

NATIONAL CENTER FOR
FOOD PROTECTION AND DEFENSE
A HOMELAND SECURITY CENTER OF EXCELLENCE

**National Center for Food Protection and Defense (NCFPD)
2005 Annual Report**

Report to University Programs
Office of Research and Development
Science & Technology Directorate
Department of Homeland Security

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I. Introduction

The National Center for Food Protection and Defense (NCFPD) was officially launched as a Homeland Security Center of Excellence (COE) in July 2004.¹ Developed as a multidisciplinary and action-oriented research consortium, NCFPD addresses the vulnerability of the nation's food system to attack through intentional contamination with biological or chemical agents. NCFPD takes a comprehensive, farm-to-table view of the food system, encompassing all aspects from primary production through transportation and food processing to retail and food service. NCFPD's research and education program is aimed at reducing the potential for contamination at any point along the food supply chain and mitigating potentially catastrophic public health and economic effects of such attacks.

Food protection and defense encompasses a wide range of critical infrastructure protection activities, involving supply chain security, public health response, economic analysis, detection and inactivation methodologies, decontamination protocols, risk communication, and education and training. Experts in these areas were selected to participate in NCFPD's research consortium; over 140 such experts from academia, private sector research organizations, professional organizations, state and federal government agencies, and the food industry are currently involved in NCFPD's research program.

In delivering on its mission to defend the safety and security of the food system through research and education, NCFPD places a high priority on the following critical aspects:

- Threats to the food system that could lead to catastrophic damage to public health or the economy
- Significant improvement in supply chain security, preparedness, and resiliency
- Rapid and accurate methods to detect incidents of contamination and to identify the specific agent(s) involved
- Strategies to reduce the risk of foodborne illness due to intentional contamination in the food supply chain
- Tools to facilitate recovery from contamination incidents and resumption of safe food system operations
- Rapid mobilization and delivery of appropriate and credible risk communication messages to the public
- High quality education and training programs to develop a cadre of professionals equipped to deal with future threats to the food system.
- Close collaboration with federal and state agencies responsible for food safety and security, other Homeland Security COEs, and private sector stakeholders to leverage expertise and resources

This report outlines NCFPD's approach to the priorities listed above and summarizes currently funded projects. Initial outcomes of these projects are highlighted below.

¹ NCFPD's three-year, \$15 million grant was awarded on June 16, 2004.

II. Research and Education Program

NCFPD’s research program is organized thematically into three primary areas—*systems* (supply chain, public health response, economic analysis, and security), *agents* (detection, inactivation, and decontamination), and *training* (risk communication and education). Preparedness is a major component of the training theme, with an emphasis on pre-crisis communication planning, message development, communication with under-represented populations, media relations, and risk communicator training for a variety of audiences, including subject matter experts, government officials, food industry representatives, and extension educators.

Each theme represents two or more research teams. Leaders of the research teams oversee their group of projects and serve as points of contact for coordination of research within NCFPD as well as between NCFPD and other COEs, national laboratories, and federal regulatory agencies. Four NCFPD Cores (Public Health, Laboratory, Risk Communication, and Education) are designed to work closely with the research teams to disseminate new tools and information developed by the research teams.

NCFPD Themes, Research Teams, Cores, and Leaders
<i>Theme I - SYSTEMS</i>
Supply Chain and Information Management – <i>Leader: David Closs, MSU</i>
Public Health Response and Epidemiology – <i>Leader: Craig Hedberg, UMN</i> Public Health Core/Workgroup – <i>Leader: Craig Hedberg, UMN</i>
Economic Analysis – <i>Leader: Jean Kinsey, UMN</i>
Security – <i>Leader: Ted Labuza, UMN</i>
<i>Theme II - AGENTS</i>
Detection and Diagnostics – <i>Leader: Vivek Kapur, UMN</i> Laboratory Core – <i>Leader: Bill Krueger, Minnesota Department of Agriculture</i>
Inactivation/Food Processing – <i>Leader: Ted Labuza, UMN</i>
Decontamination and Disposal – <i>Leader: Don Vesley, UMN</i>
<i>Theme III - TRAINING</i>
Risk Communication (including Core) – <i>Leader: Will Hueston, UMN</i>
Educational Programs (including Core) – <i>Leader: Ed Mather, MSU</i>

Academic collaborators in NCFPD’s research consortium include the University of Minnesota (UMN), Michigan State University (MSU), University of Wisconsin–Madison (UW), North Dakota State University (NDSU), Georgia Institute of Technology, University of Tennessee–Knoxville (UTK), and individual collaborators from 19 other universities. Additional research collaborators are drawn from private sector research organizations, state health and agriculture agencies, and professional organizations.

Nearly all NCFPD research and education projects involve students and research trainees. In total, there are currently 7 postdoctoral researchers, 38 graduate students, 6 undergraduates, and 2 high school students working on NCFPD-funded projects. Many of these students presented posters of their work at NCFPD’s Annual Meeting and at other food protection and defense research meetings (see Appendix B.)

At present, there are 29 NCFPD-funded projects in progress across nine research teams, as listed below. While the lead organization is highlighted, nearly all NCFPD projects include collaboration across multiple teams and organizations.

NCFPD-FUNDED PROJECTS & LEAD INSTITUTIONS OR ORGANIZATIONS - 2005	
Project	Lead Group
<i>Theme I: Systems</i>	
<i>SUPPLY CHAIN & INFORMATION MANAGEMENT</i>	
Supply Chain Security Best Practices—Suppliers & Manufacturers	MSU
Supply Chain Productivity and Resiliency—Logistics & Transportation	Georgia Tech
Supply Chain Benchmarking—Wholesale, Retail, & Food Service	UMN
Supply Chain Standards	GSC Mobile Solutions
Incident Management Infrastructure	GSC Mobile Solutions
<i>PUBLIC HEALTH RESPONSE & EPIDEMIOLOGY</i>	
Consequence Management System (CMS)	BT Safety LLC
Modeling Response and Remediation Parameters for the CMS	UMN & Rutgers University
Evaluation of Timelines for Botulism Outbreaks	UMN & CDC
Public Health Investigation of Multistate Foodborne Outbreaks	UMN & CDC
Public Health Core	UMN
<i>ECONOMIC ANALYSIS</i>	
Economic Impact Analysis	State of MN and UMN
Consumer/Citizen Survey	UMN and State of MN
Reduction of Economic Impact	NDSU
Statistical Risk Metrics	UW—Milwaukee
<i>SECURITY</i>	
Food Facility Construction for Built-In Security	UMN
<i>Theme II: Agents</i>	
<i>DETECTION & DIAGNOSTICS</i>	
Hydrophobic Extraction of <i>B. anthracis</i> Spores from Liquid Foods	UMN
Electrochemical Biosensors for <i>B. anthracis</i>	MSU
Rapid Testing for Botulinum Toxin using Egg Yolk Antibodies	UW
Botulinum Neurotoxin Sensing Technologies	UW
FASTMAN Integrated Device for Detection of Select Agents	UMN/ANDX Inc. with 3M
Biosensors for Detection of Chemical Toxins	Rutgers University
Laboratory Core	MN Dept of Agriculture
<i>INACTIVATION/FOOD PROCESSING</i>	
Heat Inactivation Kinetics of Spores in Liquid Milk	UMN
<i>DECONTAMINATION & DISPOSAL</i>	
Use of Commercial Household Sanitizers to Inactivate Spores	University of Tennessee
Inactivation of Microbial Agents with High Concentrations of Industrial Sanitizers	Ecolab Inc
Containment and Remediation System	BT Safety LLC
Plasma Technology to Decontaminate Surfaces	UW
<i>Theme III: Training</i>	
<i>RISK COMMUNICATION</i>	
Risk Communication Training (including Risk Communication Core)	UMN
<i>EDUCATION</i>	
Educational Programs (including Education Core)	MSU

III. Highlights and Accomplishments

In its first year and a half of operation, NCFPD has made significant progress in all research areas. As reflected in the preliminary results and accomplishments noted below, the Center has steadily developed new collaborations and multidisciplinary efforts across academia, the private sector, and government; additional collaborations are an ongoing focus of activity. A large cadre of students is successfully working in this program, demonstrating the capability of the academic research community to respond

flexibly and rapidly to the need for professional expertise in all aspects of food protection and defense.

Coinciding with its one-year anniversary, NCFPD presented a briefing on its progress and accomplishments for DHS Secretary Michael Chertoff in July 2005. A small group of investigators, industry collaborators, university officials, students, and staff gathered at UMN to review current initiatives and tour a detection laboratory for a hands-on demonstration. DHS University Programs Director Mel Bernstein, DHS Infrastructure Coordination Deputy Director Paul Hightower, and Food and Agriculture Sector Coordinating Council representative Clay Detlefsen also participated in the briefing. Highlighted topics included:

- The “FASTMAN” instrument, a new platform for rapid detection of potential biological and chemical agents in the food system, developed by NCFPD investigators at UMN in collaboration with private sector companies ANDX and 3M.
- NCFPD’s “consequence management system” (developed by BT Safety LLC in collaboration with multiple NCFPD investigators), which visually demonstrates the potential magnitude of public health and economic consequences of a specific contamination scenario, e.g., introduction of botulinum toxin into specialty ice cream production.
- Safe and effective methods for decontamination and remediation following a contamination incident, applicable to food processing facilities and consumer environments.

ACCOMPLISHMENTS OF NCFPD-FUNDED PROJECTS IN 2005 INCLUDE THE FOLLOWING:

► The Supply Chain Best Practices team’s discussions with food industry firms indicate that development of the **security assessment and benchmarking tool** in this project will help companies (1) understand and organize their supply chain security practices, particularly the often overlooked areas of communications, management support, interaction with suppliers, customers, and carriers, (2) identify practices that have the greatest impact on efforts to enhance supply chain security, and (3) provide a low-risk tool to educate supply chain partners regarding the importance of implementing security practices.

► Collaborators at Georgia Tech are analyzing **security practices among logistics and transportation carriers** serving the food industry and have developed a supply chain resiliency model that supports inventory planning in single-source supply chains to reduce costs associated with random disruptions at a single chokepoint; the team has also obtained US Department of Transportation funds for a companion project that will extend the results for NCFPD’s modeling efforts.

► Preliminary results of the **retail supply chain benchmarking** project indicate that (1) retail wholesalers and food service distributors are ahead of retail stores and restaurants in preparedness for catastrophic incidents, and (2) the weakest area of security practice in almost all companies was in screening employees. Data are obtained through interviews and comprehensive surveys with company executives. The results will be used to provide benchmark reports on preparedness to participating companies and to develop recommendations on improving security, protecting employees and consumers,

reducing vulnerabilities, and enhancing consumer confidence in the safety of the food supply.

► Investigators in the **Supply Chain Standards** project have reviewed security guidelines from a wide range of national and international food sector organizations in an effort to develop a common standard for security within the food industry; outcomes will include new proposed standards refined through expert review as well as recommendations for implementation and enforcement.

► In the Supply Chain **Incident Management Infrastructure** project, investigators have initiated the development of an integrative, advanced technology-based infrastructure for communications and information management, consistent with the National Incident Management System, to support secure, two-way communication in the event of a catastrophic food-related incident.

► The prototype computer-based **predictive modeling tool**, the Consequence Management System, has been used in many demonstrations—including NCFPD’s briefing for Secretary Chertoff, the NPS executive education seminar, and IFT-FDA biosecurity training sessions—to visually illustrate the nature, scope, and impact of intentional contamination of selected vulnerable foods with bioterrorism agents, allowing assessment of the effects of different intervention strategies on resulting public health and economic outcomes. Working scenarios include anthrax on lettuce and *Clostridium botulinum* toxin in ice cream.

► Using Analytica simulation software, the Public Health Response team has developed a prototype system for **modeling the public health system response** to intentional food contamination; specific data collection efforts currently focus on timelines for response to botulism outbreaks and to foodborne disease outbreaks across multiple states.

► Preliminary findings from the **economic impact analysis** of a catastrophic food contamination incident on the national economy suggest that (1) the economic shock, reflected in the cumulative current value of the loss in real GDP, could exceed \$190 billion, and (2) the impact of productivity losses over time associated with a major terrorist incident would have even larger economic consequences, far exceeding those estimated in short-term GDP losses.

► Preliminary results of a large, national **survey on attitudes toward public investment in antiterrorist activities** indicate that the American public would likely support additional spending on measures to protect the nation’s food system and to prevent intentional food contamination with chemical or biological agents.

► Investigators applied “real-options” modeling to the **cost-effectiveness analysis of investments in supply chain security**, such as “smart seals,” which incorporate RFID tags; their results indicate that adopting such seals in the small-grains logistic system is more cost-effective than the current approach of random product tracing forward and backward; similar analyses are ongoing with additional commodities.

► A unique dataset has been created to catalog incidents of intentional chemical, biological, and radiological terrorist attacks, currently totaling 314 such incidents worldwide since 1961; investigators are using a risk metric, based on Extreme Value

Statistics, to assess and predict the **probabilities of rare but catastrophic terrorist events** based on past observations, and have shown that the frequency of such terrorist events is increasing while the average length of time between incidents is declining.

► Ongoing research is progressing toward the **development of a biosensor** using polyaniline-antibody conjugates on a capture pad to detect microbial agents in less than 15 minutes per sample at 10-100 cfu/ml sensitivity; a prototype biosensor unit was tested initially on the *B. anthracis* surrogate, *B. cereus*, in culture and in artificially contaminated food products.

► Egg antibodies have been successfully used to (1) **generate large quantities of reagents for botulinum toxoid A detection**, and (2) neutralize the lethal effects of botulinum toxin in animals; recent collaborative efforts are aimed at enhancing the sensitivity of other detection methods by using the egg antibody methodology to develop extraction antibodies for isolating trace amounts of toxins or microbial agents in food products.

► Progress has been made in developing **novel detection systems for botulinum neurotoxin** using microfluidics and liquid crystal-based sensors; such sensors are designed for continuous monitoring at multiple points in the supply chain, particularly in fluid milk processing facilities, to provide timely and accurate information on potential sites of intentional contamination.

► Biosensor development continues at Rutgers University, where investigators report promising results with electrochemical impedance spectroscopy for **detection of Category B toxins** (enterotoxin and ricin) in culture at high levels of sensitivity (0.01 ng/ml).

► Studies on the thermal **inactivation kinetics of spores of *B. anthracis* surrogate strains** indicate effective time periods and temperatures needed for heat treatment to inactivate the spores in fluid milk; these results provide options for safeguarding the overall milk supply during a contamination incident.

► NCFPD's Laboratory Core has worked with officials from FDA, USDA, and a number of food and agriculture associations to create the National Food and Agriculture Laboratory Committee ([NFALC](#)), a consortium of food and agriculture control associations, which provides an effective mechanism for **coordinating efforts and communicating among laboratories**; NFALC will work with state food and agriculture laboratories to validate new diagnostic technologies evolving from NCFPD's research, integrate them effectively into the Food Emergency Response Network (FERN), and coordinate surge capacity among laboratories during a large scale incident.

► Investigators at University of Tennessee–Knoxville have identified two groups of **household disinfectant-sanitizers**—those containing sodium hypochlorite, such as bleach, and hydrochloric acid, such as drain opener—that have potential for use by consumers to decontaminate foods or surfaces in the home, thereby preventing the disposal of products contaminated with pathogenic microorganisms into the wastewater or solid waste system.

► Collaborators at Ecolab measured the inactivation of *Bacillus anthracis* surrogates on clean or food-soiled hard surfaces across a wide **range of concentrations of**

commercially available sanitizers; results represented in a time/temperature/concentration matrix provide new quantitative data on the necessity of using higher-than-typical concentrations of liquid sanitizers in industrial settings, including food processing facilities, during a potential food contamination incident.

► Investigators have made significant progress in the development of a functional **containment and remediation software system** for planning, managing, and tracking a variety of activities critical to minimizing the impact of an intentional food contamination incident— disposal of contaminated products, decontamination of sites, certification of readiness for resumption of business, and communication strategies; plans include the incorporation of validated agent- and food-specific remediation protocols and recommendations on the use of personal protection equipment.

► Investigators report preliminary success with an **atmospheric pressure plasma reactor** (which produces highly reactive oxygen species, such as free radicals and hydrogen peroxide) to inactivate *B. cereus* spores on clean and milk-soiled surfaces; potential advantages of this approach include its portability, open design, and versatility in a range of food processing environments.

► The Risk Communication team collaborated on multiple initiatives, e.g., (1) a set of ten **best practices for pre-crisis risk communication** messages, including a message development template for use as a training resource and planning tool, (2) an online summary of risk communication **educational offerings**, and (3) a risk communicator's **training curriculum** focused on intentional food contamination, piloted as a graduate course at the [Winter Public Health Institute](#) in Gainesville, Florida, January 2006.

► The Educational Programs team initiated a Web site, www.FoodProtectionEducation.org which links to the NCFPD site, to organize and disseminate a wide range of **educational resources pertaining to food protection and defense**, meeting resource needs defined by participants at a broadly attended Education Team workshop; efforts are underway to develop an Internet-based **educational resource database** and a **glossary** of food protection and defense terms.

RELATED GRANTS OBTAINED THROUGH NCFPD COLLABORATION

FDA/CFSAN: Grant obtained by BT Safety LLC (Jeff Sholl, Susan Harlander and Andrew Jaine, NCFPD Public Health Response team; NCFPD Decontamination team) to develop complimentary models for food safety events including base programming infrastructure, which will complement the NCFPD efforts and increase our overall capabilities in this area (\$600,000 in FY05, \$400,000 in FY06).

Minnesota Department of Agriculture-DHS: Milk biosecurity grant obtained by Ted Labuza (UMN, NCFPD Security in Food Processing) and Shaun Kennedy (UMN, NCFPD Associate Director) to characterize the milk system from farm through retail in the St. Paul/Minneapolis metropolitan regions (\$100,000 FY05).

USDA/CSREES/National Integrated Food Safety Initiative (NIFSI): Four-year grant obtained by Craig Hedberg (UMN; NCFPD Public Health Response team) and Bill Krueger (Minnesota Dept. of Agriculture; NCFPD Laboratory Core), in collaboration

with the National Food and Agriculture Laboratory Committee (NFALC), the Association of Food and Drug Officials (AFDO) and the National Environmental Health Association (NEHA), to provide a mechanism to facilitate communication and coordination of analytical services among state and local food and agriculture laboratories, which are responsible for a variety of analytical services to identify and respond to threats or incidents of food contamination. The project includes (1) *Applied research* to extend a prototype system to collect, organize, retrieve, and share information on technical capacity and expertise among food regulatory agencies; (2) *Education* to develop and deliver multidisciplinary courses and training programs for food regulatory personnel; and (3) *Outreach and extension* to develop a food biosecurity training module to accompany the National Environmental Health Association's "Epi-Ready" training program, which is used to prepare environmental health specialists to conduct foodborne disease outbreak investigations and to develop and deliver Web-based just-in-time training materials and new outreach content for a range of food system stakeholders and spokespersons through USDA's Extension Service (\$2 million FY06-10; www.nfalc.org/).

Dairy Marketing Institute (DMI): Grant obtained by Ted Labuza and Francisco Diez-Gonzalez (UMN; NCFPD Security in Food Processing team) to extend work on their NCFPD project "Heat Inactivation Kinetics of Spores and Toxins in Food Products", examining pasteurization profile methodology, including ways to eliminate the Maillard reaction in milk (off-flavors and browning of the milk) due to high temperature/time pasteurization needed to inactivate *B. anthracis* spores.

Food Safety Research and Response Network (FSRRN): NCFPD assisted in proposal development for the [FSRRN](#); continuing collaboration between the two centers, including joint planning for the April 3-5, 2005, Research Needs Summit (Chicago) and the Nov 3-4, 2005, Food Protection and Defense Research Conference (Atlanta); partnered on preparation and submission of a 2004 conference grant proposal to USDA-CSREES/NIFSI.

IV. Center Organization

NCFPD director, Frank Busta, and two associate directors, Michael Osterholm and Shaun Kennedy, make up the NCFPD's senior leadership team, responsible for overall strategic and tactical programs and management. The Office of the Director also includes a senior program analyst, a graduate student research assistant, and support staff for accounting, communications, administrative assistance, and Web site development. Three advisory committees, described below, provide distinct and complementary areas of guidance to the senior leadership team.

RESEARCH EVALUATION AND ADVISORY PANEL

The Research Evaluation and Advisory Panel (REAP), made up of academic collaborators, is charged with reviewing the overall direction and scientific content of the program, soliciting and peer-reviewing proposals (adding external experts when needed), and making recommendations regarding research funding. As shown below, NCFPD's senior leadership team, one representative from each of the eight research teams, and eight at-large members make up the REAP, with the NCFPD director serving as chair.

NCFPD Research Evaluation and Advisory Panel (REAP) 2005			
NCFPD Director, Frank Busta, <i>Chair</i>; Associate Directors, Michael Osterholm and Shaun Kennedy			
Research Team Members		At-Large Members (years in term)	
David Closs	MSU	Lawrence Casper (2)	University of Wisconsin–Madison
Craig Hedberg	UMN	Robert Gravani (2)	Cornell University
Will Hueston	UMN	William Nganje (1)	North Dakota State University
Vivek Kapur	UMN	Michael Pariza (3)	University of Wisconsin–Madison
Jean Kinsey	UMN	Tim Sellnow (3)	North Dakota State University
Ted Labuza	UMN	Donald Schaffner (3)	Rutgers University
Edward Mather	MSU	Chelsea (Chip) White (1)	Georgia Institute of Technology
Donald Vesley	UMN	Tsegaye HabteMariam (2)	Tuskegee University

INDUSTRY WORKGROUP

NCFPD’s Industry Workgroup (IWG) provides expert technical advice and guidance to the Center, including critical “end-user” feedback. Co-chaired by Joe Scimeca (Cargill Inc.) and Dane Bernard (Keystone Foods LLC), the workgroup includes a farm-to-table spectrum of senior scientists and executives in the food industry. Specific activities include expert consultation on research planning and data collection, along with technical support and expertise regarding topics such as:

- Critical nodes in the food production process
 - Best practices for enhanced security throughout production and processing
 - Information systems for managing consumer input
 - Strategies for improved communication about threats and contamination events
- In the event of a food contamination incident, the IWG may be asked to provide support and expertise (e.g., gathering and interpreting threat and event information, or evaluating supply chain security).

IWG members meet in person twice a year and by conference call once a month.

Members currently include:

NCFPD Industry Workgroup 2005		
Joe Scimeca, <i>Co-chair</i>	Director, Corporate Regulatory Affairs	Cargill Inc.
Dane Bernard, <i>Co-chair</i>	VP, Food Safety & Quality Assurance	Keystone Foods
Darren Blass	Dir., Quality Assurance & Product Safety	Jack in the Box Inc.
Ken Conover	Director, Incident Management	Coca Cola North America
Mike Craig	Dir., Food Safety & Security–International	Wal-Mart Stores Inc.
Sarah Geisert	Sr Dir., Product Safety & Regulatory Affairs	General Mills Inc.
Thomas Gruetzmacher	VP, Research and Development	Land O'Lakes Inc.
Jamie Jamison	Director	Nat. Corn Growers Assoc.
Cindy Jiang	Director, Food Safety	McDonald's Corp
Joan Menke-Schaenzer	VP, Food Safety, Quality Assurance & Security	Wal-Mart Stores Inc.
Kirsten Meskill	Senior Security Manager, Global Security	Kraft Foods Inc.
Debbie Miller	Sr Dir., Bus. Analysis & Promotions Planning	Restaurant Services Inc.
Phil Minerich	VP, Research and Development	Hormel Foods Corp
Ned Mitenius	National Security Director	Fresh Express
Bill Newman	VP, Quality Assurance & Regulatory Affairs	Land O'Lakes Inc.
Gale Prince	Director, Corporate Regulatory Affairs	The Kroger Co.

Mike Robach	VP, Food Safety	Cargill Inc.
David Theno	Senior VP, Quality and Logistics	Jack in the Box Inc.
Jeff Varcoe	Director of Food Safety, Microbiology	Schwan Food Co.
Dave Wankowski	Regulatory Affairs Manager	Kraft Foods
Craig Watson	VP, Quality Assurance & Agricultural Sustainability	Sysco Corp.
Dave Wiemer	Director, Quality Assurance	SUPERVALU Inc.
Gerald Zeidler	Manager, Food Safety	Burger King Corp
John Zimmermann	Zone Dir., Quality Assurance & Food Safety	Sodexo Inc.

EXTERNAL BOARD OF ADVISORS

NCFPD's newest advisory group, the External Board of Advisors (EBA), was created in 2005 to provide executive-level, strategic oversight and leadership. In its unique capacity, the EBA serves to evaluate risks and opportunities in food protection and defense, assess NCFPD's overall program and its impact, and advocate for the Center's priorities among key stakeholders. The board will play a key role in ensuring effectiveness of the Center by guiding the integration of newly developed technologies, programs, tools, and expertise into public and private sector stakeholder communities. The EBA includes national leaders in industry, government, and academia, assembled in consultation with DHS-University Programs and with the EBA chair to achieve a mission-focused, action-oriented group. The EBA plans to meet in person once or twice each year and by conference call as needed; its inaugural meeting will be held February 14, 2006, in Minneapolis. Current EBA members include:

NCFPD External Board of Advisors (EBA)		
Richard Frasch, Chair	Corporate Vice President	Cargill Inc.
Douglas Baker, Jr.	President and CEO	Ecolab Inc.
Maura Havenga	Corporate Senior VP, Restaurant Solutions Group	McDonald's Corporation
Rengarajan Ramesh	General Manager, Global Technology & Engineering	General Electric Co.
Leland Ellis	Science Advisor, Science & Technology Directorate	US Dept of Homeland Security
Mark Becker	Provost & Executive VP for Academic Affairs	University of South Carolina
Robert Brackett	Director, Center for Food Safety & Applied Nutrition (CFSAN)	US Food & Drug Administration

V. Collaboration and Integration

NCFPD participates in the Office of University Programs' ongoing Integrated Network of Centers (INC) effort through regular meetings with COE directors, participation in COE workshops, collaboration among investigator teams (e.g., in economics), and activities related to the DHS Scholars and Fellows program. The INC provides a critical foundation for such cutting-edge research by facilitating new collaborations and providing unique sounding-board advice for separate but related initiatives. As research in food protection and defense progresses toward overlapping or related research areas in other COEs, future opportunities for INC participation could include development of integrated strategies for new research, as well as joint participation in resulting projects.

NCFPD currently participates in the DHS Science & Technology Action Team (STAT), working with representatives from START, FAZD, and CREATE to develop a template for documenting emerging capabilities among the COEs that can be used by DHS-S&T and Office of Weapons of Mass Destruction Operations and Incident Management (WMDO-IM) staff. This complements STAT efforts to document current capabilities among the national laboratories for emergency response.

Regarding collaboration with federal agencies on NCFPD's research program, intensive efforts among NCFPD leadership and investigators continue to identify points of contact, visit sites in person for information-sharing meetings, and establish regular communication between NCFPD and key stakeholders, including:

- FDA: Center for Food Safety & Applied Nutrition; Office of Regulatory Affairs
- USDA: Food Safety and Inspection Service; Economic Research Service; Cooperative State Research, Education and Extension Service
- EPA
- National Laboratories, particularly Los Alamos, Sandia, Lawrence Livermore, Argonne, and Pacific Northwest
- Congressional committees (Science; Agriculture; Homeland Security)

DHS SUMMER SCHOLARS FROM MINORITY-SERVING INSTITUTIONS

During the 2005 summer, NCFPD hosted two teams of visiting scientists from Minority-Serving Institutions, as part of the DHS Summer Faculty and Student Research Team Program. Both teams worked with NCFPD's detection and diagnostics group in the laboratory of Vivek Kapur (UMN). During the internship program, the visiting teams received training in a variety of basic molecular biology methods and state-of-the-art high-throughput genomic techniques applied to the detection, diagnosis, and analysis of microbial pathogens. One of the teams was led by George Nkem Ude (Dept. of Natural Sciences, Bowie State University). Dr. Ude and two of his students worked on methodology for rapid and accurate detection of potential food contamination involving microbial pathogens. Cecilia Serrano-Hidalgo (Life Science Adjunct Professor, National Hispanic University) and two of her students worked on microarray technology for microbial strain differentiation. Both teams reported that their experience at NCFPD was highly beneficial in developing their technical skills, expanding their professional connections, and broadening their opportunities to conduct scientific research in food protection and defense.

DHS NAVAL POSTGRADUATE SCHOOL

NCFPD collaborated with the Naval Postgraduate School (NPS) Center for Homeland Defense and Security in the delivery of an NPS Executive Education Seminar entitled "Interstate Preparedness Coordination for Food Security," on November 15, 2005, in Chicago. Representatives from ten Midwestern states participated in the seminar, which included presentations by NCFPD Risk Communication team leader Will Hueston and a demonstration by NCFPD Director Frank Busta of the computer simulation model being developed by BT Safety LLC for NCFPD.

VI. Outreach Events

2005 ANNUAL MEETING

NCFPD hosted its first annual meeting November 1-2, 2005, in Atlanta, with over a hundred investigators, graduate students, postdocs, Industry Workgroup members, and federal partners participating. The goal was to enhance communication and collaboration within NCFPD and with other Homeland Security COEs, federal and private sector stakeholders, and future research partners. Wyn Jennings (University Programs) provided an overview of the Homeland Security COE program, noting in particular the unique role of universities and colleges in building future intellectual capital for homeland security efforts. Early evidence of future capital was demonstrated at the meeting itself through the participation of a large group of NCFPD-supported graduate students and postdocs, who presented an impressive array of research posters. A full set of project briefings captured the breadth and depth of NCFPD research and education efforts. Small-group discussions provided opportunities for enhancing our efforts through multidisciplinary collaboration. In a concurrent half-day session, the IWG convened to review current and future capabilities being developed in each NCFPD research team and to identify high-priority outcomes from an industry “end-user” perspective. Additional special project meetings included a briefing for food industry officials on the progress of NCFPD supply chain security research and a risk communications training session for NCFPD collaborators, who may be tapped in the event of a major food contamination incident to provide subject matter expertise. Following the meeting, all invitees were sent a CD containing the meeting’s presentations, background papers, poster abstracts, and related documents.

EDUCATION WORKSHOPS at MICHIGAN STATE UNIVERSITY

The NCFPD Education Program team convened a workshop January 20-21, 2005, at MSU, involving members from academia, industry, and government. Goals of the workshop included the development of just-in-time training materials, advanced course content, virtual training programs, and interdisciplinary degree options in food protection and defense. The workshop expanded on efforts of the National Research Council’s Committee on Educational Paradigms for Homeland Security. A follow up workshop is planned for February 2-3, 2006, at MSU; topics of discussion will include: (1) review of progress since the 2005 workshop, (2) report on new initiatives, including educational modules, Open Archives, industry training, and DHS Scholars and Fellows activities, and (3) review of the INC educational initiatives.

RESEARCH NEEDS SUMMIT

NCFPD organized a research needs summit, “Food Defense Pertaining to Potential Intentional Contamination,” April 3-5, 2005, in Chicago, with support from the Institute of Food Technologists (IFT). Participants were tasked with developing recommendations for research to address gaps and needs in these areas:

- *Discovery*: identifying the incident and the agent involved
- *Protection*: determining appropriate courses of action to protect food workers and the general public
- *Recovery*: successfully managing the decontamination, disposal, and economic recovery process

A report of the meeting was published in Food Technology, August 2005.²

FOOD PROTECTION AND DEFENSE RESEARCH CONFERENCE

² The summit’s plenary presentations, including those by NCFPD collaborators, are available at <http://members.ift.org/IFT/Research/ResearchSummits/>.

A national research conference on food protection and defense, co-sponsored by NCFPD, FAZD, FSRRN, IFT, and the Western Institute for Food Safety and Security, was held in Atlanta November 3-4, 2005. The conference followed NCFPD's annual meeting in the same location and provided state-of-the-art presentations by national experts on a broad range of food protection and defense topics.³

2005 SUMMER PUBLIC HEALTH INSTITUTE

Food safety and security are among the central recurring themes of UMN's annual [Summer Public Health Institute](#), a three-week set of courses held at the UMN-Twin Cities campus. NCFPD collaborators, including Craig Hedberg, Michael Osterholm, Will Hueston, and Don Schaffner, as well as NCFPD Industry Workgroup co-chair Dane Bernard, taught courses in the 2005 event, which was attended by 386 students from 22 states. For the 2006 Institute, new courses have been added to broaden the training options in food protection and defense.

VII. Communications

Examples of targeted media coverage of NCFPD activities in 2005 include the following:

- *A recipe for disaster: scientists race to build tools to defend the food supply from terrorism, but will food companies buy them?* by Matthew Boyle in [Fortune](#) magazine, November 14, 2005.
- *Food supply attack: costly, not disastrous*, [ScienceDaily.com](#), November 8, 2005.
- *Attack on U.S. Food Supply Would be Costly*, in [USAgNet](#) December 21, 2005 and [MeatNews.com](#) December 20, 2005.
- *Defending the food supply* by Cory M. Bryant, Jennifer McEntire, and Rosetta Newsome, in [Food Technology](#), 59(8), August 2005 [report on the April 2005 Research Needs Summit].
- *Homeland Security head, U experts discuss food safety* in [Advances](#) Magazine, University of Minnesota School of Public Health, Summer 2005.
- *Safe and secure?* by Andrew Bacskai in [Minnesota Technology Magazine](#), Winter, 2005.

The Center's senior leadership staff received media training through Himle Horner, Inc., a Minneapolis-based agency specializing in public affairs. NCFPD's media relations manager in the UMN Academic Health Center is available to assist Center staff and investigators with media requests.

In August 2005, NCFPD initiated a two-page bimonthly newsletter, written by NCFPD staff, covering current activities and research topics. The newsletter is distributed by e-mail across a wide audience—in addition to academic and industry collaborators, recipients include contacts at DHS, COEs, the national laboratories, federal agencies, state legislatures, and professional organizations.

NCFPD's Web site, www.ncfpd.umn.edu, offers a range of information and tools in public and secure sections: the public section contains information about the Center, its research activities, and its collaborators. The site was highlighted as "Site of the Week" in [The Weekly Homeland Security Newsletter](#), November 18, 2005.

³ General information, including the agenda and list of speakers, is available at <https://www.ift.org/cms/?pid=6001> and <https://www.ift.org/pdfs/fooddefenseagenda.pdf>.

The secure section of NCFPD's site (via a login/password system) provides current NCFPD investigators, students, advisors, and University Programs staff access to information regarding Center-related announcements, collaborator contacts, funding opportunities, courses/workshops, and conferences. Participants can also download NCFPD documents and make use of flash-messaging and data exchange capabilities. A separate portion of the secure site is set up for the Risk Communication team as a pilot for on-line collaboration to post drafts for review among its members and to share resources, such as slide presentations, project descriptions, and graphics.

VIII. Publications from NCFPD-funded Research

SUPPLY CHAIN AND INFORMATION MANAGEMENT TEAM

David Closs. "Achieving an integrated focus on food security," Logistics Quarterly, 11(1): 4-5, 2005 (available at <http://www.lq.ca/issues/jan2005/articles/editorial.html>).

Donald Bowersox, David Closs, and M. Bixby Cooper, Parts of Chapter 12 in Supply Chain Logistics Management, 2nd Edition (Burr Ridge, IL: McGraw-Hill), pp. 290-293, 2006.

David Closs, Cheri Speier, Dan Lynch, Robyn Mace, and O. Keith Helferich, "Protecting the supply chain from terrorist threats: a framework for guiding practice", in preparation for submission to Supply Chain Management Review.

Brian Lewis, Alan Erera, and Chelsea White III, "An inventory control model with possible border disruptions" submitted to Management Science, 2005.

Karen Griggs, Tom Deeb, Omar Helferich, "Track and tracing food supply, Distribution Business Management Journal, Spring 2005.

Omar Helferich and Robert Cook, chapter on supply chain security, Handbook on Supply Chain Management, to be published in 2006.

ECONOMIC ANALYSIS TEAM

Thomas Stinson, *The national economic impacts of a food terrorist event—initial estimates of indirect costs*, in Harry W. Richardson, Peter Gordon and James E. Moore II, eds., Economic Costs and Consequences of a Terrorist Attack. Cheltenham, UK: Edward Elgar Publishers, 2006.

William Nganje, William Wilson, and James Nolan, *Agro-terrorism and the grain handling systems in Canada and the United States*, Current Agriculture, Food & Resource Issues, A Journal of the Canadian Agricultural Economics Society, No 5, pp. 148-159, 2004 (available at: http://cafri.usask.ca/j_pdfs/nganje5-1.pdf)

William Nganje, Mounir Siaplay, Bruce Dahl and William Wilson, *Real options and policy development on the use of seals and smart seals along the grain supply chain*, submitted to Journal of International Trade and Economic Development, December 2005.

Agnes Ngale Lyonga, Timothy Sellnow, William Nganje, Simeon Kaitibie and Steven Venette, *Characterizing human factor risks in food processing*, submitted to Food Protection Trends, January 2006.

Hamid Mohtadi and Antu Murshid, *Analyzing catastrophic terrorist events with applications to the food industry*, in Harry W. Richardson, Peter Gordon and James E. Moore II, eds., Economic Costs and Consequences of a Terrorist Attack. Cheltenham, UK: Edward Elgar Publishers, 2006.

Hamid Mohtadi and Antu Murshid, *Is the tail wagging the dog: what is the risk of catastrophic terrorism?* prepared for submission to Review of Economics and Statistics.

DETECTION & DIAGNOSTICS TEAM

Amit Gore, Shantanu Chakrabarty, Sudeshna Pal, and Evangelyn C. Alocilja, *A multi-channel femtoampere-sensitivity potentiostat array for biosensing applications*, IEEE Sensors Journal, 2006 (in review).

Sudheer S. Sridharamurthy, Abhishek K. Agarwal, David J. Beebe, and Hongrui Jiang, *A fluidic chemical and biological sensing mechanism with high transduction based on dissolvable membranes*, Proc. of Transducers 2005 (in press).

Paul Takhistov, *Biosensors and its applications for the food industry*, in, Y.H. Hui (Ed), Handbook of Food Science, Technology, and Engineering (New York: Marcel Dekker), p. 1089, 2005.

Shiby Paul, Paul Takhistov, *Conductive properties of selected food products*, submitted to J. of Food Technology.

Changhoon Chai and Paul Takhistov, *Design of impedimetric biosensors for Staphylococcal enterotoxin B detection*, submitted to the Biosensors and Bioelectronics.

Sa Xu, Theodore P. Labuza, and Francisco Diez-Gonzalez, *Thermal inactivation of Bacillus anthracis spores in milk*, submitted to Applied and Environmental Microbiology.

Youvraj Sohni, Sarah Herrin, Garret Olson, Viviek Kapur, Sagarika Kanjilal, *Rapid extraction of Bacillus anthracis DNA using charge-switch technology* (manuscript in preparation for peer-reviewed publication, 2005).

Youvraj Sohni, Robert Pranis, Sarah Herrin, Viviek Kapur, Sagarika Kanjilal, *A novel microfluidic platform for the rapid detection of Bacillus anthracis* (manuscript in preparation for peer-reviewed publication, 2005).

RISK COMMUNICATION TEAM

Julie Novak, Timothy Sellnow, Steven Venette, William Nganje, *Perceptions of risk communication messages: Applications in a food processing environment*. Food Protection Trends (in press).

Steven Venette, Shari Veil, Timothy Sellnow, *Essential communication resources for combating bioterrorism: Some practical and generalizable recommendations*, Communication Research Reports, 22(1):29-37, 2005.

Timothy Sellnow, Robert Littlefield (eds.), Lessons learned about protecting America's food supply (Fargo, ND: North Dakota Institute for Regional Studies), 2005.

NCFPD STAFF

Shaun Kennedy, Frank Busta, *Biosecurity—food protection and defense*, Food Microbiology: Fundamentals and Frontiers, 3rd ed. (in final revisions)