



Biosecurity Considerations in Public Health Laboratories

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Author's Note

This was a presentation at the CDC 8th National Biosafety Symposium, Atlanta, Georgia, 2004.

Good morning, everyone. I appreciate this opportunity to talk to you about functions of our state public health laboratories and what we are faced with these days in terms of safety. The title of my presentation, "Biosafety in the State Public Health Laboratory," has an important subtitle, namely, "The Need to Address All Hazards." This subtitle identifies the main point I hope to make. While our previous speaker, Dr. Takafuji, talked about biosafety regarding infectious agents and emerging infectious diseases, in state public health laboratories today we generally find biosafety a bit too narrow. Instead, we are now forced, because of potential terrorism, to think, plan, design, and operate using an all-hazards approach to safety.

Our state public health laboratories function in two general arenas: analytical testing and emergency response. In all state public health laboratories, analytical testing includes that required to identify infectious agents. In almost all of these laboratories, testing also includes screening every newborn for inherited diseases and congenital abnormalities, and in many of the laboratories testing also includes detection and identification of hazardous chemicals, including radiochemicals. To be able to analyze clinical specimens and environmental samples for a wide spectrum of biological and chemical agents within statewide jurisdictions, these laboratories have for the most part extraordinary capability.

As an extension of this analytical capability, our

state public health laboratories play a major role in statewide emergency responses to public health threats that occur naturally, accidentally, or deliberately. Today, probably more than ever before, this emergency response role is on all of our minds and something for which we have to be continually prepared. This may involve emerging infectious diseases. We talk about severe acute respiratory syndrome (SARS), West Nile virus, and the possibility that there could be a pandemic of human influenza if strains of avian influenza occurring in chickens in the Far East suddenly develop the ability to be transmitted human-to-human. Our state public health laboratories, working with partners at CDC, are very much involved in these kinds of infectious disease issues. In addition, our emergency response role may involve environmental chemical hazards. An example of an important environmental hazard for which state public health laboratories provide analytical support today is the widespread problem of illegal methamphetamine laboratories and the necessary clean-up that is involved in these situations. There are many kinds of environmental hazards that our state laboratories must be able to analyze in emergency situations.

But the bottom line today, the situation that may keep many of us awake at night, is the possibility of an act of terrorism. Not just an act of bioterrorism, but of an act of terrorism. Such an act could involve biological, chemical, or radiological agents. As state public health laboratories, we are expected to be able to respond, to provide the analytical data needed by public safety and public health to implement effective interventions to protect the public.

To be able to do so, our state public health laboratories have made some progress over the last few years, working with CDC and other federal agencies, to become better prepared to respond.

I now want to talk briefly about three aspects of this state laboratory emergency preparedness. One of these aspects is the Laboratory Response Network, called the LRN. A second is where we are with chemical terrorism preparedness. The third, which is a very difficult problem in our state laboratories, is how to deal with “unknown” environmental samples. These are samples that could be biological, chemical, radiochemical, explosive, or all of the above. This presents us with a very dangerous situation that must be accommodated using an all-hazards approach.

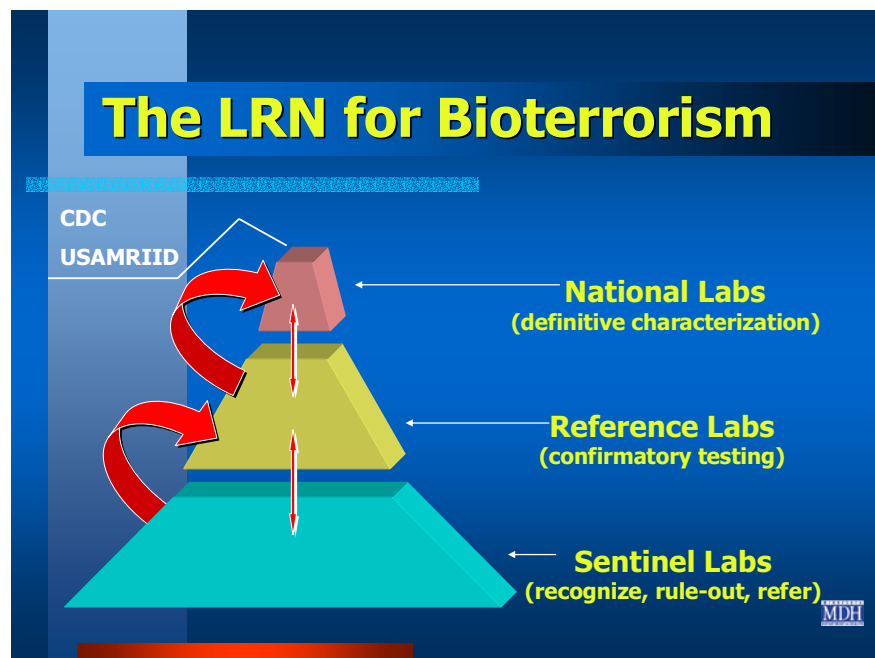
Regarding the LRN, this is a laboratory network originally established in 1999 through a collaborative effort that included the CDC, FBI, and Association of Public Health Laboratories (APHL). It is depicted here as a pyramid with a broad base referred to as the Sentinel Laboratories.

These sentinel laboratories conduct routine testing to detect and identify microbial agents. If an unusual agent is isolated from a patient, the role of these sentinel laboratories is to recognize it as un-

usual, try to rule out the possibility that it represents an agent of bioterrorism, and if they cannot rule it out, then immediately refer it to an LRN Reference Laboratory, shown as the middle section of the pyramid, for advanced confirmatory testing. In all states, the state public health laboratory is the LRN reference laboratory. In some states there are additional reference laboratories, selected by the state public health laboratory, to expand the state’s capacity to provide this reference function. In the reference laboratories, CDC standardized, validated test methods and reagents are used to confirm the existence of a bioterrorism agent. As an integral part of the LRN, our state public health reference laboratories work in close partnership with the National Laboratories at the top of the pyramid. These national laboratories, including CDC and USAMRIID, are responsible for definitive characterization of all bioterrorism agents.

Another way to look at the LRN pyramid is to tip it on its side to show how it represents an inclusive local, state, and national network. This is a very important, very functional network that fortunately was in place when our nation was faced with the anthrax situation in October 2001. As shown with the tilted pyramid, sentinel laboratories include clinical laboratories, food laboratories, veterinary laborato-

Figure 1



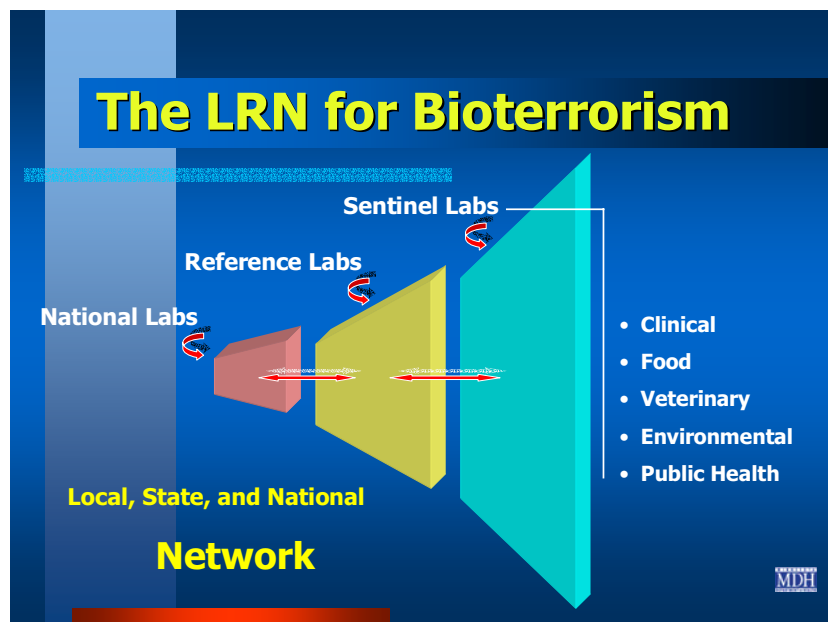
ries, environmental laboratories, and local public health laboratories. These laboratories are always out there looking for something that might be unusual. They have testing protocols that allow them to rule out things that may be suspicious.

Regarding preparedness for chemical terrorism in our state public health laboratories, we are currently developing the ability to evaluate clinical specimens—not environmental specimens, but clinical specimens, such as blood and urine—to detect human exposure to chemical agents that might have been used in a chemical terrorism event. For this kind of preparedness, our state public health laboratories are defined at three different levels: Level 1, Level 2, or Level 3. Most of the state public health laboratories are developing their capability at Level 2. There are 39 of these laboratories. At Level 1 there are six and at Level 3 there are five. The Level 1 laboratories do not have the technical capability required to test for chemical terrorism agents in specimens collected from potentially exposed humans. Their role is to coordinate specimen collection and safe transport and to develop an operational plan involving first responders and other laboratories to determine if human exposure has occurred. The Level 2 laboratories have Level 1 capability plus state-of-the-art instrumentation and the

advanced level analytical chemists necessary to test human clinical specimens for select chemical threat agents like heavy metals, lewisites, cyanide, and some toxic industrial chemicals. The Level 3 laboratories have Level 1 and 2 capability plus highly advanced analytical instrumentation such as tandem mass spectrometry. They have multiple advanced-level chemists and they also are able to test human specimens for Level 3 threat agents, which include nerve agents, mustards, mycotoxins, and the select toxic industrial chemicals.

Regarding the “unknown” environmental sample, what concerns us most is the question: How do we safely handle what potentially could be deadly material? As a state public health laboratory director, when I get a call from the FBI or I get a call from a first responder, and I am informed that something has happened somewhere in my state, or that nothing has happened but they found something suspicious that needs to be tested, they may have to bring an unknown sample to the laboratory. This poses a risk to the laboratory and its staff. We do not know whether the sample may contain a biological, chemical, or radiological agent, or a mixture of these, or if it is reactive to emit poisonous gas when mixed with water. It could even contain an explosive that might blow up part of the laboratory. Biological agents that

Figure 2



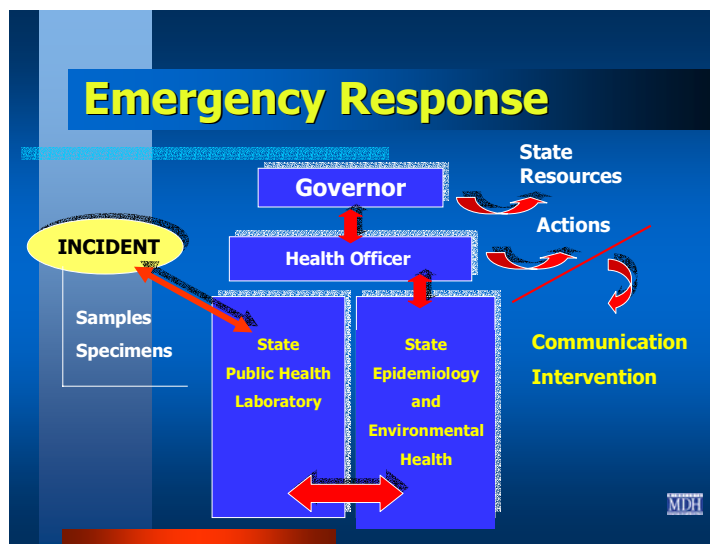
our state public health laboratories could receive in an unknown environmental sample might include infectious bacteria like *Bacillus anthracis*, or toxins like botulinum toxin, staphylococcal enterotoxin, or ricin separated from castor beans. Chemical agents that could come into the laboratory might be neurotoxins like sarin, asphyxiates like cyanide, respiratory irritants known as choking agents like phosgene, or blister agents like mustard gas. Radiological agents might also show up in the state public health laboratory. We are always concerned about the possibility of a “dirty bomb” being brought into the laboratory, or causing an incident in our state jurisdiction, with the release of alpha particles or beta or gamma radiation.

Our state public health laboratories are expected to respond to unknown environmental samples or unusual clinical situations. Since all incidents begin locally, the initial response may involve local emergency responders, i.e., police, fire, emergency medical services, or HAZMAT, concerned about an unknown material present somewhere in the environment, or a local sentinel laboratory with an unusual organism that cannot be ruled out as a possible bioterrorism agent. The initial response could also be a local medical facility where there is a cluster of patients having common symptoms without any known cause. Local poison control centers might also be the first to observe something unusual. In many states there is now a network established with

poison control centers that serve to continuously monitor for any unusual number of calls about specific kinds of symptoms suggestive of mass poisoning. In these local situations, the state public health agency is notified and the state laboratory may become involved in the emergency response. This is described in the following schematic.

If there is an incident, samples or specimens are brought to the state public health laboratory. Ideally, the state public health laboratory works in close association with state epidemiology and environmental health. State public health laboratory, epidemiology, and environmental health officials interact with the state health officer or Commissioner of Health, who interacts directly with the Governor. The Governor provides state resources, if necessary. The health officer activates a variety of actions, including communication, assuring the public, telling the public what is happening, and what they need to do. The health officer also authorizes interventions, e.g., the use of antibiotics or vaccines when appropriate to protect the public. The essential role of the state public health laboratory is to receive the material submitted for analysis and to conduct laboratory tests that provide the critical data upon which subsequent public health and safety decisions are made regarding the incident. The laboratory works to help answer these questions: What agent is it? Who was exposed? What are the risks? What needs to be cleaned-up? Is the clean-up completed?

Figure 3



The role of the state laboratory also includes confirmation of field tests. Many first responders now have field test equipment they use to determine if a hazardous agent is detectable at an incident site. While these devices may provide some useful information, they often give results that are false positive or false negative. Consequently, it is imperative that the state public health laboratory confirm all field test results.

When unknown environmental samples are brought into the public health laboratory for analysis, there is a potential risk of laboratory contamination. This actually happened in at least one laboratory during the anthrax situation in 2001. If a powder, for example, is brought into a facility without proper safeguards to prevent its dissemination, the laboratory may become contaminated and all test results may become falsely positive. If this happens, the laboratory has to shut down.

As I have mentioned, we need to employ universal safety precautions to accommodate all the hazards that might enter today's state public health laboratory. The requirements for safety in these laboratories involve three inclusive steps: preanalytical, analytical, and postanalytical. Preanalytical safety measures must begin in the field. It is not just what happens in the laboratory that is important from a safety point of view. What happens in the field before a sample is brought to the laboratory is equally important. Preanalytical considerations include field test results, medical evaluation, intelligence, collection methods, and sample receiving. Field test information important to the laboratory includes knowing what field tests were done, what instrumentation was used, and what results were obtained. This information may be helpful in determining laboratory risk. Another critical piece of preanalytical information is documented assurance that the sample has been examined for explosives by a bomb squad or other qualified personnel. In addition, the sample needs to be examined for radiation before being brought into the public health laboratory for analysis. If there is any reason to believe a sample might be radioactive, it should be tested for radiation out in the field. Bringing a highly radioactive sample into the laboratory could endanger laboratory staff and might contaminate the laboratory, making it useless for analy-

sis of low-level radioactive substances. Yet another important piece of preanalytical information is medical evaluation in the field. Are there injuries? Are there symptoms? Are there fatalities in humans or in animals? Having this information also helps the laboratory assess risk. In addition to all this preanalytical information to assess safety risk when a sample is received by the laboratory, available intelligence information can be very helpful too. Does intelligence suggest that an event may have occurred? Does it suggest a possible agent? Occasionally, we get a call in the laboratory about testing and it makes little sense for us to test the sample being considered. If, however, the FBI or local police provide us with intelligence information regarding the sample, it may become very important for us to conduct appropriate laboratory tests.

Sample collection in the field is also a part of the preanalytical process that is important to the laboratory, both in terms of safety and appropriateness for analysis. During the anthrax crisis in 2001, we had in my state a situation in a public museum. Someone observed by a security camera had entered the building carrying a briefcase. When this person left the building some time later, he no longer had the briefcase. A few minutes later, security found the briefcase sitting near one of the building's air ducts. A major concern at the time, of course, was that anthrax or some other agent might have been introduced into the air handling system. In response to the situation, the police arrived and called in a HAZMAT team. The event unfolded throughout the night. Our state public health laboratory was notified about possible testing and we prepared to do so. Eventually, I received a call to come to the front of the Health Department building. When I got there, two huge fire trucks and a large fire department van filled with air filters from the museum were parked at the curb. Unfortunately, I had to tell the fire officials that we could not bring any of the filters into the laboratory. I explained that if they would in fact contain anthrax, or some other agent, bringing them into the laboratory might contaminate the facility and expose individuals to a safety hazard. I went on to explain that what we really needed were either a small piece of each filter, or a swab of the filters, all appropriately contained. This is an example of why

appropriate sample collection in the preanalytical phase and communication are essential when a sample must be tested in the public health laboratory.

When a sample to be tested is actually brought to the laboratory, we are still in the preanalytical phase of the testing process. Upon arrival of the sample in the laboratory's receiving area, field test results are evaluated, explosive screening is checked, and the sample is examined for radiation using a handheld meter. At the sample receiving part of the testing process, it is important for our state public health laboratories to have in place a rigorous triage plan. We cannot accept just anything. During the anthrax situation, the first day or so state public health laboratories were receiving office equipment, furniture, even automobiles. They were asked to test all sorts of things that just did not fit into the biocontainment areas of our laboratories. Having a rigorous triage in place helped determine whether a sample would be accepted, whether it needed to be rejected, or whether it needed to be held for possible testing after further information was made available. These pictures show laboratory staff screening a sample for radioactivity and then placing the sample inside the containment laboratory.

With the sample received, checked, and placed into the containment area of the state public health laboratory, we now move into the analytical process with its associated safety considerations. The purpose of containment, as you all know, is to reduce or eliminate exposure, to protect laboratory workers and others, and to protect the environment outside the lab. If a sample that is dangerous is brought into the laboratory, we cannot risk having material from it accidentally released inside the laboratory or outside the laboratory building.

Primary containment involves protecting personnel and the laboratory environment. This involves good laboratory technique and appropriate safety equipment, which includes biological safety cabinets, personal protective equipment, and laboratory safety equipment. Whenever samples are manipulated in the laboratory, using processes that might create aerosols (e.g., centrifugation, mixing, homogenization, or other steps of that nature), we have to be sure we use proper equipment to eliminate the possibility of generating an aerosol that could expose individuals or contaminate the laboratory area. Personal protective equipment includes gloves, goggles, face-shields, masks, coats, gowns, aprons, and respiratory

Figure 4

Sample Receiving

- **Screening for radioactivity**
- **Placement inside containment lab**

The slide features two photographs. The left photograph shows a person in a white lab coat kneeling on a carpeted floor, using a handheld radiation detector on a sample. The right photograph shows a person in a white lab coat standing in a laboratory, possibly near a containment area, with a red biohazard sign visible in the background.

protection. The following slide shows an example of the kind of personal protective equipment that is used in our state laboratory. Below, you see an individual through the window of our Biosafety Level 3 (BSL-3) containment facility putting on a respirator in addition to being gowned up from head to toe.

Biological safety cabinets are an essential part of primary containment in the state public health laboratory. While designed for biological containment, in the initial stages of the analytical process we depend on these cabinets for primary containment of even chemical agents. There are a variety of different classes of these biological safety cabinets: Class I, II, and III. The Class I cabinets are horizontal flow. Air flows in at the front of the cabinet and is drawn to the back. In some Class I designs, the intake air is recirculated into the room, while in other designs the air exhaust is hard-ducted into the ventilation system with no recirculation into the laboratory area. The Class II cabinets are laminar flow. A curtain of HEPA-filtered air flows downward inside the cabinet into vents located at the front and back of the work surface. Individuals working at the Class II cabinet place their hands inside the cabinet, inside the front

curtain of air. The filtered air that flows down over the front prevents contaminated air from getting in from the outside or out from the inside. With the Class II A cabinet, about 70% of the air passing through the cabinet is recirculated after being drawn through a HEPA filter to remove any biological agent that might have been introduced into the air flow by working with a sample. If a possible chemical agent is present, the use of the Class II A cabinet is not advised because of this recirculation of air. With Class II B2 and Class II B3 cabinets, no air is recirculated, making them more suitable for handling samples that might contain low levels of toxic chemicals. The Class III biological safety cabinet is completely sealed. With these cabinets, an individual works through two sealed glove ports. There is no recirculation of any of the air and the flow of air inside the cabinet is negative with respect to the outside.

Because in the state public health laboratory we have to use an all-hazard approach to safety and consider chemical as well as biological agents in samples we receive for testing, the choice of which biological safety cabinet to use in our containment facility is

Figure 5



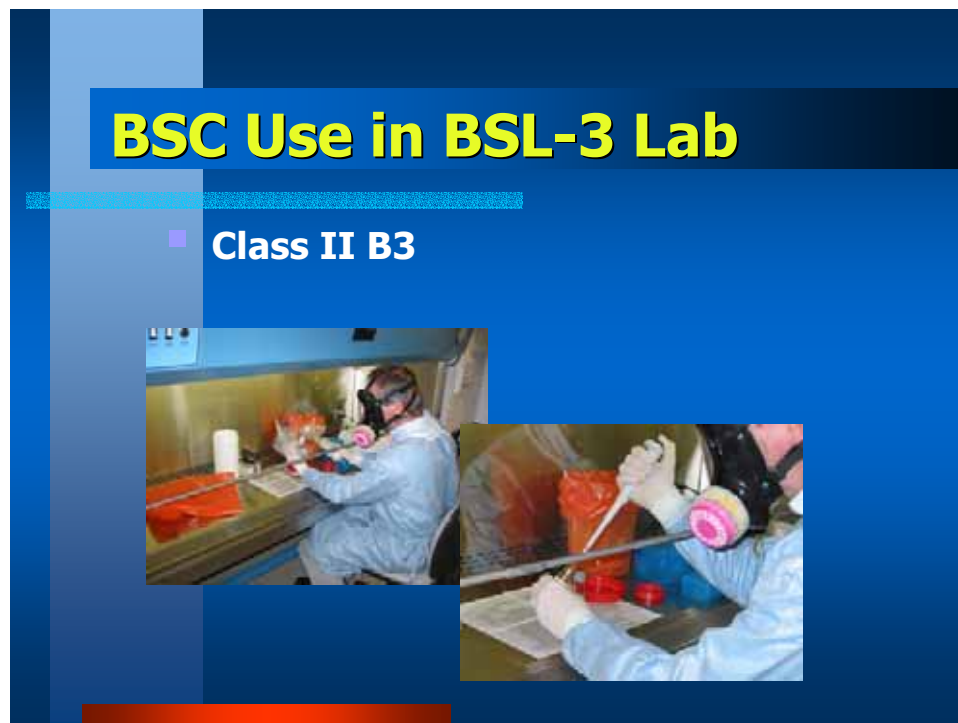
critical. While the Class I hood could be used for volatile chemicals because it has a horizontal flow away from the operator, as long as it is ducted to the outside without air recirculation, it should be used only if the amounts of volatile chemicals are minimal. Class II B2 and B3 cabinets can be used to handle limited amounts of volatile chemicals, ranging from minute amounts to small amounts, because no air is recirculated. The amounts of such chemicals have to be very small, however, because working at the cabinet could disrupt the airflow enough to cause excessive amounts of volatile chemicals to spill out into the laboratory and expose the operator. To avoid this risk, the best thing to use with both biological and chemical agents would be the sealed, glove port, negative air flow, hard-ducted Class III cabinet. This next slide shows an example of somebody in our laboratory working in a Class II B3 hood.

Secondary containment has to do with protecting the environment external to the laboratory. This depends on facility design and how the laboratory building's air flows, changes, and exhausts. It is recommended that air not be recirculated in these

buildings. Instead, outside air should be drawn in, conditioned, circulated, and then exhausted to the outside. Other features of secondary containment include increasing negative air flow in areas of the laboratory where the need for containment is increased. This includes the use of impervious bench tops, means to decontaminate equipment, easy cleaning of the facility, appropriate hand washing sinks, and strategically located emergency eye wash stations and showers. Secondary containment also involves operational practices that limit access to laboratory areas and proper engineering and maintenance.

Containment areas within state public health laboratories are defined as biosafety levels 1-4 (BSL 1-4). The first level, BSL-1, is appropriate only when working with noninfectious agents, for example, in a teaching setting. BSL-2, the most common space in the public health laboratory, is used for routine work with infectious agents that are not transmitted by aerosol. Work that involves infectious organisms transmitted by aerosol, or when the laboratory handles specimens or samples that may contain agents of terrorism, a BSL-3 space under negative air flow is

Figure 6



utilized. In addition to conducting the work in this kind of BSL-3 space, the work is also done within appropriate biosafety cabinets to insure safety. For maximum containment to work with unusual, life-threatening agents for which no treatment exists, BSL-4 space is used. Most state public health laboratories do not have BSL-4 space and have had to modify existing space to acquire the BSL-3 accommodations needed to handle agents of terrorism and emerging infectious diseases. An example of such modified space in my state's public health laboratory is shown in the next slide. This acquired BSL-3 space has an ante-room, a negative air flow general laboratory room, and two additional rooms with even greater negative air flow that are equipped with Class II B biosafety cabinets. This small BSL-3 suite is entered at the arrow shown in the lower right hand corner of the diagram. From the hallway, a person enters into an ante-room, which provides an airlock between the hallway and the first laboratory area. Before the door to the laboratory can be opened, all of the ant-room doors have to be closed. Beyond the first laboratory room, there are two additional, more restricted laboratory rooms. As you go deeper into

the 600-foot suite, you get progressively more negative, in terms of—not attitude, but in terms of the direction of air flow [Laughter].

The security of our BSL-3 requires limited access to accommodate select agent regulations. Only designated persons can enter this BSL-3 suite, and their access is continually monitored through the use of an electronic card reader, as shown on the next slide. Whenever a card is used, a record is kept of who entered and when.

For additional security, we also have a motion sensitive video recorder in the hallway, in front of our BSL-3 laboratory. If anyone tries to enter after-hours, they will be videotaped. The camera, shown on the next slide, is motion sensitive. If there is any movement near the door, the video recorder will start. When we first installed the camera, we kept using tape, but nothing was on it. There was just the door. We thought we either had a poltergeist that was activating the video equipment or something else was going on. It turns out, the explanation was simple. While this BSL-3 suite was set up with all kinds of gauges and bells and whistles, with lights and pressure differential gauges, and with lights that

Figure 7

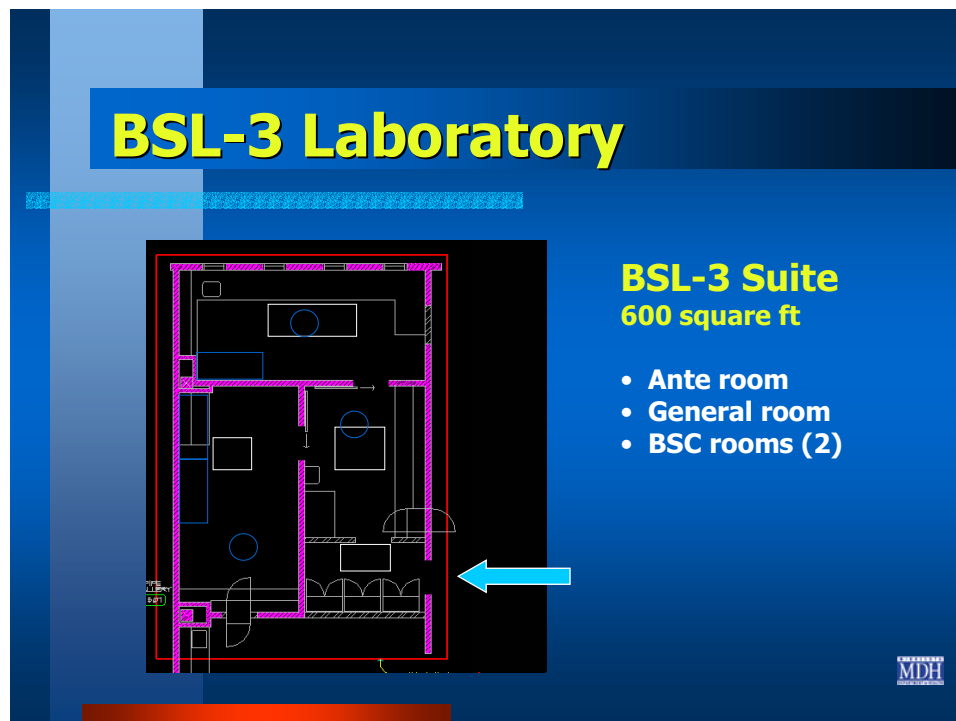


Figure 8

Security: BSL-3 Access

- **Electronic card reader**
 - **Restricted access**
 - **Monitored access**

The slide features two photographs. The left photograph shows a person in a white lab coat using a card reader next to a biohazard sign that reads 'HAZARD' and 'CAUTION BIOLOGICAL HAZARD'. The right photograph shows a door with a card reader and a biohazard sign, with a red arrow pointing from the card reader in the left photo to the one in the right photo.

go green and lights that go red and alarms that sound, we also put in place a fail-safe back-up system. We hung a piece of tissue paper from the ante-room ceiling so we can see if the air is on and if it is flowing in the right direction. This always works. But the video camera detected this tissue flapping in the after-hours breeze. The movement was turning the camera on, so we were recording nothing of particular interest. I just point this out in case you have a similar problem in your institution, this could be it [Laughter].

I have discussed factors that are important to safety in the public health laboratory during the pre-analytical and analytical phases of testing samples and specimens for agents of terrorism and emerging threats. Now I would like to talk about postanalytical considerations. This involves the concern and the need to be rigorous about decontamination and waste disposal. Storage also is an important postanalytical consideration. When dealing with agents of terrorism or emerging infectious diseases, it is imperative that they be stored securely in the laboratory with appropriately displayed hazard warnings for fire, police, or HAZMAT teams if they should need

to come into the facility in response to an emergency call. For secure storage in my laboratory, again, we use card readers on our storage freezers for restricted, documented access.

In the state public health laboratory, management is responsible for having in place a safety program to protect laboratory staff and the public. Management is responsible for providing a safe work environment and for actively promoting appropriate safety awareness and training. This is not always easy. There may be some staff members who have been doing certain things certain ways for many years and they may not see any reason to change. While the risk of infection among laboratory workers has always been of some concern in our laboratories, I think today risk awareness has to be even greater.

Today we have to be concerned not only about possible exposure during the testing process, but we also have to be concerned about the risk in bringing unknown samples and specimens into our laboratories before testing occurs. Risk assessment has become very important. In the state public health laboratory, we need to analyze all of our activities and

Figure 9



procedures for potential risk. What do we do that might result in exposure? Are the workers in the laboratory experienced and well trained? Regarding potential agents that might be brought into the laboratory, what is their pathogenicity or toxicity, their morbidity and mortality, their epidemic potential, and the risk they may pose for families of the laboratory staff? What is the infectious or toxic dose, the mode of transmission, the environmental stability, and the availability of treatment? Regarding any possible chemical agent, what is its toxicity, flammability, and reactivity? What physical effects might the chemical have? Is the agent radioactive? These and many other questions need to be asked to be sure risk is adequately assessed.

An important feature that state public health laboratories should have in place is an all-hazards safety program. There should be a safety officer, a safety plan, a safety committee, a containment laboratory, safety training, and an exposure response plan. I would like to talk briefly about each of these. The safety officer should be an individual knowledgeable about laboratory risks who preferably reports directly to the person in charge of the labora-

tory, namely the director. Ideally, the safety officer should also be knowledgeable about personnel safety and engineering fundamentals. While the individual need not be an engineer, the person should clearly understand the engineering fundamentals that make laboratory containment effective.

The role of the safety committee is quality assurance, to continually monitor laboratory activities and systems to identify and correct safety-related problems. The committee should develop policies and procedures that insure the safety of the laboratory workers, as well as the environment and persons outside the laboratory. A safety plan should be in place to assess potential risks, control potential exposures, and describe required actions when an exposure occurs. If exposure to a hazardous agent occurs in the laboratory, there needs to be a plan in place before this happens. As part of the plan, there should be a mechanism for immediate reporting of any safety-related incident. Even if an individual only thinks they may have been exposed, there should be a report. In addition, anyone potentially exposed should have a medical evaluation. If there has been an exposure, an investigation should be carried out

to determine why the incident occurred and what can be done to prevent it from happening again in the future.

Because state public health laboratories are expected to handle terrorism agents and other emerging threats, which may be infectious organisms or toxic chemicals, there is a need to have BSL-3 containment space, as I have described, within the laboratory facility. To design and construct new BSL-3 space, or to renovate existing space to meet BSL-3 standards, it is important to elicit consultative input from professionals at CDC or NIH. In addition, it is important to have the laboratory's BSL-3 space certified to make sure its operation is correct and effective. Because our state public health laboratories must be prepared for the possibility that unknown biological or chemical agents may be brought into the laboratory for testing, these laboratories should in fact have a Class III biological safety cabinet (i.e., a sealed, ducted glove box) to provide BSL-4 containment in the sample receiving area.

To be sure biological and chemical safety issues are clear and safety measures are implemented, safety training for the entire laboratory staff is essential. There should be a comprehensive checklist, developed and approved by the laboratory's safety committee, which includes general safety training for all employees and specific BSL-3 laboratory training for the individuals who work in this high-containment area. Because BSL-3 training is critical to the all-hazards safety approach in our public health laboratories, there should be a mechanism to certify training has occurred and that the person trained is proficient and knows how to deal with any hazardous situations that might arise.

Finally, the public health laboratory should have an exposure response plan in place. If suddenly an exposure occurs in the laboratory. What needs to be done about first aid? In our BSL-3 suite, we always have at least two people present. One person remains outside the laboratory, observing the work that is going on within the BSL-3 area through a glass window. If something goes wrong within the

containment space, the observer is safe and can take action from the outside to get appropriate help. Also, if a dangerous spill occurs anywhere in the laboratory, it is essential that a plan be in place to take quick, effective action. These actions should be thoroughly planned in advance. Included in the exposure plan, there should be procedures for incident documentation and laboratory decontamination. The laboratory should have a safety plan to prevent exposure and an exposure plan to direct appropriate action if something goes wrong.

In conclusion, our state public health laboratories have broad safety requirements. We need an all-hazard approach to safety. This approach has to reach from the preanalytical stage of an incident, out in the field, all the way to the postanalytical stage, where the material tested is ultimately decontaminated or securely stored. While progress is being made in both primary and secondary containment, significant gaps in the safety of our state laboratories still exist. For example, there is a critical need to develop and publish useful laboratory guidelines for chemical containment. I believe such guidelines are in the process of being developed by CDC. Regarding these guidelines, what I have seen so far indicates that chem-safety will likely be categorized into four levels: low risk, moderate risk, substantial risk, and high risk. The risk level of a particular laboratory will depend on the kind of agents it is expected to handle. Another significant safety gap is the unavailability of specific, validated procedures to handle and assay seriously dangerous chemical agents in a plethora of possible environmental samples. It is very difficult for our state public health laboratories to acquire and implement procedures that might be needed to analyze such samples, despite the fact that we are expected to do so within our respective states. These procedures do not exist in any of our laboratories. Finally, there is a training gap. It is very important that we have expert personnel in our state public health laboratories trained and able to handle all kinds of hazardous agents. We are asked to do this almost every day, safely and proficiently.