Epidemiological investigations of foodborne outbreaks

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Basic Epidemiology

- Epidemiology is the study of the origin and causes of diseases in a community.

- It is the scientific method of investigation problem-solving which aims to identify the cause of (and other contributors to) health problems and outbreaks in a community.

- For foodborne outbreaks, analytical epidemiological studies are an important part of the evidence gathering framework.
Basic Epidemiology

- **Person**
  - Who was affected?
  - Cases, hospitalisations & deaths – Age, sex, population group

- **Time**
  - When were people affected?
  - Epidemic curve

- **Place**
  - Where did people become ill?
  - Cases by location, map
Time: Epi curves

- Graphical depiction of the number of cases of illness by the date of illness onset
- Time intervals by which onsets are grouped are shown on the x-axis
- Case counts are shown on the y-axis

Hepatitis A notifications Australia Jan 2014 to Jul 15, by local or overseas acquisition
Place: Mapping
Person: demographics

- Median age (range)
- Male:female ratio
- Demographic factors
  - Occupation
  - Pregnancy status
  - Income
- Outcomes
  - Illness profile
  - Severity
What’s a cluster?

- Any 2 or more people linked by person, time or place – if that number is more than what is expected

- BUT how do you know what’s expected?
  - Generally you won’t know what defines a cluster until you have found all the people in it, but the characteristics of those people can help you understand the extent of the incident

- Two common analytical epidemiological study methods depending on what we know about the population to begin with:
  - Cohort study – relative risk
  - Case control study – odds ratio
RR example:

- Two functions on different days
  - 73 & 21 people attending
  - AR 47% (44/94)
  - 10% (7/73) +ve C. jejuni all Cohort 1

- Buffet meal - lots of seafood
  - Five foods associated with illness
  - Some food hygiene issues – undercooked parfait
  - Food tests negative
**RR example:**

<table>
<thead>
<tr>
<th></th>
<th>Exposed</th>
<th>Unexposed</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cases</strong></td>
<td>33</td>
<td>7</td>
<td>40</td>
</tr>
<tr>
<td><strong>Noncases</strong></td>
<td>12</td>
<td>38</td>
<td>50</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>45</td>
<td>45</td>
<td>90</td>
</tr>
</tbody>
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<p>| | | | |</p>
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<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td><strong>Risk</strong></td>
<td>.733333</td>
<td>.155556</td>
<td>.44444</td>
</tr>
<tr>
<td><strong>Point estimate</strong></td>
<td></td>
<td>[95% Conf. Interval]</td>
<td></td>
</tr>
<tr>
<td><strong>Risk difference</strong></td>
<td>.577778</td>
<td>.410723</td>
<td>.74483</td>
</tr>
<tr>
<td><strong>Risk ratio</strong></td>
<td>4.71428</td>
<td>2.33362</td>
<td>9.5236</td>
</tr>
<tr>
<td><strong>Attr. frac. ex.</strong></td>
<td>.787878</td>
<td>.571481</td>
<td>.89499</td>
</tr>
<tr>
<td><strong>Attr. frac. pop</strong></td>
<td>.65</td>
<td></td>
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</tr>
</tbody>
</table>

**P value (i.e. chance):**

\[
\text{chi2}(1) = 30.42 \quad \text{Pr}>\text{chi2} = 0.0000
\]

*Repeat for all foods consumed*
The real world:

- Don’t know all foods consumed
- Don’t know all people at risk
- Don’t obtain responses from all attendees (when ‘closed’ group setting)
- People don’t have great recall and/or knowledge of foods consumed
The real world:

**Foodborne outbreak**: when ≥2 people become ill after eating the same food, and epi analysis implicates the food as the source of the illness.

**Report of illness**: NSWFA complaint, member of public, GP/ED notification.

**Identification of cluster**: If more people than expected appear to have the same illness in a given time period and area.

**Investigation**: Interviews, analysis, risk assessment.

- Coincidence
- Other (e.g. P2P)
The real world: investigation steps

- **Detect**: Possible outbreak
- **Find**: Cases in outbreak
- **Generate**: Hypothesis through interviews
- **Test**: Hypotheses through analytic studies and laboratory testing
- **Solve**: Point of contamination
- **Control**: Outbreak through recall, facility improvements & industry collaboration
- **Decide**: Outbreak is over

**If cases continue**

**Not finding associations**

**If cases stop**

Case finding

- Case finding
  - Booking lists; public announcements; medical records; notifications
  - Record number and characteristics

- Early interviews

- Standard questionnaire
  - Generate hypotheses
  - Symptom profiles
  - Obtain specimens
## Incubation
- Duration: 6-72 hours (av. 12-36 hours)
- Prognosis: Diarrhoea, 1-20 days (5 days av.)

## Prognosis
- Most people completely recover within 1-2 weeks
- A small number develop complications such as reactive arthritis.
- 50% of adults >5 weeks
- 10% for >9 weeks
- Prolonged shedding more common in children

## Shedding
- 50% of adults >5 weeks
- 10% for >9 weeks
- Prolonged shedding more common in children

## Reservoir
- Colonised intestinal tract of many animals, including chickens, ducks, pigs, cows, reptiles, amphibians, native animals, dogs and cats

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**CASE DETAILS**

<table>
<thead>
<tr>
<th>First Name</th>
<th>Last Name</th>
<th>Parent's Name (if applicable)</th>
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<thead>
<tr>
<th>DOB: ___ / ___ / ___</th>
<th>Age</th>
<th>Gender</th>
<th>M</th>
<th>F</th>
</tr>
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<table>
<thead>
<tr>
<th>Address:</th>
<th>Home Phone:</th>
<th>Mobile Phone:</th>
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<table>
<thead>
<tr>
<th>Physician name:</th>
<th>Physician Phone:</th>
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<table>
<thead>
<tr>
<th>Born in Australia</th>
<th>Yes</th>
<th>No</th>
<th>If no, specify where:</th>
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<thead>
<tr>
<th>Are [you/the case] of Aboriginal or Torres Strait Islander origin? (check all that apply)</th>
<th>Yes</th>
<th>No</th>
<th>Aboriginal</th>
<th>Torres Strait Islander</th>
<th>Not stated</th>
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**OCCUPATION**

What is [your/the case's] occupation? Specify

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<thead>
<tr>
<th>Name of work place:</th>
<th>Address of workplace:</th>
<th>Contact details for work place:</th>
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Does the case’s occupation involve:

<table>
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<tr>
<th>Handling food/drink?</th>
<th>Yes</th>
<th>No</th>
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<tr>
<th>Close contact with sick people? (e.g. health care worker)</th>
<th>Yes</th>
<th>No</th>
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<tr>
<th>Close contact with the children/elderly? (e.g. child care worker?)</th>
<th>Yes</th>
<th>No</th>
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If yes, please provide relevant public health advise for exclusion period to the case

Do [you/the case] attend childcare / preschool / school / prison/ aged care facility? Yes | No

If yes, provide details

Name: 
Address: 
Contact details: 
Please provide relevant public health advise for exclusion period to the case
Case definition

- **Probable**: A person who ate at restaurant X in March 2008 & in the following 5 days experienced two or more of the following symptoms of diarrhoea, vomiting, fever, and abdominal pain.

- **Confirmed**: A person who ate at restaurant X in March 2008 & in the following 5 days experienced two or more of the following symptoms of diarrhoea, vomiting, fever, and abdominal pain and has Salmonella isolated from their stool sample.
On Sunday, January 26 the NSW Hospital ED rapid alert system notified the local public health unit (PHU) of an increase in presentations of gastroenteritis over the weekend.

At least one case required admission to a high dependency unit.

Increased presentations were also recorded at a neighbouring Hospital ED.

Over 40 gastroenteritis cases presenting to the two hospitals between 23 -25 January.
Case example: Pork rolls

- **Detect**
  - ED alerts

- **Find**
  - Review of ED records

- **Generate**
  - Initial interviews identified pork, chicken and vegetable rolls consumed among many patients – from one bakery

- **Test**
  - Required active case finding

- **Solve**
  - Epi investigation, combined with NSW Food Authority inspection, confirmed that rolls were the vehicle of illness

- **Control**
  - Prohibition order served and business fined

- **Decide**
  - PHU maintains active surveillance after closure to confirm control measures have stopped outbreak

- Laboratory notifications, other EDs, food complaints, media release...

- NSW Food Authority

- Laboratory data
The whole picture

**Investigation Findings**

- **Standardised**
  - Chain of custody
  - Requires interpretation
  - Legal standing

- **Guideline-based**
  - Many grey areas
  - Specialised interpretation
  - Scientific standing

- **Inspection-based**
  - Traceback
  - Sample & test
  - Corporate standing

**Investigation Findings**
Epidemiological investigation is changing

- Church supper no longer normal setting!
  - Point source outbreaks still common
  - Multiple outbreaks related to each other?

- Increased international travel
  - People & produce

- Greater international engagement
  - Recognition of global neighbourhood
  - WHO GOARN & IHR(2005)

- Surveillance has improved markedly
  - Use of molecular tools
Summary

- Early phase vital
  - Rapidly interview case patients
  - Develop case definition
  - Constantly re-assess situation

- Analytical evidence vital for identifying & controlling source
  - Person, time, place
  - Relies on what we know about the source population

- Three streams evidence
  - Microbiology
  - Food safety
  - Epidemiology
Questions?

- Acknowledgement and thanks to our partners in foodborne illness response:
  - Public Health Units
  - NSW Food Authority
  - Enteric Reference Laboratory (ICPMR, Westmead)
  - Communicable Diseases Branch, NSW Health
  - OzFoodNet and national colleagues