Big Data, Infections, and Quality

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Island Health
Clinical Lead – Antimicrobial Stewardship
BCPSQC
Muir Glacier Alaska
Penicillin Resistant S. aureus

Chambers et al EID 2001
Percent of Urinary *E. coli* Isolates Resistant to Ciprofloxacin by Age

<table>
<thead>
<tr>
<th>Age Group</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;10</td>
<td>5.7%</td>
<td>6.5%</td>
<td>8.4%</td>
<td>10.6%</td>
<td>10.8%</td>
</tr>
<tr>
<td>10-19</td>
<td>5.5%</td>
<td>5.3%</td>
<td>5.0%</td>
<td>7.0%</td>
<td>6.9%</td>
</tr>
<tr>
<td>20-29</td>
<td>8.7%</td>
<td>9.5%</td>
<td>9.3%</td>
<td>9.7%</td>
<td>9.8%</td>
</tr>
<tr>
<td>30-39</td>
<td>10.3%</td>
<td>10.7%</td>
<td>9.3%</td>
<td>10.1%</td>
<td>12.0%</td>
</tr>
<tr>
<td>40-49</td>
<td>11.1%</td>
<td>10.9%</td>
<td>11.9%</td>
<td>12.7%</td>
<td>13.2%</td>
</tr>
<tr>
<td>50-59</td>
<td>18.4%</td>
<td>16.0%</td>
<td>15.5%</td>
<td>17.2%</td>
<td>18.0%</td>
</tr>
<tr>
<td>60-69</td>
<td>22.7%</td>
<td>25.3%</td>
<td>23.4%</td>
<td>25.1%</td>
<td>25.6%</td>
</tr>
<tr>
<td>70-79</td>
<td>31.6%</td>
<td>32.4%</td>
<td>30.8%</td>
<td>36.6%</td>
<td>39.1%</td>
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<tr>
<td>80-89</td>
<td>42.2%</td>
<td>44.0%</td>
<td>45.0%</td>
<td>48.5%</td>
<td>51.6%</td>
</tr>
<tr>
<td>90+</td>
<td>52.5%</td>
<td>50.8%</td>
<td>51.2%</td>
<td>55.8%</td>
<td>58.4%</td>
</tr>
</tbody>
</table>

Figure 11  Percent of *Escherichia coli* urinary isolates non-susceptible to ciprofloxacin by age of patient
Source: BC Biomedical Laboratories
Dramatic Decrease in Antibiotic Drug Approvals

Source: Spellberg, CID 2004, Modified
Resistance to antibiotics rapidly rising
No new antibiotics
Infections are not diagnosed well
Antibiotics are not prescribed well
The Solution?
Structure
Thought
Care
Collaboration
Data
Data
What makes data “BIG”? 
The Three Vs

Volume

Velocity

Variety
Big data growth

Big data market is estimated to grow 45% annually to reach $25 billion by 2015

Growth of Global data - Zettabytes

Zettabyte = one million petabytes

2010 Stored data* - Petabytes

Petabyte - one quadrillion (short scale) bytes

*greater than

Sources: Nasscom - CRISIL GR&A analysis

Reuters graphic/Catherine Trevethan 05/10/12
Hadoop
Is big data “bad”?

- Snowdon
- Facebook
- Google ads
- Homeland security
- Cellphone tracking
This is very “big” but not what we are talking about in health at least not here yet
Start with “Small Data”
Start with “Small Data”
And there is plenty of it...
“Small data”

• Structured
• Easily classified
• Mostly quantitative
• Transactional
“Small data”

- Structured
- Easily classified
- Mostly quantitative
- Transactional
Transactional

• Little can be accomplished in health care without generating an electronic record
Transactional

• The first need is the re-purposing of transactional health data for traditional analysis leading to quality improvement and efficiency.
Data sources for re-purposing

- Cerner or other EHR
  - This is the time to consider structure
- Discharge Abstracts Database
  - Paper made electronic
- Financial (costing) data
How do we “re-purpose”

• Enterprise Data Warehouse with Clinical and Administrative governance
How do we “repurpose”

• Enterprise Data Warehouse with Clinical and Administrative governance

Enter
SEISMIC
SEISMIC
Surveillance and Epidemiology of Infections, Stewardship, Microbiology, and Infection Control

A Quality Assurance & Surveillance Analytical Environment for Microbiology, Antibiotic Stewardship and Infection Control

“a roadmap for the development of enhanced clinical analytical capacity within Island Health”
“a roadmap for the development of enhanced clinical analytical capacity within Island Health”
SEISMIC

• Extension of the Business Intelligence Data Warehouse
What data is needed for quality management of infections?

• Antibiotic use
• Antibiotic resistance
  – “Antibiogram”
• Measures of inflammation
  – e.g. WBC, Temperature, Procalcitonin
• Outcome measures
  – e.g. LOS, mortality, complications, readmissions
First blush

- Antibiotic use
- Based on orders
  - Much better to use administration data
<table>
<thead>
<tr>
<th>ATC_Name</th>
<th>DDD Amount</th>
<th>District Hospital</th>
<th>Nanaimo Regional General Hospital</th>
<th>Royal Jubilee Hospital</th>
<th>Victoria General Hospital</th>
<th>Grand</th>
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<tbody>
<tr>
<td>penicillin</td>
<td>1.37502</td>
<td>7</td>
<td>27.25007</td>
<td>168.68897</td>
<td>322.9187</td>
<td>332.5445</td>
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<tr>
<td>penicillin and enzyme inhibitor</td>
<td>21.75</td>
<td>58.8333</td>
<td>38.80553</td>
<td>124.07016</td>
<td>130.3328</td>
<td>163.1024</td>
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<td>cephalosporin</td>
<td>14.41669</td>
<td>3.25</td>
<td>33.25</td>
<td>73.0694</td>
<td>172.9158</td>
<td>45.4507</td>
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<tr>
<td>cephalosporin</td>
<td>7.00004</td>
<td>21.5</td>
<td>3.725</td>
<td>31.8159</td>
<td>51.7493</td>
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<td>cephalosporin</td>
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<td>20.08281</td>
<td>123.86613</td>
<td>123.86613</td>
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<td>cephalosporin</td>
<td>42.83331</td>
<td>43.41852</td>
<td>48.44419</td>
<td>139.87432</td>
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<td>cephalosporin</td>
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<td>176.08241</td>
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<td>112.45822</td>
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<tr>
<td>cephalosporin</td>
<td>41.66649</td>
<td>74.16664</td>
<td>100.58308</td>
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<td>100.58308</td>
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<td>cephalosporin</td>
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<td>150.95819</td>
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<td>96.65562</td>
<td>439.4394</td>
<td>96.65562</td>
<td>439.4394</td>
</tr>
</tbody>
</table>
Future of SEISMIC

- Relate antibiotic use to resistance
- Relate antibiotic use to outcomes
- Predict appropriate empiric therapy by personal microbiologic history
- Etc., etc., etc.
Future of SEISMIC

Iterative analysis
Forever
The ultimate vision

• All people on Vancouver Island will have their infections anticipated, prevented, diagnosed and treated in a thoughtful, efficient, SYSTEMATIC fashion.
The ultimate vision

• All people in British Columbia will have their infections anticipated, prevented, diagnosed and treated in a thoughtful, efficient, SYSTEMATIC fashion.
We are building a permanent system
Why just antibiotics?
Stewardship of everything
Utilizing our own re-purposed data