Improving Biosafety In Our Nation’s Laboratories

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Chair, APHL Biosafety and Biosecurity Committee
Biorisk Management: Biosafety & Biosecurity

- **Biosafety**: Protecting people & the environment from dangerous organisms
- **Biosecurity**: Protecting organisms from dangerous people.
Biosafety Practices Evolve
Biosafety...a brief history

• Dates back to biological weapons program from 1940’s to 1970.
  – Abandoned by President Nixon in 1969
• 1943 Camp Detrick (later Fort Detrick) established the biological weapons program for defensive purposes and biosafety was recognized as a necessary component
• In 1955 biological safety officials began to meet annually.
• In 1984 ABSA was formed
1961: Sentinel Publication

  - Based on 102 labs in 11 countries

- Conclusions:
  - Prevention of LAI requires a broad, systematic approach that should not be limited to the implementation of technical controls
  - Management has the responsibility to direct and support the safety program
  - Laboratory design impacts safety
Smallpox

- 1963-1978 there were 80 cases of LAI smallpox infections in the UK linked to 2 facilities
  - The last known smallpox fatality occurred in a medical photographer at the University of Birmingham Medical School who worked in a darkroom one floor above the lab where research was conducted with live smallpox virus (she also transmitted it to her mother who survived)
sealed vials with freeze-dried smallpox virus were found in July 2014 in a storage room at the National Institutes of Health (NIH) in Bethesda MD USA that 42 years earlier had been turned over to the FDA.
Potential laboratory-acquired Salmonella infection at CDC – March 31, 2016

CDC is investigating how one of its laboratory workers who was recently diagnosed with Salmonella infection may have acquired their infection due to work they performed in a BSL-2 laboratory (a level of lab work involving pathogens that are common and treatable causes of illness).

Preliminary laboratory tests indicate that the worker was infected with a strain of Salmonella which matched the strain being worked on in the lab... The worker had hands-on training by experienced microbiologists and completed all required safety training. The worker was following standard protocols to perform a basic procedure on a frozen sample in an effort to culture or grow the bacteria. The agency is investigating to see if additional safeguards are needed to prevent exposures when performing this procedure in the future.

Laboratory science is critical to protect America's health, however, there are risks. CDC has implemented numerous steps to enhance its laboratory safety program, including standing up the Office of the Associate Director for Laboratory Science and Safety, reviewing laboratory safety protocols, and establishing the Laboratory Leadership Service fellowship program.

http://www.cdc.gov/media/releases/2016/s0331-potential-laboratory-infection.html
# Emerging Pathogens by Decade

<table>
<thead>
<tr>
<th>Year</th>
<th>Pathogens</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970</td>
<td>Legionella, Norwalk virus, MRSA</td>
</tr>
<tr>
<td>1980</td>
<td>Legionella, Norwalk virus, MRSA, E. Coli O157, Prions</td>
</tr>
<tr>
<td>1990</td>
<td>Legionella, Norwalk virus, MRSA, E. Coli O157, Prions, Helicobacter pylori,</td>
</tr>
<tr>
<td></td>
<td>E. Coli O157, Prions, Helicobacter pylori, E. Coli O157, Prions, VRE</td>
</tr>
<tr>
<td>2000</td>
<td>Legionella, Norwalk virus, MRSA, E. Coli O157, Prions, Helicobacter pylori,</td>
</tr>
<tr>
<td></td>
<td>E. Coli O157, Prions, Helicobacter pylori, E. Coli O157, Prions, VRE</td>
</tr>
<tr>
<td>2010</td>
<td>Legionella, Norwalk virus, MRSA, E. Coli O157, Prions, Helicobacter pylori,</td>
</tr>
<tr>
<td></td>
<td>E. Coli O157, Prions, Helicobacter pylori, E. Coli O157, Prions, VRE</td>
</tr>
</tbody>
</table>

Pathogens by Decade:

- **1970**: Legionella, Norwalk virus, MRSA
- **1980**: Legionella, Norwalk virus, MRSA, E. Coli O157, Prions
- **1990**: Legionella, Norwalk virus, MRSA, E. Coli O157, Prions, Helicobacter pylori, E. Coli O157, Prions, VRE
- **2000**: Legionella, Norwalk virus, MRSA, E. Coli O157, Prions, Helicobacter pylori, E. Coli O157, Prions, VRE
- **2010**: Legionella, Norwalk virus, MRSA, E. Coli O157, Prions, Helicobacter pylori, E. Coli O157, Prions, VRE
1988 Survey of MT’s

• 1 of every 3 laboratory workers surveyed at the annual meeting of the New Jersey Society for Medical Technology reported that they were considering leaving the profession because of fears stemming from the latest deadly disease to emerge.

• 43% of all respondents (91 of 212 meeting registrants) indicated that, in retrospect, they would not have chosen a career in medical technology, knowing they would be required to handle specimens from patients infected with such dangerous bugs.
1980’s: Labs risk HIV exposure

<table>
<thead>
<tr>
<th>Occupation</th>
<th>Documented</th>
<th>Possible</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nurse</td>
<td>24</td>
<td>36</td>
</tr>
<tr>
<td>Laboratory worker, clinical</td>
<td><strong>16</strong></td>
<td><strong>17</strong></td>
</tr>
<tr>
<td>Physician, nonsurgical</td>
<td>6</td>
<td>13</td>
</tr>
<tr>
<td>Laboratory technician, nonclinical</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>Housekeeper/maintenance worker</td>
<td>2</td>
<td>14</td>
</tr>
<tr>
<td>Technician, surgical</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Embalmer/morgue technician</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Health aide/attendant</td>
<td>1</td>
<td>15</td>
</tr>
<tr>
<td>Respiratory therapist</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Technician, dialysis</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Dental worker, including dentist</td>
<td>-</td>
<td>6</td>
</tr>
<tr>
<td>Emergency medical technician/paramedic</td>
<td>-</td>
<td>12</td>
</tr>
<tr>
<td>Physician, surgical</td>
<td>-</td>
<td>6</td>
</tr>
<tr>
<td>Other technician/therapist</td>
<td>-</td>
<td>9</td>
</tr>
<tr>
<td>Other healthcare occupation</td>
<td>-</td>
<td>6</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>57</strong></td>
<td><strong>143</strong></td>
</tr>
</tbody>
</table>

The fear of HIV led to changes

- Universal precautions to prevent contact with blood and body fluids
- Bloodborne Pathogens Standard-1992
2014 - Labs faced fear of testing specimens from suspect ebola patients

• Two cases of healthcare-transmitted Ebola disease in Dallas resulted in concern about the handling of patients and samples

• Many hospital laboratories refused to run blood tests on possible Ebola patients.
  – As reported by the College of American Pathologists, a 2014 survey of the Compass Group (comprising 28 not-for-profit US healthcare systems) found that just four of 17 respondents allowed suspected or confirmed Ebola specimens into their labs.
Lab-acquired infections occur and are under reported

- Laboratory-Acquired Vaccinia Virus Infection --- Virginia, 2008
- Laboratory-Acquired Brucellosis --- Indiana and Minnesota, 2006
- Laboratory-Acquired West Nile Virus Infections --- United States, 2002
- Laboratory-Acquired Meningococcal Disease --- United States, 2000

- Kubica estimated that 8-30% of laboratories may experience tuberculin conversions.
- Kubica described 15 separate incidents in which 80 of 291 (27%) exposed lab staff developed positive TST:
  - 8 involved poor directional airflow
  - 5 associated with BSC failures
  - 1 linked to an autoclave failure
  - 1 due to equipment failure.
Recent Findings

- Overall HCW TST conversion 2.3 per 10,000 FTEs in non hospital settings
- TST reactivity claims highest for physician offices 3.7 / 10,000 FTEs
- Medical labs 2.6 / 10,000 FTEs were second

Biosafety Rules and Regulations

- **Biosafety Level 1 (BSL-1)**
- **Biosafety Level 2 (BSL-2)**
- **Biosafety Level 3 (BSL-3)**
- **Biosafety Level 4 (BSL-4)**

Diverse Laboratory Community

- Hospital labs
- Research labs
- Veterinary labs
- Government labs

All work with the same agent does not equal the same degree of risk
Why Under Reporting Is Common

• There are no reporting requirements except for fatalities (OSHA)
• Major concern is that reporting the incident reflects poorly on the facility
• Lost opportunity to learn from others experience
### TABLE 1. Most frequently reported laboratory-acquired infections in the United States and Great Britain

<table>
<thead>
<tr>
<th>Infection</th>
<th>Total no. (%) of cases reported for:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>U.S.(^a)</td>
</tr>
<tr>
<td>Brucellosis</td>
<td>274 (9.4)</td>
</tr>
<tr>
<td>Q fever</td>
<td>184 (6.3)</td>
</tr>
<tr>
<td>Typhoid fever</td>
<td>292 (10.0)</td>
</tr>
<tr>
<td>Hepatitis</td>
<td>126 (4.3)</td>
</tr>
<tr>
<td>Tularemia</td>
<td>129 (4.4)</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>174 (6.0)</td>
</tr>
<tr>
<td>Dermatomycosis</td>
<td>84 (2.9)</td>
</tr>
<tr>
<td>Venezuelan equine encephalitis</td>
<td>118 (4.1)</td>
</tr>
<tr>
<td>Typhus</td>
<td>82 (2.8)</td>
</tr>
<tr>
<td>Psittacosis</td>
<td>70 (2.4)</td>
</tr>
<tr>
<td>Coccidiodymycosis</td>
<td>108 (3.7)</td>
</tr>
<tr>
<td>Streptococcal infections</td>
<td>67 (2.3)</td>
</tr>
<tr>
<td>Histoplasmosis</td>
<td>81 (2.8)</td>
</tr>
<tr>
<td>Leptospirosis</td>
<td>43 (1.5)</td>
</tr>
<tr>
<td>Salmonellosis</td>
<td>54 (1.9)</td>
</tr>
<tr>
<td>Shigellosis</td>
<td>54 (1.9)</td>
</tr>
</tbody>
</table>

All reported infections: 2,912, 3,921, 95, 34

\(^a\) 1969 data adapted from reference 151.
\(^b\) 1976 data adapted from reference 110.
\(^c\) 1980 to 1989 data adapted from references 51 through 55.
\(^d\) Includes possibly attributable and attributable cases.
\(^e\) NADC, National Animal Disease Center; 1975 to 1985 data adapted from reference 93.
<table>
<thead>
<tr>
<th>Case</th>
<th>Yr</th>
<th>Age of patient</th>
<th>Sex</th>
<th>Serogroup</th>
<th>Outcome</th>
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<tbody>
<tr>
<td>1</td>
<td>1985</td>
<td></td>
<td></td>
<td>B</td>
<td></td>
</tr>
<tr>
<td>2&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1985</td>
<td></td>
<td>F</td>
<td>C</td>
<td>Fatal</td>
</tr>
<tr>
<td>3&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1987</td>
<td></td>
<td>F</td>
<td>B</td>
<td>Fatal</td>
</tr>
<tr>
<td>4</td>
<td>1989</td>
<td></td>
<td>F</td>
<td>B</td>
<td>Fatal</td>
</tr>
<tr>
<td>5</td>
<td>1991</td>
<td>46</td>
<td>F</td>
<td>B</td>
<td>Fatal</td>
</tr>
<tr>
<td>6</td>
<td>1991</td>
<td></td>
<td>F</td>
<td>C</td>
<td>Fatal</td>
</tr>
<tr>
<td>7&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1992</td>
<td></td>
<td>M</td>
<td>B</td>
<td>Survived</td>
</tr>
<tr>
<td>8&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1995</td>
<td></td>
<td>M</td>
<td>B</td>
<td>Survived</td>
</tr>
<tr>
<td>9&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1997</td>
<td>40</td>
<td>M</td>
<td>B</td>
<td>Survived</td>
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<tr>
<td>10</td>
<td>1997</td>
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<td>F</td>
<td>B</td>
<td>Survived</td>
</tr>
<tr>
<td>11</td>
<td>1998</td>
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<td>F</td>
<td>B</td>
<td>Survived</td>
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<tr>
<td>12&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1999</td>
<td></td>
<td>F</td>
<td>C</td>
<td>Survived</td>
</tr>
<tr>
<td>13&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1999</td>
<td></td>
<td>F</td>
<td>C</td>
<td>Survived</td>
</tr>
<tr>
<td>14&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2000</td>
<td>35</td>
<td>M</td>
<td>C</td>
<td>Fatal</td>
</tr>
<tr>
<td>15&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2000</td>
<td>52</td>
<td>F</td>
<td>C</td>
<td>Fatal</td>
</tr>
<tr>
<td>16&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2000</td>
<td></td>
<td>F</td>
<td>C</td>
<td>Fatal</td>
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<tr>
<td>17&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2002</td>
<td>50</td>
<td>F</td>
<td>C</td>
<td>Survived</td>
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<tr>
<td>18&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2002</td>
<td>21</td>
<td>M</td>
<td>A</td>
<td>Survived</td>
</tr>
<tr>
<td>19&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2002</td>
<td>65</td>
<td>F</td>
<td>C</td>
<td>Survived</td>
</tr>
</tbody>
</table>

<sup>a</sup> U.S. cases, included in analysis.
<sup>b</sup> Identified following conclusion of study.
<sup>c</sup> F, female; M, male.

Neisseria meningitidis

- BSL-2, with aerosol/droplet precautions; BSC

- 11 of 31 LAIs were fatal. (Harding & Byers, Biological Safety Principles and Practice, 2006)

- Estimate 3000 isolates of invasive Nm/year
  Est. attack rate 13/100,000 lab techs versus 0.2/100,000 adults aged 30-59. (Sejvar, J.J. et. al. 2005. JCM. 43: 4811-4814.)
  Risk – isolate manipulation without respiratory protection.
Morbidity and Mortality Weekly Report

Fatal Meningococcal Disease in a Laboratory Worker — California, 2012

Channing D. Sheets, MSEd¹, Kathleen Harriman, PhD¹, Jennifer Zipprich, PhD¹, Janice K. Louie, MD¹, William S. Probert, PhD¹, Michael Horowitz, MS², Janice C. Prudhomme, DO², Deborah Gold, MPH², Leonard Mayer, PhD³ (Author affiliations at end of text)
Brucella spp.

- Highly infectious; frequent cause of LAI
- Containment BSL-3 facility and practices
- BSC use is prudent for clinical samples or proficiency test cultures
CAP Microbiology Checklist

• Are there documented policies for handling spills of contaminated materials?
• Is there documentation of daily decontamination of bench tops?
• Are there documented policies and procedures for the safe handling and processing of specimens?
• Have policies and procedures been developed to minimize the occupational risk of exposure to infectious agents handled in the microbiology laboratory, in accordance with current recommendations regarding the biosafety levels for working with different organisms?
• Are engineering and work practice controls appropriate to the biosafety level of the laboratory defined and implemented?
• Is a biological safety cabinet available and properly used for handling specimens or organisms considered highly contagious by airborne routes?
• Is the biologic safety cabinet certified at least annually to ensure that filters are functioning properly and that airflow rates meet specifications?
Problem

• Without testing, patients can’t receive care
• Unfortunately biosafety is seen as an add-on task in the lab, not part of daily behaviors.
  – Example new instrument, you don’t think about the biosafety issues using that instrument.
  – Before last year, we never had a patient w/ ebola in the US. Now, that could easily occur.
What changes will the risk of ebola bring to laboratories?

• Lab transformation to emphasize biosafety to safeguard workers
• Biosecurity to safeguard dangerous biological materials
• Quality management systems to assure continuous reevaluation of control measures
A National Biosafety and Biosecurity System in the United States

OCTOBER 29, 2015 AT 2:30 PM ET BY LISA O. MONACO, JOHN P. HOLDREN

Summary: Administration releases joint memo to agencies, plans for enhancing biosafety and biosecurity at infectious disease laboratories.

Enhancing a national biosafety and biosecurity system that protects scientists, healthcare workers, and the American public from exposure to harmful pathogens is a critical part of the Administration’s efforts to conduct state-of-the-art life-sciences research and to make new lifesaving treatments, vaccines, and diagnostics widely available. Last year, we issued a joint memo to Federal departments and agencies, urging them to take both immediate and longer-term steps to address the underlying causes of laboratory incidents and to examine and strengthen biosafety and biosecurity practices. Since that time, the Administration has conducted a comprehensive review of the Federal Government’s biosafety and biosecurity enterprise. Over
What’s missing?

• A “Culture of Biosafety” in the Laboratory
• Biosafety is Part of the Systemic Approach to Quality
• Laboratories are mostly self-monitoring (Safety not a major component of CLIA or CAP). SA program is the exception.
• Laboratories Will Never be Risk Free
  – USA Today Report (August 2014), 240 Incidents/Year Between 2009-2012
What do clinical labs need?

- National standards and guidance (checklist)
- Incentive to get this accomplished and recognition of accomplishment
- Training and education
- Simple, comprehensive tools to make this achievable
- Engagement of all lab sections
- Commitment from administration/leadership
- National resource to report accidents and exposures
- Assistance with difficult issues, ex. Medical waste management
Potential Hazards: Chain of Infection

Susceptible Host

Agent

Reservoir

Portal of Exit

Entry Site

Means of Spread

Risk is the probability that a health event will occur after an exposure to a specified amount of hazard.
Laboratory Response Network (LRN)

- Good example of successful biosafety program
- All 50 states, DC and selected local PHLs are members of the LRN-B at the Reference Level
- Significant expertise in working with dangerous virulent pathogens
- LRN-B Reference labs have:
  - Regular inspections
  - Mature biosafety programs
  - Risk assessment experience
  - Annual trainings and drills in place that address Biosafety
  - Annual trainings and drills in place that cover Biosafety
- Move some of these practices to the entire PHL
Where do labs begin?

• There is not one simple and easy to follow source for all the information needed to build a “culture of biosafety”

• There needs to be more consensus building on biosafety issues, for example:
  – Wearing gloves in the microbiology lab to read plates
  – How to do a risk assessment
The worker is key to preventing exposures

- Host factors placing staff at increased risk
  - Known immunosuppression
  - Chronic diseases such as, asthma, emphysema or severe respiratory conditions
  - Use of medications known to reduce dexterity or reaction time
  - Pregnancy

Worker is pivotal in controlling the safe outcome of any operation!

Biosafety competencies have not been incorporated into competency program

<table>
<thead>
<tr>
<th>Field</th>
<th>Entry Level</th>
<th>Midlevel</th>
<th>Senior level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Academia or research</td>
<td>Technician, research associate, or specialist</td>
<td>Principal investigator, laboratory manager, postdoctoral student, or senior or staff scientist</td>
<td>Principal investigator or branch or division manager</td>
</tr>
<tr>
<td>Clinical setting</td>
<td>Laboratory scientist or medical technologist</td>
<td>Chief/head scientist or medical technologist, laboratory specialist, or laboratory manager</td>
<td>Pathologist, Laboratory manager, chief technologist, or hospital or clinic director</td>
</tr>
</tbody>
</table>
Laboratory Risk Assessment
For a Suspect Patient with a High Possibility of Ebola Virus Disease (EVD)

Revised: August 25, 2014

Standard precautions have been highly effective in preventing transmission of bloodborne infection in the course of handling blood and other potentially infectious material in the clinical laboratory. Standard precautions should be effective in preventing the transmission of Ebola virus and other viral hemorrhagic fever agents in the clinical laboratory. However, Ebola virus is a high consequence pathogen, and there has been limited experience handling specimens potentially contaminated with such a high consequence pathogen in a clinical laboratory using current specimen handling procedures and automated instrumentation. Therefore, this risk assessment is provided for enhanced precautions in handling specimens from patients who may be at risk of having Ebola virus infection. This risk assessment represents reasonable precautions for this level of risk, but given the lack of experience and data, laboratories may want to elevate precautions even further based on their individual assessments and resources. If more information becomes available on the risk of transmission, this risk assessment may change.

The CDC has released Interim Guidance for Specimen Collection, Transport, Testing, and Submission of specimens from patients with suspected infection with Ebola Virus Disease. This laboratory risk assessment is based on these guidelines. Please see the link below: http://www.cdc.gov/vhf/ebola/hcp/interim-guidance-specimen-collection-submission-patients-suspected-infection-ebola.html

For questions please contact:
Dr. Michael Pentella, Laboratory Director at 617-983-4362 or 617-276-7289
Cheryl Gauthier, Bioterrorism Response Coordinator at 617-983-6266
Dr. Sandy Smole, Division Director at 617-983-6966 or 617-839-3220
Mary DeMartino, Quality Assurance Director at 617-983-6236
PHL leadership of working with sentinel labs to improve practices

- Example: the successful Laboratory Response Network for preparedness

Drawbacks:
- Staff changeover
- Unable to train everyone
- Labs become less interested with time as news worthiness wanes
APHL forms Biosafety and Biosecurity Committee 3-26-15

- **Biosafety** – Protecting the workers and the environment from microbial exposure.
- **Biosecurity** – Protecting the organisms so they’re not stolen or misused.
- Strengthening lab systems to strengthen biosecurity.
BBC Membership

- APHL members: Christina Egan, Andy Cannons, Leah Gillis, Dave Hill, Royden Saah, Charlene Thomas, Dave Warshauer, Mark Wade
- ABSA representative Bill Homovec
- ASM representative James Snyder
- ASCP representative Kathleen Beavis
- CDC: Dev Howerton, John Kools, Toby Merlin, Alvin Shultz, Sephan Monroe, Betsy Weirich
- Sandia National Laboratories: Reynolds Salerno
APHL BBC

• **Purpose:** to provide leadership and guidance on policies and practices which impact Biosafety and Biosecurity in state and local governmental laboratories and clinical labs.

• **Vision:** every lab performing clinical lab testing be prepared to handle specimens safely for any emerging disease threat.
APHL Biosafety Position Statement

• Urging laboratories to enhance biosafety practices via “routine risk assessments and standardized training, identification of true risk and best practices, development of consensus standards and guidelines, and improved reporting of exposure events.”
BBC Priorities

- Serve as expert resource to public health and clinical labs
- Build a repository for biosafety and biosecurity tools
- Advise and assist in the development of a “community of practice” for biosafety officers in public health labs
- Design a core curriculum for biosafety and biosecurity and deliver training materials & convene workshops
- Encourage a culture of biosafety and biosecurity within all laboratories.
Epidemiology and Laboratory Capacity (ELC) Funding

• Funding a full time biosafety officer (for three years)
  – conduct risk assessment to assure the laboratory can safely handle and dispose of Ebola and other highly infectious agents, and providing technical assistance to strengthen biosafety practices in local clinical labs.

• CDC awarded funds to APHL to provide biosafety/biosecurity expertise and training to the public health laboratories
  – To develop materials to assist those laboratories with outreach and training for the sentinel, clinical labs in their jurisdictions.
Competencies for Biosafety Officer

- Safety
- Security
- Workforce Training
- Microbiology
- Communication
- Emergency Management and Response
- Quality Management System
- General Laboratory Practice
Building the Community of Practice

• Development of training workshops and webinars.

• Creation of online forums to foster a community of practice around biosafety/biosecurity.

• Creation of an online repository of outreach models, training courses, risk assessment templates and other biosafety/biosecurity tools that can be applied to clinical laboratories.
Template for biosafety outreach to clinical labs

- Clinical Laboratory Biosafety Risk Management Program Assessment Checklist
  - Biosafety manual
  - Risk assessments
  - Fundamental Safety Practices
  - Engineering controls implemented
  - Facilities review
  - Management of medical waste
  - Applicable to all lab sections
Encouragement of Public Trust

• The need for rigorous scientific research on best practices
• Reduce the inclination to adopt overly engineered solutions
• Need scientific evidence of effectiveness of mitigation measures
Future vision for biosafety in labs

• By accomplishing what is outlined in these slides, labs will have active biosafety programs

• Over time, quality indicators can be measured, for example:
  – Risk assessments completed
  – Risk assessments revised and reasons for revision
  – Reduction in exposures
  – Competencies in place