

Homeland Security



What if ...

We could identify threats to our homeland security via new detection technologies?

What if we could electronically identify and track medical and emergency response resources and support services all across our state when dealing with crises like terrorist threats?

What if we could conduct training that could ensure every health professional, politician, and appointed official used the same language and had the same expectations in emergency response?

What if we could apply the best practices from across the country to ensure all professionals knew everything they needed to know to make decisions to protect and safeguard communities under their charge as it pertained to threats to the healthcare system?

What if we could invent ways to detoxify blood on-scene for first responders in the event of a detonation of a weapon of mass destruction? ▶



► *At the University of South Carolina Research and Health Sciences division, we are making "what if?" what is!*

That's especially true when the subject is homeland security, including the areas of detection and surveillance; risk assessment and policy development; and preparedness, response, and recovery.

In the Department of Physics and Astronomy, Dr. Joseph E. Johnson leads multiple homeland security efforts with advanced computer software solutions. He and his Advanced Solutions Group designed and developed the S.C. Emergency Management Division information system that has managed the state's emergency information for the past six years, including event reporting, resource request tracking, and messaging.

"The system has been enhanced with full-scale components for critical facilities tracking, donated goods tracking, mapping with advanced Earth Sciences Resource Institute Web tools, and medical information—hospital beds and pharmaceuticals," Johnson said. "In addition, a statewide firefighter and first responder information system tracks the dynamic status—the inventory and use—of all equipment and teams at fire stations across the state with associated mapping. These systems have now been extended with U.S. Navy Space and Naval Warfare funding for the construction of a mathematical model of threat against critical infrastructure using an economic input-output model to compute both direct and indirect economic effects."

Johnson also has taught an innovative course in counterterrorism for USC undergraduates and graduate students. The course involved more than 30 speakers from military (Army, Navy, Air Force), governmental

(FBI, CIA, State Law Enforcement Division, health, fire fighters, and emergency management), corporate (utility companies, nuclear manufacturing, security) organizations, and University (physics, chemistry, biology, medicine, geology, history, political science, and engineering) departments.

In USC's Arnold School of Public Health and its Center for Public Health Preparedness, Interim Dean Dr. Donna Richter said her faculty focused primarily on bioterrorism risk assessment and policy development and preparedness, response, and recovery.

"Prior to 9/11, we forged a lot of solid relationships with the S.C. Department of Health and Environmental Control (DHEC), with various public health entities, with the Centers for Disease Control and Prevention (CDC), and many other partners in state and local governments as we all worked collaboratively on the prevention of infectious diseases such as HIV and other prev-

alent public health threats," Richter said. "Those relationships have served us well since 9/11 and have contributed substantially to a new emphasis to our primary mission—training first responders to identify and respond to terrorist acts."

After the anthrax scare in Washington, D.C., and concerns over weapons of mass destruction surfaced, a network of Centers for Public Health Preparedness was established by the CDC. That network now supports many of the training tasks required by the Department of Homeland Security, and "our center works with DHEC and many other state and local agencies to fulfill the training requirements for all of our first responders, as well as our politicians and governmental officials," Richter said.

"Threats of terrorist attacks, biological or chemical warfare, and even nuclear contamination have faced Americans for years," she added. "But now, the possibility that terrorism strikes could come to our com-



University of South Carolina scientists in the College of Engineering and Information Technology are investigating ways to protect first responders and emergency personnel in case of exposure to radioactive or chemical agents.





Researchers at USC's Photonics and Microelectronics Lab, led by Dr. Asif Khan, are working with UV light to detect and sterilize harmful chemical agents.

munities is frighteningly real. Anti-terrorism efforts have become much more of a priority. Everyone is trying to prevent another 9/11, and we are on the forefront of the planning and helping the pertinent personnel learn how to respond in a way that preserves human life, protects property, and contains the threat. It's a whole new challenge—one which the Arnold School of Public Health has risen to meet."

But planning and prevention are only part of homeland security. First response units, which include public safety and public health personnel, must be adequately trained and prepared to respond to threats. Finally, in the event of a terrorist act, authorities must be able to detect and gather evidence that can lead to identifying and prosecuting perpetrators.

At USC's Photonics and Microelectronics Lab, Dr. Asif Khan, chair of the Department of

Electrical Engineering (College of Engineering and Information Technology), is working with the Office of Homeland Security along with other researchers to identify and perfect various applications aimed at detecting terrorists as well as protecting their intended victims.

Two high-visibility research projects currently underway:

- developing the technologies for Ultra-Violet (UV) light powered "virtual X-ray" machines that can be used to detect contamination and prohibited cargo
- diode-powered ultra-violet sterilizers that can sterilize a room from contaminants like anthrax and other biological and chemical agents in the air, on the mail or documents, in packages, or dissolved in any variety of liquids.

"Right now, we are using microwaves to sterilize a lot of the mail that is going to government build-

ings and other sensitive areas. This process obviously damages things like photos and heat-sensitive printouts. By perfecting and implementing UV sterilization, we can make sterilization more practical for this application and many others," Khan said.

"UV instrumentation gives us a whole new spectrum of capabilities for homeland security applications. With UV and the UV diode we can devise all sorts of detection equipment that will help our law enforcement and security personnel detect chemicals, agents, and even people from entering the United States illegally," Khan said. "With the proper settings, we can penetrate container walls, packaging, and even verify peoples' identities passively with little more than a beam of invisible light," he added.

More invasive, but still beneficial, is the use of UV sterilization in a variety of applications. ▶



USC School of Medicine professor Alvin Fox and his team discovered a unique carbohydrate on the surface of the anthrax spore.

► Most bacteria, and some viruses, when exposed to sufficient amounts of UV light at the proper spectrum will be destroyed. The challenge has been making this procedure safe for the machine's operators and controllable to the proper depth to ensure that the target of the UV radiation is sufficiently exposed.

Other types of sterilization also have great potential for homeland security applications.

The use of liquid carbon dioxide has been researched for several biomedical projects with the collaboration of the Medical University of South Carolina and Clemson University. Experiments have been conducted at USC to perfect a carbon dioxide scrubbing system that helps sterilize delicate composite materials that will eventually be used inside the human body as replacement components. This same technology is being adapted by USC chemical engineering professor Dr. Mike Matthews to destroy bacterial spores, which are among the hardest of biological warfare agents.

Another issue with the carbon dioxide treatments is the question of material degradation. Many sterilization techniques, particularly UV and

steam, have detrimental side effects on some of the materials physicians want to use in the body. Silicon, and many of the plastics currently used in implant therapies, react adversely to sterilization techniques—leaving surface level striations that can cause inflammation within the body, loss of flexibility, and other problems. Carbon dioxide washing offers the promise of reducing or eliminating these unwanted side effects.

Research in the School of Medicine has demonstrated that a unique carbohydrate, discovered by Drs. Alvin and Karen Fox, is part of a glycoprotein found on the surface of the anthrax spore. Their current research interests are to characterize this glycoprotein and employ it as a target for a spore vaccine. As an extrapolation of this work, they plan to develop a rapid biodetection method using mass spectrometry and proteomics approaches because the sequence contains both species and strain specific-determinants; the latter also having great possibilities for forensics. This work is being performed in collaboration with the Savannah River National Laboratory in Aiken, S.C.

USC scientists also are working on novel ways to treat first responders and to detect crime scene evidence as a way to bring suspects to justice should the unthinkable happen again and terrorists actually succeed in carrying out one of their objectives.

Dr. James Ritter and his colleagues in the Department of Chemical Engineering (College of Engineering and Information Technology) are currently investigating ways to detoxify blood using magnetic nanoparticles. By engineering particles

that attract radioactive particles (in the event of a nuclear explosion), or complex molecules (like those found in toxic gases), Ritter is confident he can devise magnetic filters that can be self-administered by a rescuer/first responder. Think of a very small, portable dialysis machine at a WMD event that could be used until such time as the responder is evacuated to a hospital.

Similarly Dr. Steven Morgan in the Department of Chemistry and Biochemistry (College of Science and Mathematics) is working on ways to trace evidence through the novel use of textile fiber detection and identification.

Morgan and his team are developing a comprehensive database as well as specialized techniques for implementation by the FBI, the S.C. Law Enforcement Division, and other law enforcement agencies. The end product will ensure the evidence is gathered and processed using best, established practices and presented in a way that is acceptable in a court of law.

Nearly every crime scene has some type of fiber in it that can be traced to somewhere else—therefore it can be used as evidence, Morgan said. The challenge is to establish procedures and methods for reliable identification across the country, a standardized chain of custody for such evidence, and an identification regimen that ensures the potential for criminal conviction.

For more information on USC's Homeland Security and counter-bioterrorism related research, visit www.sph.sc.edu/acphp/sphpreparedness.asp or call 803-777-5458.

