The Ebola Handlers

Emory is changing the way people train to work in laboratories that handle the most dangerous pathogens in the world.

The fever was moving through villages in southeastern Congo at an alarming pace. More than 400 people were sick, their vital organs ravaged, blood seeping from their eyes and ears, and 187 would die by November 2007. Both the CDC and WHO sent emergency response teams to control this outbreak of Ebola hemorrhagic fever, a highly infectious disease for which there is no known treatment. Time was of the essence: the last major Ebola outbreak in Congo—some 12 years ago—killed 245 people. This latest outbreak raged for more than eight months.

By Kay Torrance • photography by J.D. Scott and Jack Kearse

One of the first steps scientists took upon arrival was to obtain samples of the virus and send them to a laboratory especially outfitted to handle such a deadly pathogen. These biosafety level 4 (BSL4) labs, as they are known, require the most stringent construction and operating standards, such as independent, single-pass air-handling systems with a HEPA-filtered air supply and exhaust air as well as a liquid decontamination system for lab waste water. Scientists working in these labs handle the most life-threatening pathogens ever encountered, viruses such as Ebola, Lassa fever, or Marburg. Researchers in these labs must follow safety practices carefully to minimize the risk of infection.

The laboratories are vital for progress against infectious diseases, according to Ruth Berkelman, director of the Center for Public Health Preparedness and Research at Emory's Rollins School of Public Health. Infectious diseases cause more than 15 million deaths worldwide each year and have risen to become the third leading cause of death in the United States. Bioterrorism also remains a threat. Although the labs are critical for learning how to prevent and control threats, the agents studied in the labs may pose a hazard to workers.

For example, during the SARS epidemic in 2003 and 2004, researchers in three separate laboratories became infected. The last incident occurred when a graduate student, working in China's top SARS laboratory, came down with the respiratory disease. Unfortunately, she failed to be tested for SARS until three weeks later. In the interim, the incident led to seven other people being infected, including her mother, who died. More recently, a researcher at Texas A&M University came down with brucellosis in February 2006. It was later revealed that she lacked proper authorization and training to work with the pathogen. Such events are causing scientific institutions to put biosafety practices center-stage.

Laboratory exposures are usually the result of several controls failing, usually because of human error. That fact underscores why biosafety training is so important, says Berkelman. She directs a mock BSL3/4 training program at Emory that is redefining how workers learn to navigate this dangerous environment. She also chairs the Public and Scientific Affairs Board at the American Society of Microbiology and considers

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biosafety training paramount for scientists and others working in laboratories with pathogens.

While the CDC requires training for those handling the most life-threatening pathogens in U.S. labs, training generally is left up to individual facilities. New researchers and lab staff often listen to lectures, watch videos, and train alongside co-workers to gain the necessary experience. But Emory has a new program that is changing the way training is done.

"We are trying to provide a safe environment where we assure that certain safe practices become ingrained," says Berkelman.

Emory's approach to training focuses on changing behavior. Since it opened the world's first mock BSL 3/4 laboratory designed for simulation training, Emory has trained more than 300 people, some in the mock laboratory and some at their own institutions. People have come from as far away as Pakistan, India, Singapore, and the Philippines to participate in training in the mock lab.

Emory's mock lab was the brainchild of David Stephens, vice president for research in the Woodruff Health Science Center. After the anthrax attacks in 2001, the NIH allocated additional support for biodefense research and construction of high security labs. Stephens helped Emory partner with

other Southeastern universities to form a Southeastern Center for Excellence in Biodefense and Emerging Infections. He saw a need to create better training opportunities for new BSL4 laboratories on the horizon and for workers in existing BSL4 laboratories, and Berkelman took the idea from there.

Currently there are only a handful of BSL4 labs in the world, but with the threat of emerging infectious diseases and the ease with which new pathogens travel, the need for more BSL3 and BSL4 labs is being recognized around the globe.

As those new labs come online, they'll be able to draw on the new training model at Emory. "We have changed how training is done," says Sean Kaufman, the public health educator who does the bulk of the training in Emory's mock laboratory. "Previously, training was behavior-based with little or no simulation training. With hands-on training, we can move people from being novices, we can put them safely in settings of a laboratory emergency, and overall, we can begin to create experts."

Kaufman and colleague Lee Alderman, a former biosafety officer at CDC for 30 years, have taken their program on the road, training at numerous institutions in the United States, from California to Texas to South Carolina. In addition, Berkelman and her team have received an award of $400,000 to take the training to five overseas institutions in Asia next year through a grant from the National Institute of Allergies and Infectious Disease and the NIH.

The CDC and Boston University also have caught on to Emory's pioneering program and will soon start their own mock labs for training. "We are excited to see others emulate our program," Berkelman says. "There is so much need out there, and we believe training with established competencies is the way to go."

A dark room, an unconscious person, a life-threatening emergency

The 14 people in the Emory mock BSL4 lab have been in training for several days now. They've learned the layout of the lab and can find their way around the biosafety cabinets, test tubes, and needles. They've covered the finer points of "PPE," or personal protection equipment. They've had the order on

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—Sean Kaufman, biosafety lab trainer

how to don and doff the equipment drilled into them, and they've connected their supply hoses. They've even practiced going through the decontamination showers. Today is a test of the progress they've made.

Kaufman and Alderman huddle in a corner to go over the day's game plan. Who is to be the decoy, the one who will drop to the floor, serving as the unconscious victim? They decide on Mark Sloan, a tall, 240-pound military scientist from Texas with a take-charge attitude that inspires his classmates to follow his lead. Without Sloan, the others will be forced to regroup.

All the students except Sloan are kept busy in a side room with animal cages, chasing a loose golf ball that represents

Walking in another's shoes

Research scientists and biosafety officers have different, immediate, and sometimes conflicting goals. While both groups want to avoid accidents, scientists want to get their research completed as soon as possible while biosafety officers are charged with making sure that researchers follow all the safety rules, which, on occasion, can interrupt delicate work.

No one knows this better than Lee Alderman, who has worked on both sides in the laboratory, as a biosafety officer at CDC and as director of Emory's Environmental Health and Safety Office. A good working relationship comes down to face-time, respectful interaction, and establishing a true relationship, he says. "I've known biosafety officers who sat behind their desk all day," he says. "They weren't effective or respected."

In the mock training laboratory at Emory, both scientists and biosafety officers take classes alongside each other in the first place to bring both groups together to train in safe practices. They are part of an effort by the mock lab's leaders to revolutionize interaction between the two professions.

Besides reducing the risk of lab accidents, Emory's course seeks to foster the relationship between researchers and biosafety officers. "Good biosafety officers see themselves as consultants, helping scientists do their work safely, not simply as enforcers of rules," says Alderman.

"It's very important that 'biosafety' is seen as an integral part of the whole scientific research enterprise, the purpose of which is to improve human welfare," says Ruth Berkelman, who directs the mock lab. "Everybody has the same mission—to advance science and protect workers at the same time. If biosafety is seen simply as rules to follow, it increases tension." The assessment of risk also is best accomplished by scientists and biosafety professionals working together, she adds.

When biosafety officers train in the mock lab, they get to "walk in the shoes" of lab researchers. Or in this case they get to walk in the protective booties and space suits of another. The insight that results is worth perhaps as much as all the rules combined in arriving at true lab safety.

an infected mouse that has escaped. Kaufman and Alderman brief their accomplice. When the exercise commences, Kaufman throws the others for a loop. "Mark, go down," he yells. The first person to reach Sloan is told to drop as well. Then the third.

"Why did you go over when two people are down?" Kaufman asks. "Something is wrong here. If you don't call out, nobody is going to know you're here. When you see someone who approaches the person also go down, get out and find help."

On the other side of the room, meanwhile, Alderman is running a sharps accident. One student supposedly has cut a finger (complete with fake blood that stains the hand) and becomes woozy from the loss of blood. Two people help the victim to the sink to submerge the finger in disinfectant. Then they make their way as a group around a corner to get out of the lab, struggling to doff foot coverings once they arrive in the "clean zone." Alderman gives the group a "good job," but he has more advice. "Suppose you have a catastrophic event. Forget decontamination," he says. "Just get out of Dodge. Your life is the most important."

Back to the exercise with the unconscious person, Kaufman observes that the group is learning to think and calming its initial inclination to panic. When a victim collapses,

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the students hesitate on taking the next step: Should they move the person or use the defibrillator?

"Wasting time, wasting time," Kaufman shouts. "We have a defibrillator." One of the students grabs it. "Put the defibrillator back," he says. "You haven't checked to see if the person is breathing." He then shows the class how to use plastic trays to move an unconscious co-worker.

Next on the agenda, Kaufman has everyone gather on one side of the lab and put brown paper bags over their headgear. They will need to form a conga line to find their way out of the lab, essentially blindfolded. The exercise is meant to simulate a power outage or visual impairment when people must get out of the lab safely while they are unable to see. Although the students have the layout of the lab firmly imbedded in their minds, they know better than to think it will be an easy test to pass with Kaufman in charge. The instructor doesn't disappoint, setting off ear-piercing alarms before shouting, "Go." He pulls one person off the back of the line. Will the person's co-workers notice? He also scuttles in front, moving equipment into the path. A large metal rack throws the line off, and the students walk directly into a cement wall. The lead person has to feel her way along a countertop.

"I bet three days ago you wouldn't have thought you could do in this in the dark," says Alderman, who has watched the group snake itself around the corner to find the way out.

Giving up control

In fact on the first day of training, these same students averaged only 33% on a pre-course subject knowledge test. By the end of the one-week session of 12-hour days, they will have an average score in the 90%+ range. That increase is typical of other classes taking the intensive course, which mixes the hands-on lab experiences with classroom lectures.

What else have the students learned? That they "may not always be in control," Kaufman says. Just squatting to pick up a dropped object is an exercise in strength and balance. Students are tethered to air hoses and are yanked back if they try to walk across the room. As simulated exercises progress, frustration mounts. "The students realize they are thinking at the speed of light, but they're moving at the speed of a turtle," he says.

A few students have found that the course steered them away from working in a lab. But for the majority, they've learned not only how to successfully navigate a biosafety lab but also how to deal with the unexpected. Most important, they've learned how to protect themselves and the community from life-threatening pathogens. ●

WEB CONNECTION *For an audio slideshow on the mock biosafety lab, visit* **http://www.whsc.emory.edu/biosafetylab.htm**