The Veterinary Diagnostic Laboratory System and its Role in Supporting the Public Health/Food Safety and the National Veterinary Services

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Role of a Veterinary Diagnostic Laboratory System

- **Effective Surveillance and Early Warning System for Emerging and Foreign Animal Diseases**

- **Surveillance and Diagnosis of Diseases/toxicants; agents of zoonotic/public health importance; environment, animal, human and the wildlife interface.**

- **Real Time Data Capturing, Analysis, Reporting/Dissemination, Research, Teaching and Outreach**
Role of a Veterinary Diagnostic Laboratory System

• Development and Validation of new laboratory tests

• Laboratory Quality Program: Standardized SOPs; training records; auditing; administration of proficiency testing; meeting National/International Laboratory Accreditation requirements

• Laboratory Networking: NAHLN (NVSL), FERN, AAVLD, Local Public Health labs, CDC, FDA,
Transboundary Animal Diseases (TAD) (North America: Foreign Animal Diseases)

Definition of TAD:
“Those diseases that are of significant economic, trade and/or food security importance for a considerable number of countries; which can easily spread to other countries and reach epidemic proportions; and where control/management, including exclusion, requires cooperation between several countries”.

Core Services

- Early warning system for the Transboundary Animal Diseases /FAD

CEM  FMD  ASF  AHS
Core Services:

Testing for High Impact Diseases

- Avian Influenza virus
  - Subtyping H5 and H7
- Novel H1N1
  - Swine Flu typing: H1,H3, N1, N2
- Avian Paramyxovirus-1
  - Subtyping Exotic Newcastle Disease
- Classical Swine Fever virus
- Rinderpest & African Swine Fever virus
- Foot-and-Mouth Disease virus
Foot-and-Mouth Disease

‘cheetah of infectious diseases’

- All cloven-hoofed animals
- Economic impact:
  
  $2.3$-$69.0$ billion
  (7-21 days delay of detection)

- Per hour: additional 2,000 animals slaughtered plus $565$ million loss after 21 days

Core Services: TESTING FOR FMD ‘LOOK-ALIKE’ DISEASES

Endemic Panel- PCR assay

• Custom panel(s) specifically designed for species/sample type

• Panel-types:
  – Bovine oral vesicular
  – Bovine blood vesicular
  – Ovine/caprine vesicular
  – Bovine respiratory
  – Ovine respiratory
  – Skin
Responding to Regulatory Needs: Screening and Confirmation of Veterinary Drug Residues in Milk by LC-MS/MS

FDA screen for 26 drug residues in milk using a triple quadrupole LC-MS/MS system:

1. Is the milk sample positive?
The LC-MS/MS multiresidue screen must reliably confirm the identity of each compound on the screen (n=26 drugs)

2. Is the milk sample positive at the “level of interest” (above the tolerance level)?
   0.5x, 1x, 2x; x=tolerance for each drug
   Establish the threshold level for each compound on the screen: (is it positive >50% tolerance?).

Outcome: CAHFS successfully replicated FDA’s analytical results.
Core Services.. Capacity to quickly respond to food and Animal Health/Food Safety Emergencies:

- Melamine in Meat
- Antibiotics (Pen G) in Dairy
- Chloramphenicol in Milk
- Phorate in Animal Feed

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Core Services..Capacity to quickly respond to Food Safety/Public Health and Animal Health Emergencies:

- Human and Animal Toxicosis by Naturally Occurring or Intentionally Introduced Toxins/Compounds

- Botulism
- Poisonous Mushrooms
- Lead in Rumen of a cow
- Methomyl (Pesticide) in Salsa
## Core Services: Capacity to quickly respond to Food Safety/Public Health and Animal Health Emergencies: Examples

<table>
<thead>
<tr>
<th>Year</th>
<th>Toxic Agent</th>
<th>Number of Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>1988</td>
<td>Lead</td>
<td>25 of 300 dairy cows</td>
</tr>
<tr>
<td>1996</td>
<td>Oleander</td>
<td>5 of 400 dairy cows and 7 beef cattle</td>
</tr>
<tr>
<td>1998</td>
<td>Botulism</td>
<td>430 of 460 dairy cows</td>
</tr>
<tr>
<td>1997</td>
<td>Phorate</td>
<td>167 of 1000 dairy cows</td>
</tr>
<tr>
<td>1998</td>
<td>Blue-green algae</td>
<td>24 of 175 heifers</td>
</tr>
<tr>
<td>1999</td>
<td>Botulism</td>
<td>135 of 644 dairy cows</td>
</tr>
<tr>
<td>1999</td>
<td>Botulism</td>
<td>12 dairy cows</td>
</tr>
<tr>
<td>2005</td>
<td>Oleander</td>
<td>7 of 600 dairy cows</td>
</tr>
<tr>
<td>2005</td>
<td>Botulism</td>
<td>22 of 300 dairy cows</td>
</tr>
</tbody>
</table>
**SE phage type 4 in Eggs:**

**Source:** Sewage Treatment Effluent

- **Identical plasmid profiles**

**Loss:** $2.4M

- **1/2 mile UPSTREAM**

- **Effluent spillway**

*Fig. 2. Plasmid profile of Salmonella enteritidis isolates. Lanes: 6—creek water (upstream); 7—skunk liver; 8—chicken egg; 9—chicken liver; 11—creek water (midstream); 13—creek water (downstream); 16—mouse liver; 17—raw sewage inflow; M—molecular weight marker (lambda DNA–HindIII digest).*
## Core Services

Veterinary Public Health and Control of Zoonoses

<table>
<thead>
<tr>
<th>Disease</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brucellosis</td>
<td></td>
</tr>
<tr>
<td>Tuberculosis</td>
<td></td>
</tr>
<tr>
<td>Listeriosis, EHEC, Campylobacteriosis, Salmonellosis, etc.</td>
<td></td>
</tr>
<tr>
<td>Salmonellosis</td>
<td></td>
</tr>
</tbody>
</table>

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Core Services

Other Examples of Zoonoses

- Leptospirosis
- Avian Influenza
- Rabies
- Anthrax
- Tularemia
Core Services

New information, outreach, teaching and research

- Industry stakeholders, and, veterinarians; State Program Officers
- Describe new or unusual syndromes of disease
- Teaching – veterinary students, residents, producers, vets, etc.
- Provide diagnostic material for new research
Core Services...One Health
Surveillance: Wildlife/Animal and Human Health Interface
Laboratory Quality Program

Essential for a Veterinary Diagnostic Laboratory

1. Definition:

A quality system is a structured and documented management system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for ensuring quality in its work processes, products and services.
Laboratory Quality Program: What it does:

a. Laboratory Accreditation

b. Designed to help improve, and then maintain quality and standards

c. Assurance that the laboratory is capable of producing data that are accurate, traceable and reproducible
Benefits of Accreditation

• Increases confidence in data by providing a benchmark for competence
• Increases client confidence, because accreditation is a recognizable mark of approval
• Improves the efficiency of processes (which may reduce costs)
• Increases quality awareness by all personnel
• Establishes a mechanism for continual improvement
• Required for funding
• Provides marketing advantage….think of trading partners
Electronic Messaging: *Real Time Data Capturing, Analysis, Reporting*

1. Data Capturing and Reporting System:
   - HL7 XML messages to NAHLN
   - HL7 and other XML messages to CDFA

(Extensible Mark-up Language): specially formatted file

2. Receiving submission orders
   - Developing system with CDFA to receive XML order messages
Laboratory Networks and Benefits:

- Standardization of Equipment and Procedures
- Proficiency Testing
- Surge Capacity
- Training of Personnel
- Funding Potential