year, and expects to see this number increase.

The goals of this new RTI office include:

- developing a curriculum for use at the CDP that provides an understanding of the vulnerabilities of agriculture to terrorism as well as natural disasters such as disease outbreaks,
- drawing in members of the agriculture community, such as veterinarians, to be trained in disaster response,
- developing a roadmap for future agriculture disaster training, and
- exploring use of technology to reinforce and/or accelerate learning.

Timothy Moore, MS
RTI International, Center for Strategic Initiatives (Anniston, AL)

Timothy Moore leads RTI International's Agriculture Disaster Training program at the Department of Homeland Security's Center for Domestic Preparedness in Anniston, AL. Prior to joining RTI, Mr. Moore was executive director of the Auburn University College of Veterinary Medicine's Research and Development Program. He has expertise in defense-related research on weapons of mass destruction, with specialization in agricultural biosecurity. He has provided oversight for development and execution of programs such as the first-of-its-kind USDA Food Biosecurity Awareness CD for Agricultural First Responders developed for the U.S. Department of Agriculture (USDA). Other work has included biological protective suit evaluations for USDA, and leading Emergency Response Team basic training and hazard awareness for USDA Office of Inspector General; development of chemical weapons detection and decontamination technologies; intelligence community support relating agricultural threats; and environmental remediation of sites and buildings contaminated with chemical warfare materiel. Mr. Moore has a BS in biology and an MS in microbiology.

Combining Anticipatory Failure Determination (AFD) with Traditional Risk Assessment Tools to Identify, Evaluate, and Mitigate Possible Foodborne Bioterrorism Threats

Roberta Morales, Sumeet Patil

Anticipatory failure determination (AFD) is a risk assessment approach derived from the Russian theory of innovative problem solving (or TRIZ). The strength of AFD lies in the inversion of the problem. Applying the TRIZ principles to a risk assessment question (how did the failure occur?), one would formulate the *inverted problem* and ask "If I want to create this failure, what would I do to make it happen?" In order to safeguard a system, we need to first understand how it can fail. Traditional approaches are predicated on finding a cause for a failure that has already occurred (failure analysis). AFD provides a qualitative framework for identifying and structuring scenarios where failures *have not yet* occurred (failure prediction).

This paper proposes a risk ranking framework to evaluate potential high-threat agents and system vulnerabilities. The first step is to develop a threat effectiveness matrix (TEM) of potential agents of concern and their threat attributes (i.e. heat/cold tolerance, stability, resistance). Next, AFD is used to develop a scenario structured matrix (SSM) of possible failure scenarios, explicitly identifying the important scenarios. In the implementation phase, a risk indexing approach can be applied to the TEM and the SSM. An application to foodborne bio-terrorism is presented.

Roberta Morales, PhD, MPVM, DVM
RTI International

Roberta Morales is a senior researcher in the Food and Nutrition Policy and Consumer Behaviors Program in RTI International's (RTI's) Center for Regulatory Economics and Policy Research. She is a veterinarian with graduate degrees in epidemiology and economics. Dr. Morales has 18 years of experience in food safety, public health, and animal health. She is serving her third consecutive term as a member of the National Advisory Committee on Microbiological Criteria for Foods. She served on the U.S. delegation for the Codex Alimentarius Commission's Committee for Food Hygiene from 1997 to 1999 and was a member of a Food and Agriculture Organization/World Health Organization Expert Consultation on Hazard Characterization and Microbial Risk Assessment. Her research has focused on the epidemiology, risk assessment, and economics of food safety issues. She is an adjunct assistant professor in epidemiology and public health at North Carolina State University's College of Veterinary Medicine. She also serves on the graduate faculty of the University of North Carolina at Chapel Hill. Prior to joining RTI, Dr. Morales was assistant professor of food safety at the Virginia–Maryland Regional College of Veterinary Medicine, where she co-directed the epidemiology residency program. She has also worked with the U.S. Department of Agriculture's Food Safety and Inspection Service on an interagency personnel agreement (IPA) with North Carolina State University to develop the agency's core competency in risk analysis.

Medicine and Public Health I

Sarin Compromises the Blood Brain Barrier

Mohamed B. Abou-Donia, Ali A. Abdel-Rahman, Ashok K. Shetty

Adult male rats were exposed to sarin by a single intramuscular injection of 1, 0.5, 0.1, and 0.01xLD_{50} corresponding to 100, 50, 10 and 1 μg sarin/kg body weight of animals. Sarin at 1 and 0.5xLD_{50} caused significant decrease in plasma butyrylcholinesterase. A dose of 1xLD_{50} sarin produced significant inhibition of AChE in all brain regions and a decrease in m2 mAChR ligand binding in the cerebrum. The m2 mAChR ligand binding however, showed a significant increase in the brainstem following exposure to all doses of sarin. [H^3]hexamethonium iodide uptake demonstrated significant increase in blood brain barrier permeability after 1xLD_{50} sarin. LD_{50} sarin caused decrease in the expression of endothelial barrier antigen (EBA), a diffuse neuronal cell death and a decrease in MAP-2 positive elements within the cerebral cortex and the hippocampus, and degeneration of Purkinje cells in the cerebellum. While animals treated with 0.5 and 0.1xLD_{50} did not exhibit the above changes, animals treated with 0.5xLD_{50} showed Purkinje neuron loss in the cerebellum. The results indicate that brain damage after acute exposure to sarin is dose-dependent. The early neuropathological changes after a single dose of 1xLD_{50} sarin could lead to a profound long-term neuronal degeneration in many regions of the brain, resulting in behavioral abnormalities. (DOD Contract: DAMD 17-98-C-8027).

Mohamed B. Abou-Donia, PhD
Duke University Medical Center, Durham, NC

Mohamed B. Abou-Donia is a professor of pharmacology and cancer biology at Duke University Medical Center. He also holds a secondary appointment as a professor of neurobiology. He obtained his PhD from the University of California at Berkeley and he has been a certified toxicologist by both the American Board of Toxicology since 1981 and the Academy of Toxicological Sciences since 1982. He was the deputy director of the toxicology program at Duke University from 1981 to 1995 and is currently the deputy director of Duke University Marine Biomedical Center, a position he has held since 1995. He edited a book Neurotoxicology in 1992 and has published more than 300 papers, mostly in the area of neurotoxicology.

Dr. Abou-Donia teaches the following courses in toxicology to medical students and graduate students: Clinical Toxicology, Mammobian Toxicology, Neurotoxicology, and Case Study in Toxicology. He is a member of the Medical Student Admissions Committee. The thrust of Dr. Abou-Donia's research program is directed toward understanding the basic mechanisms of chemically induced neurodegenerative disorders.

Antibodies for Detection of and Protection against Toxins

C. Edgar Cook, Carol C. Whisnant, Patricia V. Basta

Antibodies may serve as highly selective analytical tools, as capture agents for chemicals or as catalysts for chemical reactions. For defense against toxins, we have prepared antibodies to fungal toxins and immunogens for the nerve agent soman. This paper describes work on catalytic antibodies for protection from cyanide. We devised a transition state analog (TSA) that mimicked the transition state for the reaction of cyanide with a derivative of 1,2-diphenylpropenone, generated monoclonal antibodies that catalyzed this reaction, showed that they stabilized the transition state for it and were not inhibited by the product. We also determined the antibody sequence. A two-part protective system is envisioned from this approach. Individuals at risk could be immunized (actively or passively) so as to have a concentration of the catalytic antibodies in their serum prior to any expected exposure. When exposure was possible, the second component (the enone, or drug) could be taken. Antibodies with higher catalytic turnover rates than the ones developed so far are needed. These may be achieved by modifying the current antibodies by molecular biology techniques (as is being done in our lab for other antibodies), by use of other transition state analogs, or by modifying the substrate. Ideally, one can develop antibodies to catalyze the reaction of the toxin with an endogenous compound, so that the "drug" component becomes unnecessary.

C. Edgar Cook, PhD
RTI International

Edgar Cook obtained a BS degree from Carson-Newman College in 1957, with a major in chemistry, and a PhD degree in organic chemistry in 1961 from the University of North Carolina at Chapel Hill, where his research focused on heterocycle synthesis. After a postdoctoral year at the University of Cambridge, he joined RTI International (RTI) in 1962. He began work on the synthesis of steroidal and nonsteroidal hormones, which continues today, with recent patents on selective androgen and progestin response modulators and a research program in other hormone modulators. After a brief detour into natural product chemistry, which included isolation and structure determination of the witchweed seed germination stimulant strigol, he turned his attention to drug metabolism and pharmacokinetics. There his research covered a range of compounds from the early oral contraceptive drugs to drugs of abuse and treatment drugs, including PCP, cocaine, methamphetamine, buprenorphine and tetrahydrocannabinol. A major interest has been the development and utilization of antibodies as highly selective chemical tools for detection and analysis of small molecules and for catalysis of their reactions. He and his colleagues developed antibodies for drugs ranging from the antiepileptic phenytoin to the marijuana constituent Δ^9-THC and including antibodies capable of chiral selectivity between drug enantiomers. Dr. Cook has served RTI as director for bioorganic chemistry and vice president for chemistry and life sciences and is currently chief scientist in the Center for Organic and Medicinal Chemistry of the Science and Engineering Group.

Homeland and Health Security: What Can Science and Engineering Do?

Thomas W. Marrero

The design of effective policies to ensure homeland security requires understanding of the dangers and risks associated with terrorism and the technical capabilities to combat them.

Scientists and engineers at RTI International (RTI) have an established history and a proactive vision for continued contributions toward homeland and health security. Both singular and multidisciplinary approaches to research in collaboration with various governmental agencies have led to the development of capabilities to improve the human condition and support homeland and health security. This presentation will focus on specific examples and allude to related poster presentations.

Protection

- Scavengers (enzyme mimics) to consume nerve agents in vivo before the onset of debilitating and often fatal reactions
- Inhibitors of acetylcholinesterase phosphorylation caused by chemical warfare agents.

Detection

- Biological/chemical sensors using nanoparticles, particularly highly functionalized dendritic and hyperbranched polymers
- Detection based on protein biomarkers, which are universal to all potential classes of threats (viral, microbial, toxin) using mass spectrometric detection used for the sentinel monitoring of buildings, field sites, or for rapid clinical diagnostics for air or liquid samples
- Devices for sampling, collection, filtration; we have expertise in the use of selective surfaces for these applications
- Bioterrorism or chemical-warfare forensics—fingerprinting, profiling; environmental sampling to prove exposure; pattern recognition.

Treatment

- Catalytic antibodies for protection, e.g., against cyanide
- Anti-infectives (including anti-fungals)
- Treatment agents, e.g., anti-convulsants and reactivators of acetylcholinesterase after nerve gas exposure.

Decontamination

- Simulants of chemical warfare agents
- Bug-based remediation.

Thomas Marrero, PhD
RTI International

Thomas Marrero at RTI International (RTI), holds a PhD in analytical chemistry, and has been involved in environmental research and analysis for over 5 years. Dr. Marrero is responsible for scientific research on numerous human exposure studies as well as research on the treatment and disposal of mixed wastes. These studies utilize various applications of analytical chemistry and radiochemistry. Dr. Marrero's work at RTI includes the design of experiments, sample collection, extraction, and analysis, as well as data review and analysis. Dr. Marrero has served over 4 years in the U.S. Army, Medical Service Corps, and over 5 years in the U.S. Army Reserves. He currently holds the rank of captain.

Statistics and Syndromic Surveillance

Data Confidentiality, Data Integration, Data Mining, Data Quality: Homeland Security Challenges for Statisticians

Alan Karr

This talk will lay out homeland security-driven challenges for statisticians arising from four classes of data-driven problems, with particular attention on interactions among the problems, many of which are not understood well. The talk will focus on what statistical scientists cannot do yet, rather than on what we have done.

The problems to be treated include several in which the National Institute of Statistical Sciences currently is engaged: data confidentiality (DC), data integration (DI), data mining (DM), and data quality (DQ). Interactions among these four problems pose important research challenges for statisticians. For example, poor DQ protects confidentiality, while DI (in the form of record linkage) is a means of breaking confidentiality. Similarly, techniques to protect DC and poor DQ both affect strongly the ability of DM to identify anomalous data.

The challenges will be discussed at multiple levels: abstractions, theory and methodology, and (scalable) software tools.

Alan Karr
National Institute of Statistical Sciences

Alan F. Karr is director of the National Institute of Statistical Sciences (NISS), a position he has held since 2000, prior to which he was associate director (1992-2000). He is also professor of statistics and operations research, and biostatistics at the University of North Carolina at Chapel Hill (since 1993), as well as associate director of the Statistical and Applied Mathematical Sciences Institute (SAMSI). Before coming to North Carolina, he was professor of mathematical sciences and associate dean of the School of Engineering at Johns Hopkins.

His research activities are cross-disciplinary collaborations involving statistics and such other fields as data confidentiality, data quality, software engineering, information technology, transportation, materials science and e-commerce. He is the author of three books and more than 80 scientific papers. Karr is a Fellow of the American Statistical Association and the Institute of Mathematical Statistics, a member of the Council of the latter, and served as a Member of the Army Science Board from 1990 to 1996.

Surveillance of Syndromes: Methods of Surveillance and Intuitive Power Assessment

Ken Kleinman

One source of data that can be used for surveillance to detect biological terrorism is encounter data from outpatient visits. This presentation examines how these data can be useful from a homeland security viewpoint, reviews several statistical techniques currently in use or under development, and informally assesses the bioterrorism attacks that each would have high power to detect. The data can be useful because many bioterrorism agents have non-specific prodromes and contain geographic data. The techniques currently in use include simple time-series models, discrete small area models, adapted spatial clustering techniques, and inter-case distance methods. Even the relatively simplistic methods currently available will jointly detect a wide variety of attacks.

Ken P. Kleinman, ScD, MS
Harvard Medical School

Ken Kleinman is an assistant professor of ambulatory care and prevention at Harvard Medical School. He received his ScD and MS, both in biostatistics, from Harvard. His BA is from Oberlin College. Dr. Kleinman was among five 2002 finalists selected for the Sandra Daugherty Award for Excellence in Cardiovascular Disease and Heart Association Hypertension Epidemiology, administered by the American Heart Association. He is general statistical reviewer for *Biomed Central Medicine Journals*, and has been a reviewer for several peer review journals, including *The American Journal of Psychiatry*, *Journal of the American Statistical Association*, *Biometrics*, and *Journal of Gerontology: Psychological Sciences.* Dr. Kleinman is a member of the American Statistical Association and the International Biometric Society.

Sensors, Monitoring, and Protection

The NASA Aviation Security Program, "An RTI Opportunity"

James G. Haidt, Frank Allario, Michael L. Heck, Chi Nguyen

The National Aeronautics and Space Administration (NASA), a premier developer of advanced aviation technologies, is currently planning a five-year Aviation Security Program. The program is centered on four themes: (1) harden the National Airspace System; (2) secure and protect aircraft; (3) increase effectiveness of aviation information screening; and (4) integrate advanced sensors throughout the system. The RTI Center for Aerospace Technology (CAST) has the technical competencies to support themes one and four. Our internal analysis suggests that a major terrorist threat lies in using general-aviation (GA) aircraft to attack high-value assets. Although the nation appears to have secured itself against threats from large commercial aircraft, we feel the same cannot be said of GA aircraft. We have developed advanced concepts in forward-looking sensors (remote sensors) to enable low-cost radar and infrared imaging sensors to detect threats from GA aircraft. CAST has converted these concepts into proposals to develop low-cost, ground-to-air sensors to protect high-value assets against GA threats and to convert every commercial air carrier into an air-to-air surveillance agent that could, for example, be activated in the event of an emergency to create a nationwide situation assessment. For the RTI Fellows Symposium we will outline the NASA Aviation Security Program, focusing upon GA aircraft as posing a major threat. We will summarize the concepts provided to NASA as future opportunities for RTI.

James G. Haidt, PhD
RTI International

James G. Haidt is director of the Center for Aerospace Technology at RTI International (RTI), and directs work at RTI's offices in Research Triangle Park, NC; Hampton, VA; and Cocoa Beach, FL. Since joining RTI in 1974, he has worked on various research and development programs for the National Aeronautics and Space Administration, including detection of microbursts and atmospheric turbulence from airborne platforms, wake-vortex avoidance systems for hub airports, automated pilot advisory systems for uncontrolled airports, and automated metering and spacing techniques for air traffic control. Before coming to RTI he worked as a member of the technical staff at Bell Laboratories in Whippany, NJ. He received a PhD in Control Sciences from the University of Minnesota in 1968.

An Integrated Mass Spectrometry System for Universal Threat Agent Detection

Jonathan L. Bundy, Benjamin J. Cargile, Karin K. Foarde, David S. Ensor, James L. Stephenson Jr.

In the current state of world affairs, the possibility exists more than ever for a terrorist attack employing infectious agents. A system based on electrospray (ES) mass spectrometry is proposed here, which could be used for the sentinel monitoring of buildings, field sites, or for rapid clinical diagnostics. Detection is based on protein biomarkers, which are universal to all potential classes of biothreats. No other analytical technique offers as broad a capability or range of targets. The proposed system targets proteins from potential viral or microbial pathogens as biomarkers for the presence of a specific organism or toxin. Mass spectrometry can identify proteins by employing a combination of molecular weight determination and partial protein sequencing. The enabling technology in our system is a novel configuration of mass spectrometer which is capable of performing ion/ion recombination chemistry (IIRC), a technique that allows multiple-charged species to be reduced to their singly charged state, facilitating identification of sample constituents of complex mixtures. The IIRC technique can also be used here to reduce spectral complexity, so that sequence information can be easily deduced. Identification of the protein is possible by using the molecular weight and the partial protein sequence obtained from the mass spectrometer to search protein databases. Traditionally, ES mass spectrometry has been done on liquid samples. However, a concept aerosol-based sampling interface for the mass spectrometer platform has been in development that could be used to sample the air directly for potential pathogenic species.

Jonathan Bundy, PhD
RTI International

Jonathan Bundy of RTI International's (RTI's) Center for Analytical and Chemical Sciences center obtained his BS in biochemistry at North Carolina State University and his PhD in the same field at the University of Maryland. His doctoral work centered on the application of modern mass spectrometry technology to rapidly identify and characterize microorganisms. More specifically, he developed several bioactive affinity surfaces for rapidly cleaning up and concentrating microorganisms from complex sample matrices prior to mass spectrometric analysis. This project was funded by the Defense Advanced Research Projects Agency (DARPA) and the U.S. Food and Drug Administration. Dr. Bundy also has experience designing immunoaffinity based methods for the analysis of protein toxins by mass spectrometry, an area of research he pursued while working at the U.S. Army Medical Research Institute of Infectious Diseases. During a postdoctoral Fellowship at Oak Ridge National Laboratory, his research was focused on the application of mass spectrometry for proteomic analysis, using novel mass spectrometry techniques employing ion-ion chemistry. He also participated in the development and implementation of alternative separation strategies to two-dimensional gel electrophoresis for protein mixture analysis.

Reducing the Vulnerability of Water Supply Systems to Terrorism: Monitoring System Design

Keith Little

The tragic events of September 11, 2001 have forced an examination of public infrastructure systems to identify vulnerabilities to terrorist attacks. One of the most vulnerable systems is undoubtedly public water supply systems. In particular, treated water distribution systems are especially vulnerable because introduced hazardous chemical or biological agents receive no further treatment nor any further means of detection before reaching consumers. Indeed, every residential plumbing fixture is a potential point for introducing hazardous agents, and all that is needed to do so is a rudimentary understanding of hydraulics and commonly available equipment. The vulnerability of every water supply system to such attacks is of significant concern.

Monitoring devices capable of detecting the presence of hazardous agents in water distribution networks in near real-time are currently under development. Costs of these devices will be significant, however, and will effectively preclude widespread installation of monitors in any given system. The protection afforded then becomes a statistically determined, expected protected population (EPP) measure. The monitoring design problem is how many monitors should be made available and where they should be located. These two decisions are not independent, however. Given a specified number of monitors, there are many different ways to locate those monitors, with differing EPP implications; it is obviously desirable to locate them such that the EPP is maximized. Conversely, when one is considering how many monitors should be available to best balance costs and benefits, it is essential that the maximum EPP be associated with each alternative number of monitors scenario. Thus, for either decision, a method of optimally locating monitors within the system is required.

Keith Little, PhD
RTI International

Keith Little is a senior water resources and environmental engineer in RTI International's (RTI's) Center for Environmental Analysis. He has been with RTI for over 10 years and works in the areas of environmental media modeling, risk assessment, water quality analysis, and optimization. Dr. Little has a PhD from the University of North Carolina at Chapel Hill and is a registered Professional Engineer in North Carolina.

Economic Impacts

The Economics of Policies to Counter Terrorism

Paul Rothstein

Economic principles provide some general guidance in answering the basic normative questions of resource allocation presented by the need for homeland security: how much should we spend, where does the private sector's role end and the public sector's role begin, and where does the federal role end and the state and local roles begin? These principles must be taken into account by policies and institutions that use resources well over the long term. We begin with an overview of the costs of homeland security, its position in the federal budget, and its position in American fiscal federalism. We then discuss the relevant economic principles and identify the key centralizing and decentralizing forces that provide the economic rationale for assigning different responsibilities to different tiers of government. We next apply these principles to the six critical mission areas defined by the National Strategy for Homeland Security (July 2002). Economic principles provide consistent and useable methods for identifying differences among policies that seem similar on other grounds and for finding similarities among otherwise different public sector activities. In some cases it is possible to offer concrete recommendations, although most often economics contributes one analysis among many.

Paul Rothstein
Weidenbaum Center on the Economy, Government, and Public Policy
Washington University

Paul Rothstein is an associate professor in the Department of Economics and associate director of the Murray Weidenbaum Center on the Economy, Government, and Public Policy at Washington University. He is also a Resident Fellow in the Center in Political Economy and member of the executive committee for the Center in New Institutional Social Sciences, also at Washington University. He earned his BA at Yale University and his PhD in Economics at the University of California at Berkeley. He has held positions at the University of Texas at Austin, Carnegie-Mellon University, and the University of Rochester.

Dr. Rothstein's specialty is public sector economics, and he has written in the areas of local public finance, taxation, and public choice. His previous work includes, *Learning the Preferences of Governments and Voters from Proposed Spending and Aggregated Votes*, Journal of Public Economics (1994), *Models with an Uncongestible Public Good and a Continuum of Consumers*, Journal of Urban Economics (2000), and *Possibility, Impossibility and History in the Origins of the Marriage Tax*, National Tax Journal (2003), the last two with Professor Marcus Berliant. Dr. Rothstein is currently interested in federalism, the benefits and costs of competition among local governments, and the role of political processes, legal institutions, and central government in channeling this competition. His current working papers develop theoretical models of fiscal competition and federation formation and empirical work on the political economy of urban mass transportation.

Probabilities, Perceptions, and Prices: Valuing Reduction in Homeland Security Risks

Reed Johnson

Homeland security risk-management efforts often appear to lack a consistent rationale across potential threats and over time. Regulators may impose severe restrictions in instances where the potential risks appear relatively low, while lenient restrictions may apply in other instances where the potential risks appear relatively high. Furthermore, the net effect in some cases actually may be to increase the overall health and safety if resources are diverted from existing health and safety programs to new, less familiar threats.

Such policies are consistent with several well-established findings from the substantial literature on risk perception, risk communication, and risk-preference measurement. For example:

- People have difficulty manipulating and evaluating small (smaller than about 0.0001) probabilities accurately.
- People care as much about such risk characteristics as voluntariness, familiarity, catastrophe, dreadfulness, and timing as they do about probability.
- People evaluate different sources of risk information differently.
- People evaluate decisions framed as gains differently than decisions framed as losses.
- People translate population risks to personal risks using a variety of heuristics. Some of these decision rules are inconsistent with objective risk measures.

These perceptual biases can lead to suboptimal risk-reduction strategies and may distort priority-setting for homeland security policy. Furthermore, there is less consensus about how to communicate risks effectively, the role of the media and other public sources of risk information in influencing risk perception and protective behavior, and how to measure risk preferences accurately and reliably.

Dr. F. Reed Johnson, PhD
RTI International

F. Reed Johnson is principal economist and RTI Fellow at RTI International (RTI). He is adjunct professor of public policy at the University of North Carolina at Chapel Hill and is a member of the U.S. Environmental Protection Agency's Scientific Advisory Board. Dr. Johnson received his PhD degree in economics from the State University of New York, Stony Brook in 1974. He has served on the economics faculties of Illinois State University, Simon Fraser University, the Stockholm School of Economics, the University of Stockholm, Linköping University, and the U.S. Naval Academy. He previously worked as an economist in the Office of Policy Analysis, U.S. Department of the Interior, and in the Office of Policy, Planning, and Evaluation, U.S. Environmental Protection Agency. From 1994 to 2001 he was Vice President for Research and Development at Triangle Economic Research. He has been awarded a Brookings Economic Policy Fellowship and two Fulbright Fellowships.

As a staff member in the U.S. Environmental Protection Agency's environmental economics research program during the 1980s, Dr. Johnson helped pioneer development of basic nonmarket valuation techniques. These techniques are now widely used for cost-benefit analysis in health and environmental economics. He has designed and analyzed numerous surveys for measuring willingness to pay for improved health and environmental quality. His current research includes developing improved methods for quantifying patient and physician stated preferences for healthcare interventions and health risks.

Insurance, Self-protection, and the Economics of Terrorism

Darius Lakdawalla

This paper investigates the rationale for public intervention in the terrorism insurance market. It argues that government subsidies for terror insurance are aimed, in part, at discouraging self-protection and limiting the negative externalities associated with self-protection. Cautious self-protective behavior by a target can hurt public goods like national prestige if it is seen as "giving in" to the terrorists, and may increase the loss probabilities faced by others if it encourages terrorists to substitute toward more vulnerable targets. We argue that these externalities distinguish the terrorism insurance market and could help explain why availability problems in this market have engendered much stronger government responses than similar problems in other catastrophe insurance markets. From a normative point of view, these issues are essential to analyzing the relative merits of government intervention in the terrorism insurance market.

Darius Lakdawalla, PhD
The Rand Corporation

Darius Lakdawalla is an economist at RAND, and a Faculty Research Fellow at the National Bureau of Economic Research. He received his PhD in economics from the University of Chicago, and his BA in mathematics and philosophy from Amherst College. Dr. Lakdawalla has published papers in leading economics and medical periodicals on topics in the economics of insurance and the economics of health care. He has been the recipient of grant awards from the National Institute on Aging, the National Institute on Occupational Safety and Health, and the National Bureau of Economic Research. He speaks regularly at national conferences on insurance, risk theory, health economics, and public policy. His most recent research has analyzed the economics of terrorism and terrorism insurance, as well as the economic incentives that underlie cycles of violence, conflict, and terrorism. Dr. Lakdawalla is also an assistant professor of economics at the RAND Graduate School, where he teaches Microeconomic Theory.

The Political Economy of Homeland Security: Who's Responsible for Protecting What?

Jerry Cromwell and Ed Drozd

The U.S. Department of Homeland Security has already allocated billions of dollars to states for several anti-terrorist protection and readiness activities. The Congress has mandated that a substantial fraction of the money be distributed according to a formula that gives each state a fixed amount plus an additional amount proportional to population. This approach ignores any cost-effectiveness considerations in allocating funds. This paper presents alternative allocation formulas that take into consideration the geographic distribution of likely terrorist targets, the costliness of protecting certain targets, and the equity to taxpayers of funding protection. The examination of likely targets recognizes several distinctly different types of domestic and international terrorist groups and the challenges each presents to evaluating target risks. It also considers displacement, or deflection, effects that inadvertently raise the risk of attack when other targets are protected. Protection costs are reviewed, ranging from border security to airline waiting times. Psychic costs to "lost security" and "lost privacy and civil liberties" are also considered. Finally, inequalities in state wealth, relative to potential targets, suggest further distortions in the existing allocation formula.

Edward Drozd, PhD
RTI International

Edward Drozd is a research economist at RTI International (RTI) who received his doctorate degree in economics from Harvard University in 2000, studying public finance and health economics. Dr. Drozd has been employed at RTI and Health Economics Research, Inc., (acquired by RTI in 2002) working on projects related to health care financing and other health care cost issues. Many of these projects concern developing new or refining existing payment systems for physicians, hospitals, and other providers. The remaining projects involve evaluating the cost and effectiveness of initiatives and demonstrations intended to reduce Medicare costs or otherwise improve payment systems.

Statistical Issues in Bioterrorism

Biosurveillance Geoinformatics of Hotspot Detection and Prioritization for Biosecurity

G. P. Patil

Geoinformatic surveillance for spatial and temporal hotspot detection and prioritization is a critical need for the 21st century. A hotspot can mean an unusual phenomenon, anomaly, aberration, outbreak, elevated cluster, or critical area. The declared need may be for monitoring, etiology, management, or early warning. The responsible factors may be natural, accidental or intentional, with relevance to both infrastructure and homeland security.

This presentation describes a multi-disciplinary research project for hotspot detection and prioritization. The case studies are expected to deal with critical societal issues, such as carbon budgets, water resources, ecosystem health, public health, drinking water distribution system, persistent poverty, environmental justice, crop pathogens, invasive species, biosecurity, biosurveillance, remote sensor networks, early warning and homeland security.

Our methodology involves an innovation of the popular circle-based spatial scan statistic. It employs the notion of an upper level set and is accordingly called the upper level set scan statistic system, pointing to the next generation of a sophisticated analytical and computational system, effective for the detection of arbitrarily shaped hotspots along spatio-temporal dimensions. We also propose a novel prioritization scheme based on multiple indicator and stakeholder criteria without having to integrate indicators into an index. It is called poset prioritization and ranking system. The research advances in the sciences and technologies necessary to make such a system work are the thrust of this five year project for the National Science Foundation (NSF) Digital Government Program.

G. P. Patil, PhD, DSc
Pennsylvania State University

G.P. Patil is Distinguished Professor of Mathematical and Environmental Statistics in the Department of Statistics at the Pennsylvania State University, and is a former visiting professor of biostatistics at Harvard University in the Harvard School of Public Health.

He has a PhD in Mathematics, DSc in statistics, and honorary degrees in biological sciences, and letters. He is a Fellow of the American Statistical Association, Fellow of the American Association of Advancement of Science, Fellow of the Institute of Mathematical Statistics, elected member of the International Statistical Institute, and founder Fellow of the National Institute of Ecology and Society for Medical Statistics in India.

He is a founder of the Statistical Ecology Section of the Ecological Society of America, a founder of the Statistics and Environment Section of the American Statistical Association, and a founder of the International Society for Risk Analysis. He is founding editor-in-chief of the international journal *Environmental and Ecological Statistics* and founding director of the Penn State Center for Statistical Ecology and Environmental Statistics. He has published 30 volumes and 300 research papers. He has received several distinguished awards, which include: Distinguished Statistical Ecologist Award of the International Association for Ecology, Distinguished Achievement Medal for Statistics and the Environment of the American Statistical Association, Best Paper Award of the American Fisheries Society, and Best Paper Award of the American Water Resources Association.

Currently, Dr. Patil is principal investigator of a 5-year National Science Foundation grant for surveillance geoinformatics for digital government in the 21st Century.

Statistical Models for Anthrax

Ron Brookmeyer

This talk will consider the role of statistical models in understanding anthrax outbreaks and in developing effective public health responses to manage the consequences. In the fall of 2001, an act of bioterroism resulted in an anthrax outbreak in the United States. Public health officials responded by distributing antibiotics to attempt to reduce morbidity and mortality. We develop a statistical model that links the dates of onset of disease, exposure to the anthrax spores, and the initiation of antibiotic prophylaxis in order to estimate the numbers of cases of inhalational anthrax that were prevented in 2001 by the distribution of antibiotics. A second model is developed to determine the optimum duration of time that persons exposed to anthrax spores should remain on antibiotic prophylaxis. We develop a competing risks model to address the question of the optimum duration of antibiotics that accounts for the risks of spore germination and spore clearance. The optimum duration of antibiotics depends critically on the dose of inhaled spores. In a massive outbreak in which persons are exposed to very high doses of anthrax spores we show that exposed persons would need to remain on antibiotics for at least four months, and considerable morbidity would likely occur before antibiotic prophylaxis could even be initiated. At very low doses, 60 days of antibiotic prophylaxis is adequate.

References:

Brookmeyer R and Blades N (2002). Prevention of Inhalational Anthrax in the U.S. Outbreak. Science, 295, 1861.

Brookmeyer R, Johnson E, and Bollinger R (2003) Modeling the Optimum Duration of Antibiotic Prophylaxis in an Anthrax Outbreak. Proceedings of the National Academy of Sciences, 100:10129-10132.

Dr. Ron Brookmeyer, PhD
Department of Biostatistics
Johns Hopkins Bloomberg School of Public Health

Ron Brookmeyer is a professor in the Department of Biostatistics of the Johns Hopkins University Bloomberg School of Public Health. Dr. Brookmeyer received his PhD in statistics from the University of Wisconsin and is a graduate of Cooper Union College. Dr. Brookmeyer is a Fellow of the American Statistical Association and the American Association for the Advancement of Science. He is a recipient of the American Public Health Association's Spiegelman Gold Medal for outstanding contributions to health statistics. Dr. Brookmeyer has served as chair of the Biometrics Section of the American Statistical Association and as an associate editor of the Journal of the American Statistical Association, Biostatistics and Statistics in Medicine. Dr. Brookmeyer is also the director of the Johns Hopkins University Master of Public Health Program. Dr. Brookmeyer's main research interests are in the development of statistical models for monitoring and forecasting the health of populations. He has worked extensively with AIDS and is currently working on problems in bioterrorism.

Medicine and Public Health II

Defining Public Health Preparedness: Past, Present, and Future

David L. Driscoll

Recent assessments paint a disquieting picture of our nation's ability to recognize and respond to such public health challenges as biological, chemical, or radiological terrorism. The nation's media services offer weekly examples of the woeful state of our public health infrastructure with reference to potential events that would have seemed improbable at one time, but today seize the imagination of a vulnerable population. In this presentation, how the meaning of the term *public health preparedness* has evolved over the past century in the United States as a consequence of the public health challenges of the day is discussed. The sudden and dramatic reinterpretation of this term in the past few years has challenged the federal agencies, particularly the Centers for Disease Control and Prevention (CDC), which are charged with public health infrastructure development. How these challenges have and will translate into research opportunities is described, as are details about examples of recent work conducted at RTI, specifically work defining the core components of public health preparedness for biological and chemical terrorism. Finally, the presentation discusses how the meaning of public health preparedness may evolve in the future, and the likely ramifications of this natural evolution on researching and evaluating public health infrastructure development.

David L. Driscoll, PhD
RTI International

David Driscoll is an applied medical anthropologist and epidemiologist whose transdisciplinary work combines qualitative and quantitative methods to understand and communicate the social and behavioral context of public health challenges. He develops health communication messages describing population health risks, and evaluates programs intended to identify or prevent those risks. His methodological experience spans a range of techniques, including unobtrusive structured observation, semistructured and structured individual and group interviews, focus group interviews, telephone interviews, group-administered questionnaires, and mail surveys. His analytical experience includes narrative and contextual qualitative analysis, perception mapping, univariate and multivariate quantitative approaches, and the triangulation of these analyses into a cohesive final product. Dr. Driscoll has led studies evaluating and refining systems to identify or respond to such disparate public health challenges as bioterrorist and chemical terrorist attack, cancer clusters, and HIV/AIDS. He is currently developing health education campaigns to describe health risks from environmental contamination and to enhance informed decision making regarding cancer screening. He has more than 10 years of experience conducting analytical and descriptive studies, including cross-sectional (prevalence) surveys, community-based environmental health assessments, health risk characterizations, and needs assessments.

Rational Response: RTI Research Supporting Health System Preparedness

Lucy A. Savitz

The RTI International (RTI) Integrated Delivery System Research Network (IDSRN) identified bioterrorism preparedness as a research priority two years ago. Based on IDS input, RTI partnered with member systems to secure Agency for Healthcare Research and Quality (AHRQ) funding for an applied research agenda.

The foundation for our research is represented in our *Workbook for Sharing Regional Bioterrorism Preparedness Tools*. The workbook is intended to guide decisions in rationally allocating scarce resources; it includes the Pittsburgh Matrix, an assumption matrix, and a cost capture tool. Our work is led by RTI with clinical researchers at University of Pittsburgh Medical Center (UPMC) Health System/University of Pittsburgh (UPMC/Pitt) with replication research at Intermountain Health Care. The workbook is complemented by *An Innovative Technology-Based Intervention for Hospital Bioterrorism Preparedness Training*. The tool provides opportunity for more efficient and effective preparedness drills. Our principal partner is UPMC/Pitt.

As RTI works with IDSRN partners to advance decision support and training tools for preparedness, we have sought to create enhanced dissemination channels. These efforts are supported through an AHRQ grant, *Partnership for Advancing Quality Together* (PAQT), where we are studying: (1) how interventions can be transported and adapted; and (2) synergies between bioterrorism preparedness and quality improvement.

Next steps include dissemination and extending completed research. Our research is featured in an upcoming AHRQ Regional Bioterrorism Preparedness series for Health Resources and Services Administration (HRSA) awardees, as well as a two-part site visit for state and federal policy makers. We will submit a grant in January 2004 to enhance the Pittsburgh Matrix with simulation capabilities and study the implementation of completed work through PAQT.

Lucy A. Savitz, PhD, MBA
RTI International

Lucy Savitz holds a PhD from the Department of Health Policy and Administration at the University of North Carolina at Chapel Hill (UNC) and an MBA from the University of Denver. With more than 17 years' experience in health care delivery and health services research, she has worked as a financial planner at UNC Health Care, a researcher at the Cecil G. Sheps Center for Health Services Research, as a faculty member at the UNC School of Public Health, and now as a senior health services researcher at RTI International (RTI) in the Health Care Quality Program. Prior to joining RTI, Dr. Savitz served as an economist for the Colorado Legislative Council. At RTI, Dr. Savitz directs the AHRQ-funded master task order, *Accelerating the Cycle of Research in Integrated Delivery Systems,* and has led several task orders including *Assessing the Information Technology Infrastructure in IDSs, IDS Solutions for Transferring Medication Information Across Patient Care Settings, AHRQ-Sponsored Workbook for Sharing Regional Bioterrorism Preparedness Tools*, and *Developing an Innovative, Technology-Based Training Intervention for Hospital Bioterrorism Preparedness*. Her research expertise in evaluating the implementation of clinical process innovations, collaborative research, and translation of research into practice has been primarily funded by the Agency for Healthcare Research and Quality (AHRQ) and the Centers for Disease Prevention and Control (CDC). Dr. Savitz has been acknowledged as an examiner for the 2001 and 2002 Malcolm Baldrige National Quality Program, administered by the American Society for Quality and the National Institute for Standards and Technology in the U.S. Department of Commerce. She is also a Fellow in the Intermountain Health Care Quality Institute, a research Fellow at the Cecil G. Sheps Center for Health Services Research, and a research assistant professor in the UNC Department of Health Policy and Administration (HPAA). She has taught the core strategic management course in HPAA for 7 years and currently guest lectures there as well as teaches a module in the CDC Management Academy, which is based at UNC.

The Juncture of Health Security and Public Health Systems Research

Ronald R. Fichtner, PhD

Preparedness and partnering have become the new main priorities for public health, no longer the institution it once was. Being ready for terrorism is now seen as more important than delivering services. Thus, the key research questions have become:

- How can we define the new public health infrastructure and chart its progress?
- How do we measure the infrastructure's preparedness?
- How do we evaluate its response to real threats?
- How do we evaluate the relationships of resources to outcomes/performance?

Within RTI's recent opportunities in health security, including those described in this session, it is striking that a great number of these can also be classified as *public health systems research*, which can be somewhat implicitly defined as:

- Assessing the degree of preparation of public health systems and their infrastructures for potential threats to population health.
- Evaluating skills and competence among the public health work force.
- Understanding and describing the relationships of public health systems performance and community health outcomes.

Thus, the new frontiers in health security research will utilize, probe, and expand the methods of public health systems research, a very multidisciplinary endeavor, using many of the same methods as health services research, but with a focus on our public health systems (its behaviors, dimensions, vitality, constraints, readiness, resources, and variability across jurisdictions).

Ronald Fichtner, PhD
RTI International

Ronald Fichtner serves as director for Research Development, Statistics, Surveys, and Computing Sciences, having joined RTI International (RTI) in early 2001 after a 23-year career with the Centers for Disease Control and Prevention (CDC). He also leads the Health Security Team of RTI's Social and Statistical Sciences research unit and has worked with scientists across RTI to develop and respond to research opportunities in health and home security since 9/11. Trained as a theoretical mathematician, Dr. Fichtner was director, Prevention Informatics Office, Office of the Director (OD), National Center for HIV, STD, and TB Prevention (NCHSTP) at CDC from 1996 until 2001, a position that supported all of NCHSTP's divisions and its OD. Dr. Fichtner began his CDC career in 1979 as a mathematical statistician in CDC's Division of Venereal Disease Control and also served in management positions in behavioral intervention research in NCHSTP. The head of RTI's Atlanta office, Dr. Fichtner currently serves as the Director of RTI's master task order contract with CDC: Scientific, Technical, and Operational Services for Epidemiology, Surveillance, and Laboratory. Dr. Fichtner has made numerous programmatic and scientific contributions to public health prevention research, to surveillance, including behavioral surveillance, and to public health informatics. His research is reflected in a diverse portfolio of scientific publications.

Training and Communication

National Capital Area Medical Simulation Center

Alan Liu

The realistic training of first responders in a weapons of mass destruction (WMD)/mass-casualty situation requires significant resources, logistics, and planning. Training at major facilities can disrupt normal operations. Scenarios cannot be dynamically reconfigured. Virtual environments and medical simulators provide a unique training modality that can be effectively adapted to mass-casualty training. The NCA Medical Simulation Center is engaged in research to meet these training requirements. This presentation discusses the current and future issues in using simulation technology to address the medical challenges of homeland defense.

Alan Liu
The National Capital Area Medical Simulation Center, Uniformed Services University

Alan Liu is project scientist for the National Capital Area Medical Simulation Center, Uniformed Services University. The SimCen is the nation's largest integrated simulation facility for medical education. He is involved in defining research directions and technical infrastructure for VR-based medical simulators. Dr. Liu is the principal developer of the center's pericardiocentesis and diagnostic peritoneal lavage simulators. They are the world's first computer-based trainers for these procedures. These simulators were used in the nation's first advanced trauma life support (ATLS) course conducted without animals or cadavers. The SimCen's present focus is the development of an immersive virtual environment for training first responders in homeland defense scenarios.

Types of Terrorists and Their Likely Threats to Homeland Security

Margaret A. Zahn

This presentation will describe the five major types of terrorists groups: left wing, right wing, religious, single issue, and separatists. The basic characteristics of each group will be outlined, including examples of each. These groups' preferred modes of attack, as well as their usual targets, will also be outlined. Both domestic and international groups will be illustrated, with some discussion of their aims, methods, and potential likelihood of success.

These materials are based on a course taught by the presenter on Terrorism and Public Policy at North Carolina State University, and draws on material secured when the presenter co-directed the Social Science Terrorism Task Force at the National Institute of Justice. While the materials are not health related per se, they can provide some conceptual overview of the groups we are dealing with.

Margaret A. Zahn, PhD
RTI International

Margaret A. Zahn is a nationally known criminologist with 30 years' experience in violence research. She currently directs RTI International's (RTI'S) Crime and Justice Program, and most recently served as director of the Violence and Victimization Division of the National Institute of Justice in Washington. Prior to that, she was dean of the College of Humanities and Social Sciences at North Carolina State University. During her academic career, she has led a number of research projects, including studies of intimate partner homicide and multicity studies of homicide. She is a Fellow and has served as president of the American Society of Criminology. Dr. Zahn is a member of the peer-review panel for injury research at the Centers for Disease Control and Prevention, as well as peer reviewer for multiple agencies and journals. She is also a member of the faculty of North Carolina State University in the Department of Sociology and Anthropology. She has edited three books on violence and homicide and has published extensively in peer-reviewed social science and criminology journals. She co-led the task force on social science research in the area of terrorism at the National Institute of Justice following the attacks of 9/11 and recently taught a course on Violence, Terrorism and Social Policy at North Carolina State University.

Virtual Patient Simulation for Emergency Preparedness Training

Paul Kizakevich

Adequate training for major disasters such as bioterrorism, explosions, or the release of dangerous chemicals is difficult to sustain, because these events occur so rarely. Large-scale exercises require coordination among various emergency response providers and live actors to portray realistic casualties. For several years RTI has been developing interactive 3D trauma casualty simulations for training emergency medical personnel; now RTI has extended this simulation architecture to support chemical exposure and multiple-casualty scenarios.

Sim-Patient presents a scenario comprising a virtual scene, trauma or medical conditions, and one or more patients. The caregiver can navigate and survey the scene, interact and converse with the virtual patient, use medical devices, administer medications, monitor data, and perform interventions. The simulation presents animated, 3-D patients with signs and symptoms related to level of exposure for recognition of the appropriate level of treatment. The simulated patients represent casualties with four levels of exposure: minimal, mild, moderate, and severe. Animations such as vomiting, tearing, coughing, seizure, and convulsions are dependent upon calculated estimates of cyanide in blood level after exposure. Physiological effects such as respiratory arrest, increasing pCO_2, catecholamine effects, and skin color changes are also based on blood levels and imply the appropriate treatment for each level of exposure.

Virtual patient simulation can familiarize emergency providers with rare casualties, train them to recognize signs and symptoms, and assess their competence to recognize and treat specific conditions. By integrating patient simulation and traditional training technologies, RTI's Sim-Patient could become a national model for emergency preparedness training.

Paul N. Kizakevich, MS, PE
RTI International

Paul N. Kizakevich is manager of medical simulation and training at RTI International (RTI) and is principal investigator responsible for the overall scientific and technical direction of the project. Mr. Kizakevich is principal investigator for multiple medical simulation projects including the STATCare trauma and chemical casualties, U.S. Army Self-Aid/Buddy-Aid casualties, and the Sim-Patient MILES XXI "laser-tag" casualties. He also serves as a study director on RTI's Bioterrorism Initiative for innovative approaches to training clinicians for bioterrorism preparedness (funded by the Agency for Healthcare Research and Quality. STATCare received the 2001 Industry Award for Modeling and Simulation Training Group Team Award of the National Training Systems Association (NTSA).

The Communication of Fear: Past, Present, and Future Strategies for Discussing Homeland Security Issues with the American Public

Anna Weaver and Jill Denning

Warnings and instructions from the U.S. government to prepare for disaster (specifically, foreign attack) are nothing new. The "duck and cover" rhetoric used during the Cold War was abandoned in the early 1980s, and a sense of security pervaded the nation until September 11, 2001.

Events of that day and concerns about future terrorist threats have spurred a new line of rhetoric from the government about measures Americans should take to stay safe. One of the most readily apparent examples is the U.S. Department of Homeland Security's Web site for the public, *www.ready.gov*. While its effectiveness is yet to be determined, it appears to offer advice that could apply to any disaster situation, natural or man-made.

This presentation will briefly outline the history of the rhetoric used in communicating foreign threats to the public. The presentation will also look at potential rhetorical strategies that could be used in developing future communications to the American public, including:

- public health communication strategies (e.g., AIDS in the 1980s, STDs, tobacco),
- tactics taken from literature on organizational crisis communications, and
- communication strategies employed by other nations (Israel, United Kingdom, Australia, etc.).

Finally, the presentation will suggest areas of future study, including surveys to measure effectiveness of current rhetorical strategies and usability studies of Web sites (such as *www.ready.gov*) and other instructional materials.

Jill Miller Denning, MS
RTI International

Jill Miller Denning brings her experience in journalism, public relations, and a nonprofit trade association to her role as RTI International's employee communications supervisor. She oversees internal communications, which include StaffNet, RTI's Intranet; RTI's company store; and news vehicles such as *RTI News Connection*, a newsletter published every other week; NewsDesk, RTI's Intranet news site; and the quarterly video news program RTI in Focus. In addition, she serves as the communications liaison for Institute-wide initiatives and serves as the company's transportation representative for Research Triangle Park's Transportation Management Association, SmartCommute@RTP. Ms. Denning received her MS in technical communication from North Carolina State University and her BS in agricultural communication/print journalism from the University of Illinois (Urbana-Champaign).

Anna Weaver, MS
RTI International

Anna Weaver has more than 5 years of experience in technical communication—as a practitioner, academic researcher, and instructor. As a technical editor and writer in RTI International's Office of Communications, Information, and Marketing, she has supported project deliverables and proposals across the Institute, encompassing such fields as education research, aerospace technology, toxicology, energy technology, and international development. Ms. Weaver edits technical documents (including reports, proposals, presentations, and journal articles targeting both expert and nonexpert audiences) and writes original material (including newsletter articles and marketing materials for internal and external audiences). She has also conducted research to help guide organizational communications, and drafted internal communications plans for a variety of initiatives. Ms. Weaver holds an MS in technical communication from North Carolina State University, where she pursued studies in the rhetoric of science, the history of rhetoric, environmental and health communication, and crisis communication.

Posters

1. Protective Agents Against Nerve Gas Attack

Anita H. Lewin, Jerzey Szewczyk, S. Wayne Mascarella, F. I. Carroll

Exposure to the lethal chemical warfare agents soman (GD), sarin (GB), and VX leads to uncontrolled increases in the concentration of the neurotransmitter acetylcholine at cholinergic nerve junctions, ultimately leading to respiratory failure. The mechanism of action is known to involve inactivation of the enzyme acetylcholinesterase (AChE) by phosphorylation. Preventing the phosphorylation of AChE by pretreatment with a suitable chemical agent could therefore protect against the toxic effects of such chemical warfare attacks. Pyridostigmine and physostigmine are two agents whose effectiveness is due to this mechanism; both have seen large-scale use as premedications during the Persian Gulf War. Unfortunately, use of both agents is limited by their side effects, particularly as factors in the declines in subjective health status after use. We have taken advantage of the known effect of the *Amarylidaceaea* alkaloid galanthamine on chemical reactions at the esteratic site of AChE, and of the published structural features required for binding of small molecules to AChE to design analogs of galanthamine as possible protective agents. Analogs were synthesized and evaluated for their toxicity, ability to protect mice against GD, and undesirable side-effects. Several promising (orally bioavailable, on-toxic) therapeutic leads for protection against nerve agent attack were identified.

Wayne Mascarella, PhD
RTI International

S. Wayne Mascarella received his PhD from the University of North Carolina at Chapel Hill while developing total syntheses of triquinane and fenestrane terpenoid natural products via photochemical and organocuprate chemistry. Preceding his graduate research, Dr. Mascarella, as a research associate in the Department of Physiology of the Louisiana State University School of Medicine, worked on the synthesis of hemicholinium neurotoxins. Dr. Mascarella later joined the Center for Bio-Organic Studies at the University of New Orleans as a research associate in HPLC, gas chromatography and mass spectrometry methods development and microanalysis.

Since joining RTI International (RTI) in the summer of 1986, Dr. Mascarella has worked on projects involving the design and synthesis of new enzyme inhibitors and neurochemical receptor ligands. Dr. Mascarella has also participated in pioneering the application of computational chemistry at RTI. He has applied the techniques of computer-aided drug design in the development of predictive pharmacophore models and the detailed study of drug-receptor interactions.

As part of this research, Dr. Mascarella carries out molecular mechanics, molecular visualization, molecular dynamics, and quantum mechanics-based theoretical studies on the structure-activity relationships of numerous classes of pharmacologically active compounds. An important part of this chemoinformatic research has been the design and implementation of several large-scale chemical structure and property databases.

Dr. Mascarella is the co-author of over 60 scientific publications, eight patents and two book chapters.

2. Biodefense Partnerships: Anti-smallpox Agents from Basidiomycetes (mushrooms)

Nicholas H. Oberlies, Stewart Shuman (Sloan-Kettering Institute), E. Edward Mena (LifePharms)

The basic strategy for eliminating smallpox involves eradication of the virus via prophylactic immunization of the entire population, and the success of this has been viewed as a medical triumph. However, treatments for those infected with smallpox are virtually nonexistent. This shortcoming makes it a promising target for bioterrorism, especially given the large segments of the population who have not been vaccinated due to the aforementioned victory in eradicating the disease. We have been expanding our natural products drug discovery efforts to include possible bioterrorism targets by screening a library of mushroom extracts against assays that model smallpox. The major goals of this collaboration are to find compounds from mushrooms that may serves as drug leads for the treatment or chemoprophylaxis of smallpox. Our screening strategy will focus on essential poxvirus-encoded proteins involved in transcription of viral early genes. Specifically, our mushroom extract library (>13,000 basidiomycetes and ascomycetes) will be tested for the inhibition of mRNA synthesis and mRNA processing by purified infectious orthopoxvirus particles. The most promising leads will be prioritized based on a several factors, including relative potency of the extract, potential of the mushroom to reveal novel compounds, and supply of the organism on hand. Bioactivity-directed fractionation will be used to focus our purification efforts towards the most bioactive compounds. A host of secondary assays will be used to assess the potential of the purified lead compounds, with the ultimate goal of determining their mechanism of antiviral action.

Nicholas H. Oberlies, PhD
RTI International

Nick Oberlies is the head research chemist in RTI International's (RTI's) Natural Products Laboratory. Along with Dr. Mansulch Wani, Dr. Oberlies leads a multidisciplinary effort to identify, isolate, and characterize new drug entities from natural sources such as plants, mushrooms, and bacteria. At RTI since 1998, he was selected by Dr. Wall to train as his successor. Dr. Oberlies was recently recognized by the American Cancer Society with a research scholar grant to study novel anticancer compounds from mushrooms. The studies proposed herein are an extension of this research.

He earned his BS in Chemistry from Miami University and his PhD in Medicinal Chemistry and Pharmacognosy from Purdue University, where he studied under Professor Jerry McLaughlin. He completed a postdoctoral Fellowship at American Cyanamid before joining RTI. He was recognized for his graduate work with the Kilmer Prize, an honor awarded jointly by the American Society of Pharmacognosy and the American Pharmaceutical Association. He recently served as chairman of the organizing committee for the 44th Annual Meeting of the American Society of Pharmacognosy, which took place in July 2003.

3. Artificial Enzymes Afford Protection Against Chemical Warfare Nerve Agents

Herbert H. Seltzman, Dale L. Koble, R. Wayne Hendren, Dan G. Groblewski, Anne F. Gilliam, Madhu S. Lonikar, Zdzislaw M. Szulc, Gregory E. Despopoulos, Stanton Q. Smith

The debilitating and often fatal effects of organophosphate nerve agents (soman, sarin, VX, tabun) operate by blocking the function of the nervous system regulatory enzyme acetylcholinesterase (AChE). Once AChE is inactivated, the nerve cells become depolarized in 5 minutes and cease to control the numerous physiological operations they mediate, and the associated life maintaining functions fail. Antidotes do not work in many cases, and alternative pharmacological scavenging protocols are an area of current focus for protection.

A scavenging-based protection was developed that destroys nerve agents in vivo before they can reach the nervous system and inactivate AChE. This protection uses artificial enzymes based on β-cyclodextrin (βCD) that rapidly scavenge soman under physiological conditions both in vitro and in vivo.

Two classes of modified βCD scavengers were found to be effective. The first was stoichiometric scavengers (one molecule of scavenger consumes one molecule of soman). Capped βCD derivatives were developed which were three orders of magnitude more active in vitro than unmodified βCD. The best of these to date protected guinea pigs against soman toxicity. This compound was within two orders of magnitude of the activity of AChE, which is one of the most active enzymes in the body.

A second type of scavenger was catalytic enzyme mimics (one molecule of scavenger hydrolyzes multiple molecules of soman without being consumed). Catalytic hydrolysis of soman multiplies the effectiveness of the scavenger and is a unique property that even AChE does not exhibit. These artificial enzymes are new chemical entities that offer a pharmacological protection against chemical warfare nerve agents.

Herbert H. Seltzman, PhD
RTI International
Center for Organic and Medicinal Chemistry
Science and Engineering Group

Herbert H. Seltzman has pursued research in organic and medicinal chemistry through numerous programs at RTI International (RTI) since earning his PhD at the University of Pittsburgh. A research area related to the current presentation has been the development of enzyme mimics to scavenge the chemical warfare agent soman. Over the course of three programs with the Army, increasingly sophisticated structures that exhibit the function of even substantially more complex natural enzymes were designed, synthesized, and tested. These compounds reacted with the toxic soman rapidly at physiological conditions. The most promising compound protected animals against the fatal effects of the toxic nerve agents. Further design advances introduced true catalytic activity for hydrolyzing soman, which natural enzymes could not achieve. Dr. Seltzman is currently exploring wider applications of this technology. Other achievements include the development and patenting of a non-caloric high intensity sweetener in research conducted for the National Institute of Dental Research. A long standing focus has been in drug synthesis and discovery for studies of drug abuse and medicinal research. This has been directed at cannabinoids, which interact with the brain and peripheral neurochemical system on which marijuana acts. Other areas of research include the development of new methods for radiochemistry and synthesis of compounds for cancer research.

4. Research on Terrorism: A Cross-national Comparison of Inter-agency Coordination Between Public Health and Law Enforcement

Joe Eyerman, Kevin J. Strom

In the post-9/11 world, public health and law enforcement are required to assume new and overlapping roles in response to terrorist threats. As a result, it is critical that we improve both the level and means of cooperation between U.S. public health and law enforcement agencies across federal, state, and local jurisdictions.

This project examines strategies for inter-agency coordination in the United States, the United Kingdom, and Canada, emphasizing technological mechanisms that can be used to facilitate communication, such as public health surveillance systems. The project's primary goal is to yield a set of best practices that will help U.S. agencies improve cross-agency preparation and response to terrorist threats. In addition, the study will catalogue the methods and technological tools used to coordinate public health surveillance and law enforcement in the three countries, as well as barriers to coordination, new technologies and methods for coordination, and data quality issues that impact the utility of systems. As part of this effort, RTI researchers will interview law enforcement and public health stakeholders in each of the three countries.

The RTI team will be supported by an expert panel comprised of internal and external consultants with expertise in terrorism incident response, bioterrorism preparedness, public health surveillance, and law enforcement operations. The study's researchers will also draw on the help of area consultants from the United Kingdom and Canada. This project is funded by the National Insitute of Justice, the research arm for the U.S. Department of Justice.

Joe Eyerman, PhD
RTI International

Joe Eyerman has research experience with international and comparative studies of the relationship between the structure of political systems and the prevalence of war, political violence, and international terrorism. His work has included game theoretic and statistical models of the decision process used by terrorism organizations when targeting states with violence. He has served as analyst or survey methodologist on a variety of terrorism preparedness and surveillance system studies, including evaluation of surveillance system design for the Behavior Risk Factor Surveillance System, surveys of public health lab preparedness as part of Assessing Laboratory Preparedness for Chemical Attack, and assessment of the role of the health care provider in terrorism response on the Agency for Healthcare Research and Quality-sponsored Workbook for Sharing Regional Bioterrorism Preparedness Tools project. He is currently co-principal investigator on the study, Research on Terrorism: A Cross-National Comparison of Inter-agency Coordination between Public Health and Law Enforcement. His current research interests include data quality issues in surveillance systems, and the study of coordination across agencies.

5. Monitoring of Participants Who Received the Extended Post-exposure Anthrax (Bacillus Anthracis) Prophylaxis

Brian Burke, Brian Evans, R. Suresh

A prevention program was undertaken as a consequence of bioterrorist attacks involving the distribution of *Bacillus anthracis* in mailed packages and letters in the fall of 2001. As of December 5, 2001, the Centers for Disease Control and Prevention (CDC) has identified a total of 22 cases of anthrax that were presumed to result from workplace exposures related to these acts of bioterrorism. Post-exposure prophylaxis for approximately 10,000 persons was recommended and undertaken.

The CDC is in the evaluation phase of the program that distributed antibiotics (ciprofloxacin and/or doxycycline) to persons as part of the post-exposure prophylaxis against anthrax. The objectives of this evaluation are to assess the provision of antimicrobial agents and educational materials to affected persons, to identify any adverse events associated with the use of the antimicrobial agents, and to characterize adherence to the recommended regimen. The information from this evaluation will be critical to CDC's effort to improve the technical assistance and supplies needed with any future anthrax post-exposure prophylaxis campaigns and to comply with Food and Drug Administration regulations for monitoring for adverse events.

The CDC has contracted with RTI International to conduct telephone interviews of all persons for whom post-exposure antibiotic prophylaxis was recommended.

This poster will describe methodological challenges encountered and solutions implemented for this study and the lessons learned that will be used to develop best practices and white papers that can be readily applied to the evaluation and monitoring design to other bioterrorist or disease outbreaks.

Brian J. Burke, MBA, MS
RTI International

Brian Burke, a senior survey director, has been with RTI International since 1990. He has more than 23 years of experience in managing survey research projects. Mr. Burke worked for the U.S. Bureau of the Census for 11 years as an area manager, demographic coordinator, and program supervisor. At RTI, he designs and manages survey research projects on various topics, such as homeland security, bioterrorism, pharmaceuticals, alcohol and drug use, mental health services, home ownership, and health-related topics. His experience includes more than 10 years of work on the National Survey on Drug Use and Health (NSDUH), one of the largest federally sponsored surveys and RTI's largest field data collection effort. The NSDUH collects data on the use of tobacco and alcohol, illicit drugs, and the non-medical use of prescription drugs from the civilian, non-institutionalized population of the United States. Additionally, Mr. Burke served 1 year on the National Survey on Child and Adolescent Health, 2 years on the National Longitudinal Study of Adolescent Health (Add Health), and is currently Project Director on studies for CDC, the University of North Carolina at Chapel Hill, and a commercial client. Mr. Burke has an MBA from the Kenan-Flagler Business School at the University of North Carolina at Chapel Hill, and an MS in ecology and environmental biology from the University of Notre Dame.

6. The *NoVac* Study — Evaluation of Non-participants in the Pre-release Smallpox Vaccination Program

Brian Burke, Brian Evans, Kristine Fahrney, Paul Levy, R. Suresh

In the aftermath of the 9/11 tragedy and the increasing evidence that smallpox virus may have been taken from a repository in the former Soviet Union, the Advisory Committee on Immunization Practices (ACIP) in 2002 recommended smallpox vaccination of personnel designated to investigate and follow up initial smallpox cases and selected health care workers in facilities designated as smallpox referral centers. On December 3, 2002, the president of the United States announced a new official government policy for vaccinating health care workers against smallpox.

It quickly became evident that there was considerable resistance among these health care workers to being immunized. In an effort to identify and document the barriers to participation, the Centers for Disease Control and Prevention (CDC) contracted with RTI International to design and implement an evaluation study. Once these barriers were identified, a framework of educational and other interventions could be developed to lessen these barriers. This study was designed to include 10,000 participants in five states. Each of the states has a state coordinator who works with the CDC and RTI to recruit the hospitals and state health departments. The participants would be recruited from these hospitals and state health departments within the five selected states. The respondent lists will be uploaded from the recruited entities to RTI via an ftp site. The primary mode of data collection is telephone, with options for a self administered Web survey and a self-administered mail survey component. This poster presentation will discuss in detail the study methods and will include discussion of our initial progress and barriers encountered.

Brian J. Burke, MBA, MS
RTI International

Brian Burke, a senior survey director, has been with RTI International since 1990. He has more than 23 years of experience in managing survey research projects. Mr. Burke worked for the U.S. Bureau of the Census for 11 years as an area manager, demographic coordinator, and program supervisor. At RTI, he designs and manages survey research projects on various topics, such as homeland security, bioterrorism, pharmaceuticals, alcohol and drug use, mental health services, home ownership, and health-related topics. His experience includes more than 10 years of work on the National Survey on Drug Use and Health (NSDUH), one of the largest federally sponsored surveys and RTI's largest field data collection effort. The NSDUH collects data on the use of tobacco and alcohol, illicit drugs, and the non-medical use of prescription drugs from the civilian, non-institutionalized population of the United States. Additionally, Mr. Burke served 1 year on the National Survey on Child and Adolescent Health, 2 years on the National Longitudinal Study of Adolescent Health (Add Health), and is currently Project Director on studies for CDC, the University of North Carolina at Chapel Hill, and a commercial client. Mr. Burke has an MBA from the Kenan-Flagler Business School at the University of North Carolina at Chapel Hill, and an MS in ecology and environmental biology from the University of Notre Dame.

7. Surveillance for Presence of Anthrax Spores in Our Mailrooms: "Seek and Ye Shall Find"

Paul S. Levy

Finding a needle in a haystack is difficult. Proving that the needle is NOT in the haystack is even harder. This problem—demonstrating with confidence that something is not present—became a grave concern of politicians and scientists in the Autumn of 2001, when mail-associated anthrax attacks struck fear in the United States and panic in the nation's capital. After anthrax spores were found in a letter addressed to then Senate Majority Leader Thomas Daschle, investigations revealed that the mailroom serving Sen. Daschle was part of a network of approximately 3,200 other mailrooms. Contamination of these other mailrooms by anthrax spores escaping from the Daschle letter or other letters became an immediate concern. However, testing all of the 3,200 or so mailrooms for anthrax would be expensive, labor-intensive, and too slow to prevent further cases of this potentially lethal disease.

In the Spring 2002 issue of *CHANCE*, the presenter and several co-authors reported a study investigating whether a sample of these mailrooms could have been taken to determine the likelihood of further anthrax contamination. We came to the conclusion that approximately 3,040 of the 3,200 (95% of them) would have to be sampled to give reasonable assurances that there was no further contamination. Thus, sampling in this instance would not have saved much in the way of timeliness and resources. We concluded that when investigators aim to find and eliminate all reservoirs of anthrax (or other lethal hazards), sample sizes are not only large, but exactly proportional to the level of certainty the investigators wish to assume. In essence, if investigators want to be 100% certain there is no needle in a particular haystack, they have to check the entire haystack.

This presentation presents additional statistical work done since then and shows that a Bayesian approach might lower the necessary sample size dramatically.

Paul S. Levy
RTI International

Paul S. Levy is a distinguished biostatistician and epidemiologist at RTI International (RTI), who began his career in public health 43 years ago at the Centers for Disease Control and Prevention (CDC) in the Epidemic Intelligence Service (EIS). His career includes positions on the faculty of Harvard Medical School and the National Center for Health Statistics, followed by 31 years at the University of Illinois at Chicago (UIC), where he was a founding faculty member of the School of Public Health and the first director of the combined Division of Epidemiology and Biostatistics. He has held leadership roles in major epidemiological studies and clinical trials, as well as contributing to statistical methodology. He has served throughout his career on numerous federal expert panels, study sections, and data safety monitoring boards. After retiring from UIC in 2002, he joined RTI as a senior research statistician, where his work has focused on CDC-supported projects, including the sample survey of health care workers who have refused smallpox vaccination, the Behavioral Risk Factor Surveillance System (BRFSS), and the Assessment of Perinatal HIV Testing Rates by Medical Chart Review. Most recently, he has been awarded through RTI a CDC grant to investigate the accuracy of hepatitis A immunization rates that are obtained from parental recall data. His work in epidemiology and biostatistics has been recognized by his election as a member of the American Epidemiological Society, and as a Fellow of both the American College of Epidemiology and the American Statistical Association.

8. Computer-based Security Analysis Tool

W. Joseph Alexander

The U.S. Coast Guard is requiring some 5,000 facilities located on ports or navigable waterways to conduct security assessments. Petroleum refineries are attractive to terrorists because of the large impact a disruption in this industry sector could have on our economy.

The American Petroleum Institute (API) and the National Petrochemical & Refiners Association (NPRA) developed a security vulnerability analysis (SVA) methodology for their industry. An SVA identifies facility assets, vulnerabilities, and terrorist threats. These factors are analyzed to determine the most appropriate countermeasures. Although valuable, the SVA process is cumbersome and requires several weeks to conduct.

RTI has met with API, NPRA, industry, and security professionals to discuss development of a computer-based security analysis tool to improve the SVA process. The tool will feature industry-specific templates with standard asset, vulnerability, and threat information. The templates will make data entry and analysis efficient, allowing users to focus on the most valuable assets needing protection. This information will feed into a facility database, allowing users to retrieve and analyze security information using a variety of parameters and reporting features (e.g., most vulnerable assets, cost of new countermeasures).

RTI's security analysis tool will be applicable to other industries, including chemical, fertilizer, and pharmaceutical manufacturers. Other applications include financial institutions, hospitals, and local governments. An enterprise edition is envisioned to merge multiple facility databases into a corporate-wide database. Planned geographic information systems (GIS) enhancements include integration of facility maps, with spatial links to assets, security information, and surrounding geographic features to aid in security assessments.

Joe Alexander
RTI International

Joe Alexander is with RTI International's (RTI's) Environment, Health, and Safety Division. He recently received security vulnerability analysis (SVA) training and has researched related security vulnerability methods. In addition to leading the development of a security analysis tool, he has spearheaded development of other RTI decision support tools to serve commercial client needs. He led an environmental safeguard evaluation of a nuclear storage facility to assess potential consequences of worst-case scenarios in response to homeland security concerns of private industry.

Mr. Alexander has been involved in a wide range of multidisciplinary projects during his 20 years at RTI, including hydrogeologic site assessments, brownfields redevelopment, remedial technology, and GIS. He worked for consulting engineering firms for 10 years prior to joining RTI. He holds a master's degree in geology from Northern Arizona University and a bachelor's degree in geology from East Carolina University.

9. Capabilities in Accreditation/Certification of Security Sites

John Mitchell, Mike Baylor, Craig Sutheimer

RTI International (RTI) has developed a performance-based assessment model for programs that require high levels of performance, technical expertise, database reporting, troubleshooting of issues, and remediation of deficiencies. Included in this model are facility certification and inspection, training/monitoring of key facility personnel in program requirements, and performance appraisal of technical operations. This model is applicable to security operations in airports and other sites with general public access, laboratories, and other programs requiring standardization. RTI developed this model through its experience with the National Laboratory Certification Program (NLCP).

The NLCP facilitates the certification of forensic urine drug testing laboratories by the U.S. Department of Health and Human Services. RTI conducts inspections (including unannounced inspections) of certified and candidate laboratories utilizing trained inspectors consisting of consultants and RTI staff. In addition to this rigorous on-site scrutiny, participating laboratories must also demonstrate acceptable performance in an equally rigorous performance testing (PT) program that examines every aspect of the laboratories' testing procedures. NLCP/RTI staff administer a respondent program of remedial actions to correct deficiencies discovered through these activities.

RTI has significant capabilities to offer agencies in establishing an accreditation/certification program for facilities and operational programs. The necessity for maintaining and documenting a high standard of operation with defined quality assurance and training programs for security checkpoints is more important than ever. The flexibility of the model allows development of programs as an integral part of an agency, independent of agency personnel or as a combined effort. In either case, a complete unbiased review of program performance is achievable.

Michael R. Baylor, PhD
RTI International

Michael R. Baylor is a senior research forensic toxicologist at RTI International (RTI) in Research Triangle Park, NC. He currently serves as co-project director for the National Laboratory Certification Program (NLCP). He is responsible for managing the NLCP laboratory inspection activities. Dr. Baylor also is involved with the National Forensic Laboratory Information System (NFLIS) working with the drug chemistry sections of state and local crime labs throughout the nation.

Dr. Baylor received his doctorate degree in pharmacology from West Virginia University in 1976. He served in the U.S. Army Medical Department from 1976 to 1987 as a forensic toxicologist, where he was involved in post mortem toxicology, urine drug testing, and clinical toxicology. Since then, he has been involved in various aspects of drug testing including serving as the director of CompuChem Laboratories (1987-1990). He was appointed senior staff Fellow (1990-1993) at the National Institute of Drug Abuse and special expert (1993-1994) for the Substance Abuse and Mental Health Services Administration (SAMHSA) developing technical policies and procedures for federal workplace drug testing.

He has presented numerous lectures for continuing education workshops and toxicology review courses. Dr. Baylor is active in the American Academy of Forensic Sciences (AAFS), the Forensic Toxicology Certification Board (FTCB) and the Society of Forensic Toxicologists (SOFT) where he currently serves on the Board of Directors and the Membership Committee.

10. The Use of Surrogate or Simulant Biowarfare Agents

Karin Foarde, Jonathan Black, Jim Hanley, Dave Ensor, Deborah Franke

Since 9/11, there has been a great need for information on biological warfare agents (BWA). How to sample a contaminated environment, what is the susceptibility of BWA to antimicrobial chemicals, how can we effectively decontaminate large spaces, and how can we protect ourselves against future attacks are just a few of the issues that have to be addressed. Not only are the answers needed, but also they need to be correct.

The monetary and time commitment required to use live agents is prohibitive. The need to use actual agents is highly controversial. In order to arrive at solutions in a timely manner, the question of when is the use of simulants or surrogates is appropriate and when live agents are necessary has been hotly debated. Furthermore, considerable controversy surrounds the issue of which surrogates should be selected.

We have been addressing the question of which surrogates are appropriate and for which applications. We have been using a variety of surrogates/simulants. All are appropriate dependent upon the requirements of the research and the needs of the clients. For some applications, carefully selected, related microorganisms are used. For others, molecular biology techniques are appropriate; while for others inert particles have been used. Often a combination of surrogates is necessary. This poster will address some of those questions and a variety of projects will be discussed.

Karin Foarde, MS
RTI International

Karin Foarde is a senior research microbiologist with over 25 years of experience, and is the program director of RTI International's Microbiology Department. She designs, directs, and conducts applied and basic research in microbiology and aerobiology. She has authored or co-authored five book chapters and over 70 papers on methods, systems, or process development, environmental monitoring and exposure assessment, and decontamination efficacy evaluations. Her research interests focus on bioterrorism associated with biological aerosols and the environmental causes of allergy and asthma. Her bioterrorism research experience includes the detection of, the decontamination of, and protection from biowarfare agents. The asthma/allergy work focuses on researching the biological contaminants isolated from the environment to identify environmental causes of illness and to recommend methods for preventing such biological contamination and its associated adverse health effects. These organisms include airborne allergens as well as pathogens.

Ms. Foarde also conducts laboratory and field research in environmental microbial assessment, environment biopollution, and antimicrobial/biocide efficacy evaluations. She supervises the sampling, isolation, identification, quantitation, and inactivation of microorganisms (bacteria, fungi, viruses) in air, water, soils, and industrial fluids and materials. Her work leads to assessment and evaluation of microbial colonization, ecological niches, and biotic relationships. Her extensive background in microbiology has enabled her to make significant contributions in bacteriology and mycology by sampling and analysis of microbiological agents, elucidating components or by-products, developing appropriate study design, assessing quality assurance and quality control, and evaluating personal exposure to biological agents.

11. Testing Program for Collective Protection Technologies

Deborah Franke

RTI International has established a safe buildings Environmental Technology Verification (ETV) Program for products that clean ventilation air. This program is funded by the U.S. Environmental Protection Agency under its National Homeland Security Research Center's Safe Buildings Program. Products that may be tested include devices such as filters or other particulate air cleaners, ultraviolet radiation units, and carbon or other chemical filters that work in building ventilation systems/ducts or in individual rooms. Both biological and chemical threats are included for the testing. Test/quality assurance (QA) plans are developed, after input from a group of stakeholders representing government, industry, and academia. This paper will discuss the ETV process, types of products that may be tested, test procedures, and the initial tests on selected commercial filters.

Deborah Franke, MS
RTI International

Deborah Franke in RTI International's Center for Aerosol Technology has managed and participated in defense, environmental and electronics research and development. She has worked extensively on government, industry, and joint public-private funded projects. She has managed a range of projects, including the development and maintenance of environmental databases and electronics design. She has degrees in physics and electrical engineering.

12. Chemical Warfare Agent Simulants

Anita H. Lewin, Yen Bao, Colin G. Pitt

Decontamination is an essential component of a response to attack by a chemical warfare (CW) agent. Development of effective decontamination protocols requires testing and validation. To minimize the exposure of personnel to the actual CW agent it is desirable to use simulants during the validation of any decontamination procedure. Such simulants possess physical and chemical properties closely resembling those of the CW agent but are devoid of significant toxic effects. In a program designed to identify simulants for the nerve agent sarin (GB), compounds were designed, synthesized and evaluated. Three non-toxic sarin simulants with the requisite volatility, water and organic solubility, and reactivity were identified. One of the simulants had a saponification rate slightly exceeding that of sarin, and it reacted slowly with hypochlorite. The other two simulants were found to have saponification rates very close to that of sarin and they were completely inert to hypochlorous acid.

Anita H. Lewin, PhD
RTI International

Anita Lewin obtained her PhD from the University of California at Los Angeles. Her doctoral research focused on conformational analysis utilizing kinetic, thermodynamic, and NMR methods. Her current focus on physical organic chemistry includes molecular modeling and simulation, methods that are instrumental in drug discovery (computer assisted drug design) and medicinal chemistry.

Before joining RTI International in 1974, Dr. Lewin was research assistant professor at the University of Pittsburgh (1963-1966) and professor of chemistry at the Polytechnic Institute of Brooklyn (now Polytechnic Institute of New York). She was principle investigator on grants from the Petroleum Research Fund (PRF) and from the National Institutes of Health (NIH). The PRF grant supported research on the role of copper (I) in organic chemistry, and the NIH grant supported work on the conformational analysis of peptides.

At RTI, Dr. Lewin developed expertise in radiosynthesis and has been principal investigator on a contract to prepare radiolabeled ingredients of cosmetics for the study of skin penetration (FDA). She is co-principal investigator on NIDA and NIMH contracts to prepare labeled and unlabeled CNS-active compounds and metabolites.

Dr. Lewin further expanded her areas of expertise by working two years in the laboratory of Dr. Phil Skolnick at the National Institute of Diabetes, Digestive and Kidney Diseases (NIDDK) to learn pharmacological techniques. This translated into the discovery of ACPC, a unique ligand for the NMDA receptor complex, and the development of high specific activity ACPC.

Major areas of Dr. Lewin's research include potential intervention and treatment methods for Parkinson's, Huntington's, Alzheimer's, and infectious diseases, as well as addiction and detoxification, pain, and cancer.

13. Towards the Development of a Metalloporphyrin-based "Chemical Reactivity" Sensor: Organophosphate Reactants

J. McKinney, R. Helburn (Pace University)

Organophosphorus compounds comprise the reactive (toxic) component of several nerve agent formulations that are of concern from an environmental security standpoint. The anticipated sensor will utilize a metalloporphyrin (MP) array as the input transducer where the signal will be based on changes in the multiple ultraviolet/visible spectra of the individual metalloporphrins as they interact with target chemicals. Chemometric data pattern recognition routines embedded in the processor will be used to sort the spectral responses according to the pre-determined behavior of the chosen "reactivity-based" analyte group. In this initial work, we examine the ability of a suite of tetraphenyl metalloporphyrins to capture the characteristic chemical reactivity of selected organophosphate (OP) reactants via changes in their solution phase ultraviolet/visible spectra. The OP pesticides are less reactive structural relatives of the nerve gases. Several OP pesticides and their more reactive (toxic) oxon metabolites are being examined in preliminary solution phase studies. The concept of a "reactivity-based" array sensor and the importance of MP spectral changes in the development of the front-end chemistry of this type of sensor will be discussed.

James D. McKinney, PhD
RTI International

James McKinney's work experience includes over 30 years of service in the federal government (both the National Institutes of Health (NIH) and the Environmental Protection Agency [EPA]) as a research chemist/scientist. He is currently a senior scientist in Analytical and Chemical Sciences at RTI International. Specific qualifications and experience include performing as a bench scientist, a research program manager and laboratory chief/supervisor, senior science advisor and program analyst, with emphasis on the chemical/biochemical aspects of the environmental health sciences. Relevant work experience includes research in the area of environmental and pesticide chemistry and metabolism involving the synthesis and characterization of metabolites, directing major research programs in pharmacokinetics, environmental health related chemistry, analytical and synthetic chemistry, and bioorganic chemistry with emphasis on development of structure activity relationships as applied to the study of mechanisms of action of chemical toxicants. Accomplishments and recognition of work have included awards, invited presentations and other honors, patents, committee and consultant appointments, membership in professional societies, and numerous publications, with a significant number being in the area of analytical and pesticide chemistry and metabolism. Collaborators and other affiliations throughout this work include graduate/dental/medical students, NIH/EPA postdoctoral/visiting/staff Fellows, and NIH visiting scientists.

14. RTI's Support for TSWG in the Development of Standard Methods for Testing HVAC Air Cleaners

Charles E. Rodes, and Douglas W. VanOsdell

The events of 9/11 focused the potential for terrorist insertion of contaminants into the building HVAC systems, especially for high-visibility structures (e.g., embassies). Minimizing human risks from these events requires rapid removal of the contaminants by filtration media. Existing and new filter media are becoming available to allow gas-phase contaminants to be extracted from the air; however, the efficiencies of these technologies have not been evaluated in any systematic manner.

The Technical Support Working Group (TSWG) asked RTI to utilize its existing gas phase testing capabilities to develop standardized test methodologies to evaluate filtration media performance.

The goals of the research are to:

- define small and large scale test methods that can subsequently be implemented by the media development and manufacturing industry,
- validate the methods using real filtration media, and
- provide the methods to the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) for potential adoption consideration.

A method development had already been conducted at RTI that challenges ~50 g of bulk media at a low flowrate (28.32 lpm) for determination of contaminant removal effectiveness. It was tailored for TSWG specifically for SO_2, NH_3, and DMMP challenges. A concurrent RTI large-scale method to conduct the same testing to replicate commercial HVAC system operation at 1,000 cfm flowrates has also been developed for the same contaminants.

This presentation describes the capabilities that led TSWG to come to RTI, our experimental approaches, and the current project status.

Charles E. Rodes, PhD
RTI International

Charles Rodes in RTI International's (RTI's) Center for Aerosol Technology has over 36 years of experience planning, conducting, managing, and reporting research and development studies related to environmental assessment and control. Technical specialty areas have included test method development for gas phase sorption media, human exposure and activity assessments for adults and children; indoor air, microenvironmental, and personal air sampling (especially for children); size-specific aerosol and ETS exposure sampling sensors and systems; receptor modeling of size-specific aerosols in urban environments; dermal transfer of dusts and residues; indoor air velocity and turbulence characterizations; in-vehicle multi-pollutant exposures, $PM_{2.5}$, PM_{10}, and total inspirable aerosol sampler evaluations; size-specific aerosol sampling, and removal of gas-phase toxics by in-line media beds. The panel studies have also included activity level assessments and associated human health indicators (e.g., cardio-pulmonary functions, metabolic rate) and biological aerosols, including endotoxins.

15. Strategies to Protect Buildings Against Chemical and Biological Attack: Potential Research Areas

Jonathan Thornburg, Douglas Van Osdell, Deborah Franke, Phil Lawless, David Ensor

The Center for Aerosol Technology at RTI International (RTI) currently has a contract with the Defense Advanced Research Projects Agency (DARPA) to provide technical support for the Immune Building Program. The program has three goals: (1) to protect the human inhabitants of such buildings in the event of a chemical or biological agent attack; (2) to restore the building to full function as quickly as possible after the attack; and (3) to preserve forensic evidence for treatment and retaliation.

Our work on this program has provided insight into gaps in the technical knowledge base that possibly will lead to new research in several of RTI's core disciplines. Innovative research in chemical/biological sensors and forensic evidence collection methods possibly could yield patents and commercial licensing agreements. Compact, low cost sensors that provide a wide dynamic range and high accuracy are required. Legally defensible methods for collection and long-term storage of chemical/biological agents or their by-products are required as well. Potential work in the development of test protocols is another area to pursue. A new paradigm for testing building protection systems is required, considering the number of new sensors and control technologies that will become available. Similarly, new modeling methods are required to characterize building airflow patterns and test different protection strategies without the expense of field experiments. The new models would provide more detail than simple box models, without the complexity of computational fluid dynamics. Finally, risk analysis tools to assess the feasibility of the protection strategies for application by other groups and technology transfer methods for effective distribution of this knowledge need to be developed.

Jonathan Thornburg, PhD
RTI International

Jonathan Thornburg started his career as an aerosol engineer in RTI International's (RTI's) Center for Aerosol technology in 1999 after completing his PhD in aerosol science and engineering at the University of North Carolina at Chapel Hill. His research at RTI has focused on aerosol physics and exposure assessment. He recently evaluated strategies for protecting buildings against chemical and biological attack. This evaluation included testing methods and effectiveness of the protection technique. He also has characterized the performance of several real-time aerosol monitors. This work led to improvements in their design that increased their accuracy and precision. His collaborative exposure assessment research examined exposure pathways to lead particles in carpet, particulate matter within residences, and oil mists from industrial processes. Currently, he is evaluating particle resuspension mechanisms from flooring. He has a BS in Chemical Engineering from Purdue University and a MSE in Environmental Engineering from the University of Wisconsin.

16. Use of Responsive Virtual Human Technology for Interview Training

Geoffrey Frank, Curry Guinn, Robert Hubal

A critical area of training for homeland security involves interaction skills, to include interviewing, negotiation, de-escalation, and information elicitation. Appropriate and continuous interaction skills training must be provided to large numbers of individuals who are dispersed over a large area in a wide range of professions.

Role-playing is a well-known method for teaching interview techniques, but it is expensive, since each learner is working one-on-one with a role-playing actor. The variation in how actors respond to situations makes it difficult to ensure that all the learners receive the same quality of practice and evaluation. Role-playing is also time-consuming, limiting learner practice time. Web- and CD-delivered simulation technology is evolving to make learning-by-doing practical for first responders studying homeland security techniques such as interviewing suspects.

Over the last eight years, RTI International has developed responsive virtual human technology with the support of federal agencies including the National Institute of Justice, Agency for Healthcare Research and Quality, National Institute on Drug Abuse, National Institutes of Health, and the National Science Foundation. Computer simulation of the role-playing actor, using a responsive virtual character, eliminates the cost of actors, ensures consistent behavior by the subject, and enables on-demand repetitive practice. The ability to download simulation software over the Internet or send out on CD-ROM makes it possible to distribute up-to-date training broadly and quickly.

Geoffrey Frank
RTI International

Geoffrey Frank is a principal scientist at RTI International. He has a PhD in computer science from the University of North Carolina at Chapel Hill. He was project leader for the NIJ JUST-TALK project, and is a principal investigator on a National Science Foundation grant on responsive virtual human technology (RVHT), leading efforts to assess the use of RVHT for training applications.

17. Using Interactive 3D (i3D) Technology for First Responder Medical Simulation and Training

Jerry Heneghan

The need to improve medical readiness for trauma, bioterrorism, chemical terrorism, other man-made events, and natural disasters is clear. Simulation-based training can provide the means to train and evaluate providers for these infrequent events without the expense of large-scale, live-actor exercises. Although instrumented manikins have become popular resources for such exercises, they cannot portray the subtle and changing nature of medical signs and symptoms, nor the casualty movement, multiple-casualty chaos, and teamwork of emergency personnel in a disaster situation.

RTI's Sim-Patient™ software provides physiologically accurate, fully immersive, dynamic virtual scenarios that enhance mission-critical lifesaving skills for the first responder.

Sim-Patient™ is a simulation suite that replicates trauma, chemical injury, and limited biological injury. A dynamic physiology engine lies at the heart of the technology and responds in real time to user interventions. User interactions and physiological data are recorded for after-action reviews. Standard notebook and pocket personal computers are used as portable i3D treatment interfaces to assess competency at various skill levels.

In this presentation, Jerry Heneghan will discuss how RTI's solution can be used to simulate disasters in a dynamic virtual setting so that providers can learn, practice, and validate triage, medical response, and decision-making skills at their convenience using affordable and deployable personal computer software.

Jerry Heneghan, BS, MBA
RTI International

Jerry Heneghan, is a program manager in RTI International's (RTI's) Technology Assisted Learning Division. His duties include managing the RTI Sim-Patient portfolio of medical simulation and training software applications. Mr. Heneghan is a U.S. Military Academy graduate and former U.S. Army Apache helicopter pilot and commander. He is also a veteran of the commercial software industry, having developed products at Tom Clancy's Red Storm Entertainment, Interactive Magic, and Nortel Networks. He holds a Global MBA from Duke University and has extensive international business experience in the following countries: Germany, Austria, Italy, Czech Republic, Holland, United Kingdom, China, Korea, Japan, Brazil and Chile.