CDC LABORATORY SYSTEMS, PATHOLOGY AND DIAGNOSTIC ROLE IN GLOBAL HEALTH

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CENTERS FOR DISEASE CONTROL AND PREVENTION
On July 1, 1942 the Communicable Disease Center (CDC) opened its doors and occupied one floor of a small building in Atlanta. Its primary mission was simple yet highly challenging: prevent malaria from spreading across the nation. Armed with a budget of only $10 million and fewer than 400 employees, the agency’s early challenges included obtaining enough trucks, sprayers, and shovels necessary to wage war on mosquitoes.
A health threat anywhere is a health threat everywhere.
Countries with Outbreaks Reported by GDDOC in 2017
CDC LABORATORIES

1700+ SCIENTISTS
200+ LABS
1 MISSION

PROTECT. AMERICANS. 24/7.
Existing Capacity: USG
Shared Priorities

LABORATORY
- Specimen referral network reaching > 80% of districts
- National reference laboratory performing 6 testing methods under IHR

Surveillance
- >3 core syndromes & confirmed reportable infections
- Capacity to analyze and link data for functional real-time biosurveillance

WORKFORCE DEVELOPMENT
- National workforce planning
- Minimum of 1 trained field epidemiologist per 200,000

EMERGENCY OPERATIONS
- EOC activation when needed
- Functional IMS use for preparedness and response

GLOBAL HEALTH SECURITY AGENDA

IHR

INTERNATIONAL HEALTH REGULATIONS

GHSA
Without capacity for early detection & response

Developed from Pinner et al., J Infect Diseases 1992
If surveillance & response system is effective – *Lab + reporting*

Diagram showing:
- First Case
- Detection/Reporting
- Lab Confirmation
- Response

Potential cases prevented
Emergency Operations Center
Crisis/Outbreak Management

- Deployment
- Logistics
- Epidemiology
- Surveillance
- Lab support
- Response coordination
Unknown Disease Outbreaks Algorithm

- Liberia 2017 N. Meningitis's
- Uganda 2018 Malaria with unusual presentation
Applications of laboratory diagnostics and pathology:

- I.D. Outbreak Response
  - Ebola in West Africa
  - Zika in the Americas

- Potential threats
  - Exposure to pandemic threats (specific threat rule in/out-Ebola, flu)
  - Queens “Lady in the iron coffin”-Smallpox

- Surveillance and evidence based clinical study
  - CHAMPS
Physical appearance is consistent with smallpox

- Umbilicated lesions
- Firm to touch
- Gross pathology
- Lesion distribution
“Normal” skin

Mummy skin

Smallpox in skin

The tissue was poorly preserved so difficult to conclude presence of virus
CHAMPS Journey to Ascertaining Cause of Death

Assigning a definitive cause of death involves a series of steps to collect, analyze and interpret relevant data.

1. **Mortality Surveillance**
   - Identify deaths for MITS and collection of additional data

2. **Community Assessment & Engagement**
   - Understand acceptability of proposed processes

3. **Specimen Collection**
   - Collect tissue and non-tissue specimens for further laboratory analysis

4. **Clinical Data**
   - Verbal Autopsy
     - Gather other information around terminal state to improve context for DeCoDe panel

5. **Microbiology, Real-Time PCR Analysis**
   - Identify pathogens in specimens that may have caused death

6. **Local & Central Histopath Analysis**
   - Analyze tissues to understand pathogens associated with cellular changes; compare central and site findings

7. **DeCoDe Panel**
   - Review all findings and assign a definitive cause of death
<table>
<thead>
<tr>
<th>Specimen Type</th>
<th>In-Country</th>
<th>Central Lab</th>
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<tbody>
<tr>
<td></td>
<td>Path</td>
<td>Culture</td>
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<tr>
<td>Tissue</td>
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<tr>
<td>Brain</td>
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<td>Heart</td>
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<td>Liver</td>
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<td>Placenta</td>
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<td>Umbilical cord</td>
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<td>Bone Marrow</td>
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<td>Spleen/Kidney</td>
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<tr>
<td>Skin</td>
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<tr>
<td>Lymph nodes</td>
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<tr>
<td>Deaths</td>
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<td>Non-Tissue</td>
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<td>Blood</td>
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<td>Stool</td>
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<tr>
<td>NP/OP swab</td>
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<tr>
<td>CSF</td>
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<td>Hair*</td>
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<td>Urine*</td>
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<td>Non-Tissue</td>
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<td>NP/OP swab</td>
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<tr>
<td>NP aspirate</td>
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<tr>
<td>CSF (if indicated)</td>
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<tr>
<td>Hair*</td>
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<tr>
<td>Urine*</td>
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*Only collected under extended protocol
*Only collected if child has severe respiratory illness
† For QA/QC
CHAMPS

- Identify infectious agents
- Integrative pathology and diagnostic analysis
- Comparative epidemiology
- Specificity of syndromic cause
- Identification of mortality cause

TaqMan® Array Cards
“Without laboratories men of science are soldiers without arms.”

Louis Pasteur in his laboratory. The red object in the jar is the spinal cord of a rabbit infected with rabies. He used this to develop the rabies vaccine.