Epidemiology and Laboratory Capacity Update: California Department of Public Health (CDPH) Perspective and Future Challenges

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CA Foodborne Disease Surveillance Overview

- CA Population: 39.6 million
- 61 Local Health Departments (LHDs)
  - 58 counties + 3 cities
  - Decentralized

- Certified PulseNet Laboratories In California:
  - California Dept. of Public Health
    - Microbial Diseases Laboratory, Food and Drug Lab
  - Local Public Health Laboratories (current)
    - LA County, Orange County, and Santa Clara County. San Diego certification is in process.
The “Three-Legged Stool”: Coordination and Collaboration at CDPH

INFECTIOUS DISEASES BRANCH, DISEASE INVESTIGATIONS SECTION
Epidemiological

MICROBIAL DISEASES LABORATORY
VIRAL AND RICKETTSIAL DISEASE LABORATORY
FOOD AND DRUG LABORATORY BRANCH
Laboratory

FOOD AND DRUG BRANCH, EMERGENCY RESPONSE UNIT
Environmental

Local CD, CDC

Local EH, USDA, FDA

Local PHL, CDC
DIS Team

- 15 full time team members (and 2-4 PT student interns!)
- 11 (plus students) funded by CDC grants

**OUTBREAK RESPONSE**
- Cholera
- Salmonellosis

**SURVEILLANCE OF COMMUNICABLE DISEASES**
- Group A strep
- Typhoid
- Vibriosis
- Legionellosis
- Fish Toxicities

**SUPPORT FOR LHDS**
- Shigellosis
- Yersiniosis
- Waterborne Diseases

**PROVIDE SUBJECT MATTER EXPERTISE**
- Botulism
- Campylobacteriosis
- Anthrax
- Brucellosis
- STEC
- Ebola
- Leprosy
- Listeriosis

**EDUCATION AND TRAINING**
- Unexplained ID Deaths
- Norovirus
- Brucellosis

**INFORMATICS; DATA ANALYSIS AND APPLICATION**
- Coccidioidomycosis
- Vibriosis
- Yersiniosis
- Shigelliosis
- Typhoid

**California Department of Public Health**

Division of Communicable Disease Control
Foodborne Disease and Investigations in California

• Over 9400 *Campylobacter*, 5300 *Salmonella*, 2600 *Shigella*, 1400 STEC, and 125 *Listeria* cases reported in 2017
  – Majority sporadic cases
  – Case investigation is done by LHDs
  – 59/61 LHDs enter information directly into state electronic database

• Over 700 enterics clusters and outbreaks investigated in 2017
  – Local clusters and outbreaks investigated by LHJs
  – CDPH involved if multiple jurisdictions involved, media interest, or if consultation requested
  ▪ Approximately 100 clusters investigated by DIS
Challenges

• Huge and heterogeneous state, demographically diverse population, lots of disease, competing priorities, limited staff

• LHDs with range of capacities
  - County population range from 1,000 (Alpine) to 10 MILLION (LAC)
  - Two largest LHDs not on state electronic surveillance system
  - Several CA PHLs enter information directly into PulseNET
  - LHDs do not all use same case investigation forms for initial follow up of enteric diseases

• Rapidly advancing technology
  - CIDT- unclear sensitivity and specificity
  - WGS....
### The WGS Challenge for CA Epi

<table>
<thead>
<tr>
<th>Representativeness / Prioritization</th>
<th>(Past) PFGE</th>
<th>(Future) WGS</th>
<th>Challenges/ Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>PFGE done for:</td>
<td>WGS will be done for:</td>
<td>For <em>Salmonella</em>:</td>
<td></td>
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<tr>
<td>- 100% of <em>Salmonella</em> isolates</td>
<td>- Approximately 33 - 50% of <em>Salmonella</em> isolates</td>
<td>- How to prioritize isolates?</td>
<td></td>
</tr>
<tr>
<td>- 100% of STEC O157</td>
<td>- 100% STEC O157</td>
<td>- Will this be representative of strains circulating in CA?</td>
<td></td>
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<tr>
<td>- 0% <em>Listeria</em> (WGS since 1/18)</td>
<td>- 100% Listeria</td>
<td>- Will we miss clusters of rarer strains?</td>
<td></td>
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<thead>
<tr>
<th>Communication with MDL, Other PHLs</th>
<th>Shared spreadsheets with MDL SEDRIC for PHLs</th>
<th>120 day linelist for <em>Listeria</em>; impact of all PHLs having access to Bionumerics?</th>
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<tbody>
<tr>
<td></td>
<td>• 120 day linelist for <em>Listeria</em>; impact</td>
<td>Big WGS learning curve for epis</td>
</tr>
<tr>
<td></td>
<td>of all PHLs having access to Bionumerics?</td>
<td>• whole vs core genome</td>
</tr>
<tr>
<td></td>
<td>• Under discussion for other pathogens</td>
<td>• alleles vs SNPs</td>
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<tr>
<td></td>
<td></td>
<td>• allele codes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>How to get WGS information from other CA PHLs?</td>
</tr>
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<tr>
<th>Cluster identification</th>
<th>By MDL and by aberration detection using SEDRIC data for CA state and LHD PHLs</th>
<th>By MDL once Bionumerics 7.6 is available</th>
<th>Can aberration detection be done without the historical data? What will the cutoffs for cluster identification be?</th>
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<tr>
<th>Timeliness</th>
<th>Lag time inherently long because isolates often go from clinical lab to LHD PHL to MDL</th>
<th>Lag time has been even longer waiting for WGS analysis by PulseNet</th>
<th>This may be remedied by MDL and LHD access to Bionumerics 7.6</th>
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<tr>
<th>Historical data</th>
<th>PFGE data in SEDRIC has been very valuable in cluster/outbreak investigations</th>
<th>WGS for historical isolates will be limited</th>
<th>Dependent upon allele codes being added in SEDRIC for historical isolates</th>
</tr>
</thead>
</table>
MDL Laboratory Overview – PulseNet

• ELC Budget (PulseNet, NARMS, CC)
  – Sustain and enhance lab capacity
  – Improve lab coordination and outreach
  – Improve surveillance
  – Enhance outbreak investigation response

• PulseNet activities (PFGE and WGS) supported
  – 9 staff certified - 5 ELC-supported

• PFGE performed by Foodborne and Waterborne Disease Section FWDS, Genotyping Unit

• WGS performed by MDL CORE Unit
  – Transfer of responsibilities to FWDS
PulseNet Activities – PFGE Testing

<table>
<thead>
<tr>
<th>Year</th>
<th>Jan 01- Dec 31, 2017</th>
<th>Jan 01- Oct 31, 2018</th>
</tr>
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<tbody>
<tr>
<td>Salmonella</td>
<td>3089</td>
<td>3026</td>
</tr>
<tr>
<td>E. coli O157</td>
<td>365</td>
<td>245</td>
</tr>
<tr>
<td>Non O157</td>
<td>72</td>
<td>101</td>
</tr>
<tr>
<td>Listeria</td>
<td>67</td>
<td>3</td>
</tr>
<tr>
<td>Shigella</td>
<td>243</td>
<td>94</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>3836</strong></td>
<td><strong>3469</strong></td>
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PulseNet Activities – WGS Testing

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<tr>
<td><strong>Salmonella</strong></td>
<td>266</td>
<td>687</td>
</tr>
<tr>
<td><strong>E. coli O157</strong></td>
<td>59</td>
<td>235</td>
</tr>
<tr>
<td><strong>NonO157</strong></td>
<td>80</td>
<td>23</td>
</tr>
<tr>
<td><strong>Listeria</strong></td>
<td>66</td>
<td>48</td>
</tr>
<tr>
<td><strong>Shigella</strong></td>
<td>17</td>
<td>10</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>488</td>
<td>1003</td>
</tr>
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Fiscal Impact of PulseNet Technology Change

Estimated supply cost of WGS ($134/isolate) vs. $9/isolate for Salmonella and $26/isolate for E. coli for PFGE
Strategies for Transition to WGS:

• Technology change transition in climate of limited resources:
  – Training and certification of PFGE staff
  – Overcoming funding limitations
    ▪ Develop test algorithms to optimize resources
    ▪ Communicate with epidemiologists to inform on change and consult on best strategies
    ▪ Finding efficiencies
    ▪ Additional funding streams
  – Advocate and assist local public health laboratories in joining PulseNet or partnering with adjoining PulseNet laboratories
Conclusions

• California is a large and complicated state, with a big burden of communicable diseases
• Dedicated California public health professionals work to prevent and control disease, but face many challenges
• PulseNet highlights the need for good collaboration between epidemiologists and laboratorians
• Technology change will come with a host of challenges and demands on limited resources
  – Cost / test, equipment, human resources (any Bioinformaticians??)
• ELC support is essential for critical surveillance activities in California
Acknowledgements

• FWDS
  – Stephanie Abromaitis
  – Varvara Kozyreva
  – PFGE Team

• CORE Lab
  – Ritu Mukhopadhyay
  – WGS Team

• Infectious Diseases Branch
  – Duc Vugia (IDB Chief)
  – Disease Investigation Section
    • DIS Team

Thank You!