Analysis of foodborne illness complaints in Kansas, 2009-2012

Yang (Jeanne) Liu
MPH Field Experience Report
July 30, 2013
Background

- 240 on-site hours
- February 1, 2013 to July 10, 2013
Field Experience Background

- Placement facilitated through Governor's Office Internship Program

- **Department**
  - Kansas Department of Health and Environment

- **Division**
  - Division of Public Health

- **Bureau**
  - Bureau of Epidemiology and Public Health Informatics
Field experience projects

- Daily telephone conference
- Telephone interview of Hepatitis C
- School survey of vaccination among students in grade 6, 7 and 8
- Analysis of foodborne illness complaints in Kansas, 2009-2012
5 Core concept areas

- The Master of Public Health program promotes proficiency in 5 core public health concepts:

1. Biostatistics
2. Epidemiology
3. Environmental Health
4. Health Services Administration
5. Social and Behavioral Sciences
<table>
<thead>
<tr>
<th>Core concept</th>
<th>Projects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biostatistics</td>
<td>• School survey of vaccination among students in grade 6, 7 and 8</td>
</tr>
<tr>
<td></td>
<td>• Analysis of foodborne illness complaints in Kansas</td>
</tr>
<tr>
<td>Epidemiology</td>
<td>• Daily telephone conference</td>
</tr>
<tr>
<td></td>
<td>• School survey of vaccination among students in grade 6, 7 and 8</td>
</tr>
<tr>
<td></td>
<td>• Analysis of foodborne illness complaints in Kansas</td>
</tr>
<tr>
<td>Environmental Health</td>
<td>• Telephone interview of Hepatitis C</td>
</tr>
<tr>
<td>Health Services Administration</td>
<td>• Daily telephone conference</td>
</tr>
<tr>
<td></td>
<td>• Analysis of foodborne illness complaints in Kansas</td>
</tr>
<tr>
<td>Social and Behavioral Sciences</td>
<td>• Daily telephone conference</td>
</tr>
<tr>
<td></td>
<td>• Telephone interview of Hepatitis C</td>
</tr>
<tr>
<td></td>
<td>• Analysis of foodborne illness complaints in Kansas</td>
</tr>
</tbody>
</table>
Study objective

- The objectives were to examine the characteristics of these complaints and to compare complaints that led to outbreak investigations to those that did not.

- The analysis of restaurant-associated foodborne illness complaints in Kansas received by Kansas Department of Agriculture (KDA) from 2009 to 2012.
Background about foodborne illness

- Foodborne illnesses refer to diseases acquired through eating or drinking contaminated food or liquids.

- The most common symptoms are vomiting, and diarrhea.

- Each year, roughly one out of six people (about 48 million citizens) in the United States gets sick from foodborne diseases, 128,000 are hospitalized, and 3,000 die (CDC, 2012; CDC, 2011a).

- Foodborne illness is a preventable public health problem.
Background about foodborne illness (cont.)

- Restaurants are a significant contributor to the burden of foodborne disease.

- 1998-2004, 52% foodborne outbreaks were associated with restaurants (Jones and Angulo, 2006).

<table>
<thead>
<tr>
<th>Etiology</th>
<th>No. (%) of outbreaks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unknown</td>
<td>3377 (72)</td>
</tr>
<tr>
<td>Norovirus</td>
<td>496 (11)</td>
</tr>
<tr>
<td><em>Salmonella</em> species</td>
<td>349 (7)</td>
</tr>
</tbody>
</table>

Etiology of restaurant-associated outbreaks reported to the Centers for Disease Control and Prevention during the period 1998-2004 (Jones and Angulo, 2006)
Duties of KDHE

- KDHE is responsible for collecting, analyzing, and interpreting data on a variety of conditions of public health importance.

- Notifiable conditions, including diseases that may be caused by foodborne illness, must be reported to KDHE.

- KDHE assists local health departments with the investigation of infectious disease cases, and with outbreak investigations, if one is detected.
Duties of Kansas Department of Agriculture (KDA)

- KDA is responsible for enforcing agribusiness regulations, including inspecting commercial food operations.

- The Food Safety and Lodging Program at KDA is responsible for routine inspections, licensing businesses, and receiving complaints.
KDHE defines a foodborne disease outbreak as two or more individuals who experience a similar illness after eating a common food or food from a common place, in the absence of other shared exposures (living in the same household).

If the symptoms and incubation periods reported are consistent with foodborne illness, KDHE and the local health department conduct a full outbreak investigation.
Complaints and Outbreaks (cont.)

- Three phases:
  - receiving a complaint
  - conducting an environmental inspection and initial epidemiological investigation
  - and conducting a full outbreak investigation.
Complaints and Outbreaks

- A typical investigation: epidemiologic investigation, laboratory analysis, and an environmental assessment.
- Additional interviews and specimens collection may apply.

KDHE  Shares epidemiology results  KDA
 Shares inspection results

Write an investigation report

Make corrective measures
Methods

- The data set included restaurant-based complaints that were received by the KDA through an online complaint form or telephone calls.

- Only complaints that were initially reported to KDA were included; complaints that citizens first reported to KDHE or a local health department were excluded.

- Beginning in 2009, KDHE transferred the data from each complaint into Microsoft Excel spreadsheets each calendar year.
The day of the week column in each complaint was determined by using SAS version 9.2.
For this analysis, 1011 complaints regarding RTE (ready-to-eat) food were included.
The complaints were grouped with records from the KDHE outbreak database, and were classified into three categories: no investigation, not an outbreak, and outbreak.

Investigation rate = \( \frac{\text{number of investigations}}{\text{number of complaints}} \times 100\% \)

Outbreak rate = \( \frac{\text{number of outbreaks}}{\text{number of investigations}} \times 100\% \)
Results and Discussions

Complaints in each year

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of complaints</th>
<th>Number of investigations</th>
<th>Number of outbreaks</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>248</td>
<td>24</td>
<td>1</td>
</tr>
<tr>
<td>2010</td>
<td>270</td>
<td>23</td>
<td>9</td>
</tr>
<tr>
<td>2011</td>
<td>214</td>
<td>29</td>
<td>17</td>
</tr>
<tr>
<td>2012</td>
<td>279</td>
<td>33</td>
<td>19</td>
</tr>
<tr>
<td>Total</td>
<td>1011</td>
<td>109</td>
<td>46</td>
</tr>
</tbody>
</table>

Total 1011 complaints, 109 investigations, and 46 outbreaks. Investigation rate was 10.8%, and the outbreak rate was 42.2%.
Complaints submission Methods

In 2009-2012, 676 (66.9%) complaints were received by telephone, 239 (23.6%) complaints were received by the KDA website, and 96 (9.5%) complaints had no record of the means by which it was received.
Complaints distribution by received measures
Anonymous complaints distribution in years

![Bar chart showing the number of complaints in three years: 2009, 2010, and 2011. The chart indicates the following:
- 2009: 32 complaints, 2 not an outbreak, 0 outbreak, 0 no investigation
- 2010: 40 complaints, 1 not an outbreak, 0 outbreak, 0 no investigation
- 2011: 71 complaints, 1 not an outbreak, 1 outbreak, 0 no investigation]
## Outbreak etiology

<table>
<thead>
<tr>
<th>Pathogen</th>
<th>Number of outbreaks, 2009-2012</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Norovirus</td>
<td>14</td>
<td>30.4</td>
</tr>
<tr>
<td><em>Salmonella</em> spp.</td>
<td>4</td>
<td>8.7</td>
</tr>
<tr>
<td>Unknown</td>
<td>28</td>
<td>60.9</td>
</tr>
</tbody>
</table>
Foodborne illness complaints received by Kansas county, 2009-2012

SG + SN + JO = 58.8%
Outbreaks identified from foodborne illness complaints by Kansas county, 2009-2012
County peer groups
## County Population Density Peer Group

<table>
<thead>
<tr>
<th>County</th>
<th>No investigation</th>
<th>Not an outbreak</th>
<th>Outbreak</th>
<th>Total complaints</th>
<th>Population per region (Estimate 2011)</th>
<th>Percent of population (2011)</th>
<th>Complaints per 10,000 people</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frontier</td>
<td>11</td>
<td>0</td>
<td>1</td>
<td>12</td>
<td>113,453</td>
<td>3.95%</td>
<td>1.058</td>
</tr>
<tr>
<td>Rural</td>
<td>32</td>
<td>0</td>
<td>32</td>
<td>102</td>
<td>237,591</td>
<td>8.27%</td>
<td>1.347</td>
</tr>
<tr>
<td>Dense Rural</td>
<td>92</td>
<td>3</td>
<td>7</td>
<td>102</td>
<td>477,364</td>
<td>16.63%</td>
<td>2.137</td>
</tr>
<tr>
<td>Semi-Urban</td>
<td>140</td>
<td>6</td>
<td>10</td>
<td>156</td>
<td>462,211</td>
<td>16.10%</td>
<td>3.375</td>
</tr>
<tr>
<td>Urban</td>
<td>627</td>
<td>40</td>
<td>42</td>
<td>709</td>
<td>1,580,619</td>
<td>55.05%</td>
<td>4.486</td>
</tr>
</tbody>
</table>

Complaint distribution corresponds to the population distribution.
Complaints by county geographic region

18
35
50
233
631
44
## Complaints by county geographic region

<table>
<thead>
<tr>
<th>Regions</th>
<th>No investigation</th>
<th>Not an outbreak</th>
<th>Outbreak</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>North Central</td>
<td>48</td>
<td>0</td>
<td>2</td>
<td>50</td>
</tr>
<tr>
<td>Northeast</td>
<td>570</td>
<td>29</td>
<td>32</td>
<td>631</td>
</tr>
<tr>
<td>Northwest</td>
<td>16</td>
<td>0</td>
<td>2</td>
<td>18</td>
</tr>
<tr>
<td>Southeast</td>
<td>38</td>
<td>1</td>
<td>5</td>
<td>44</td>
</tr>
<tr>
<td>South Central</td>
<td>200</td>
<td>17</td>
<td>16</td>
<td>233</td>
</tr>
<tr>
<td>Southwest</td>
<td>30</td>
<td>2</td>
<td>3</td>
<td>35</td>
</tr>
</tbody>
</table>
## Counties with no complaints (2009-2012)

<table>
<thead>
<tr>
<th>NORTH-EAST</th>
<th>SOUTH-EAST</th>
<th>SOUTH CENTRAL</th>
<th>NORTH CENTRAL</th>
<th>NORTH-WEST</th>
<th>SOUTH-WEST</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brown</td>
<td>Anderson</td>
<td>Comanche</td>
<td>Clay</td>
<td>Cheyenne</td>
<td>Clark</td>
</tr>
<tr>
<td>Chase</td>
<td>Elk</td>
<td>Harper</td>
<td>Jewell</td>
<td>Decatur</td>
<td>Greeley</td>
</tr>
<tr>
<td>Doniphan</td>
<td>Greenwood</td>
<td>Kingman</td>
<td>Lincoln</td>
<td>Ness</td>
<td>Hamilton</td>
</tr>
<tr>
<td></td>
<td>Linn</td>
<td>Kiowa</td>
<td>Osborne</td>
<td>Norton</td>
<td>Haskell</td>
</tr>
<tr>
<td></td>
<td>Woodson</td>
<td>Pawnee</td>
<td>Ottawa</td>
<td>Phillips</td>
<td>Hodgeman</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Stafford</td>
<td>Rice</td>
<td>Rawlins</td>
<td>Kearny</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Smith</td>
<td>Rooks</td>
<td>Lane</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Washington</td>
<td>Sheridan</td>
<td>Meade</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Morton</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Scott</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Stanton</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Wichita</td>
</tr>
</tbody>
</table>
Complaints distribution by day of the week

Day of the week

Monday: 247
- Outbreak: 22
- Not an outbreak: 13
- No investigation: 222

Tuesday: 233
- Outbreak: 13
- Not an outbreak: 11
- No investigation: 220

Wednesday: 153
- Outbreak: 13
- Not an outbreak: 8
- No investigation: 132

Thursday: 131
- Outbreak: 7
- Not an outbreak: 13
- No investigation: 111

Friday: 137
- Outbreak: 5
- Not an outbreak: 4
- No investigation: 128

Sunday: 1
- Outbreak: 1
- Not an outbreak: 0
- No investigation: 0
Time between estimated exposure, illness onset, and complaint

Number of days from exposure to report

Exposure → Illness → Report

Number of days from exposure to report

Number of days from illness to report
Complaint exposures distribution by day of the week

<table>
<thead>
<tr>
<th>Day of the week</th>
<th>Number of complaints</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monday</td>
<td>120</td>
</tr>
<tr>
<td>Tuesday</td>
<td>111</td>
</tr>
<tr>
<td>Wednesday</td>
<td>115</td>
</tr>
<tr>
<td>Thursday</td>
<td>104</td>
</tr>
<tr>
<td>Friday</td>
<td>127</td>
</tr>
<tr>
<td>Saturday</td>
<td>141</td>
</tr>
<tr>
<td>Sunday</td>
<td>137</td>
</tr>
</tbody>
</table>

- **Outbreak**
- **Not an outbreak**
- **No investigation**
Complaints distribution in exposure-to-illness days

- **Number of Complaints**
- **Exposure-to-illness days**
  - 0: 537 (outbreak 27, not an outbreak 28)
  - 1: 249 (unknown)
  - 2: 23 (unknown)
  - 3: 7 (unknown)
  - 4: 1 (unknown)
  - 6: 1 (unknown)
  - 8: 0 (unknown)
  - 13: 0 (unknown)
  - **Unknown**: 81 (outbreak 4, not an outbreak 0, no investigation 0)

Legend:
- Green: outbreak
- Red: not an outbreak
- Blue: no investigation
Complaints distribution in illness-to-report days

[Bar chart showing the distribution of complaints across different illness-to-report days.

- 0 days: 76 complaints
- 1 day: 265 complaints
- 2 days: 144 complaints
- 3 days: 101 complaints
- 4 days: 74 complaints
- 5 days: 43 complaints
- 6 days: 19 complaints
- 7 days: 16 complaints
- 7-14 days: 46 complaints
- 14-30 days: 26 complaints
- More than 30 days: 19 complaints

Legend:
- Green: outbreak
- Red: not an outbreak
- Blue: no investigation]
Complaints distribution in exposure-to-report days

Number of Complaints

Exposure-to-report days

0 1 2 3 4 5 6 7 8-14 15-30 More than 30 Unknown

- Outbreak
- Not an outbreak
- No investigation
Complaints grouped by number of households involved

Investigation rate: 1.5%
Outbreak rate: 30%

Investigation rate: 31.4%
Outbreak rate: 58.1%

Investigation rate: 61.5%
Outbreak rate: 100%
Summary

1. In total, from 2009-2012, the investigation rate was 10.8%, and the outbreak rate was 42.2%.

2. For the period of study (2009-2012), two-thirds of complaints were telephone-based. However, increasing trend towards website-based reporting.

3. Number of anonymous complaints was increasing from 2009 to 2011, and only one outbreak was detected from 149 anonymous complaints.
Summary (cont.)

4. Of the 1011 complaints, 46 were detected as outbreaks. Only 39.1% of the outbreaks detected a pathogen, of which norovirus was 30.4% and *Salmonella* spp. was 8.7%.

5. Only three counties had more than 10 outbreaks: Johnson County, Shawnee County, and Sedgwick County. The western half of Kansas had only 5 (10.8%) outbreaks.

6. Complaints were concentrated in Johnson, Sedgwick and Shawnee counties. The complaint distribution corresponds to the population distribution.
Summary (cont.)

7. The geographic area with the most complaints report was the northeast region, while the least complaints report was the northwest region.

8. Complaints have an unbalanced distribution throughout the week.

9. Complaints that involve multiple households are more likely to be classified as outbreaks.
10. Outbreaks were accompanied by three intervals. (exposure-to-illness days, exposure-to-report days, and illness-to-report days)

- **Exposure-to-illness days:**
  provide more detailed information, norovirus 24h incubation

- **Illness-to-report days**
  a person might be busy treating their symptoms or seeing a doctor, so reporting the complaint is not their first priority

- **Exposure-to-report days**
  individuals cannot report an illness until they get sick, and it takes time from exposure to start having symptoms
Recommendations

- **Methods of complaint submission:**
  
  Currently, the KDA and KDHE have specialists to answer complaint calls. But on the KDA website, the anonymous option makes it difficult to investigate. It is very simple to choose to make an anonymous complaint, and no personal information is required.

- **Time between estimated exposure, illness onset, and complaint.**
  
  In this study, time between exposure, illness onset, and complaint were calculated in days. Further study could be more accurate by calculating time in hours.
Limitations

- Under-reporting data: Complaints that were not submitted into these databases would be left out.

- Incomplete information in the complaint data (missing data fields, such as no date of illness onset)

- Complaints may or may not be actual cases of foodborne illness.

- Compare complaint numbers with the number of restaurants in each county.
References

Acknowledgement

- Daniel Neises
- The KDHE family

- Dr. Abbey Nutsch
- Dr. Michael Cates
- Dr. Weiqun Wang
- Dr. Kimathi Choma
- Barta Stevenson

Thank you!