Proceedings of the EMII Connected Learning Risk Research Symposium II: Food Contamination

Edited By: McMullan, C., & Brown, G.D. 2018, DCU, Dublin, Ireland

7th September 2018

Food Contamination Risk: Expert and Public Perception

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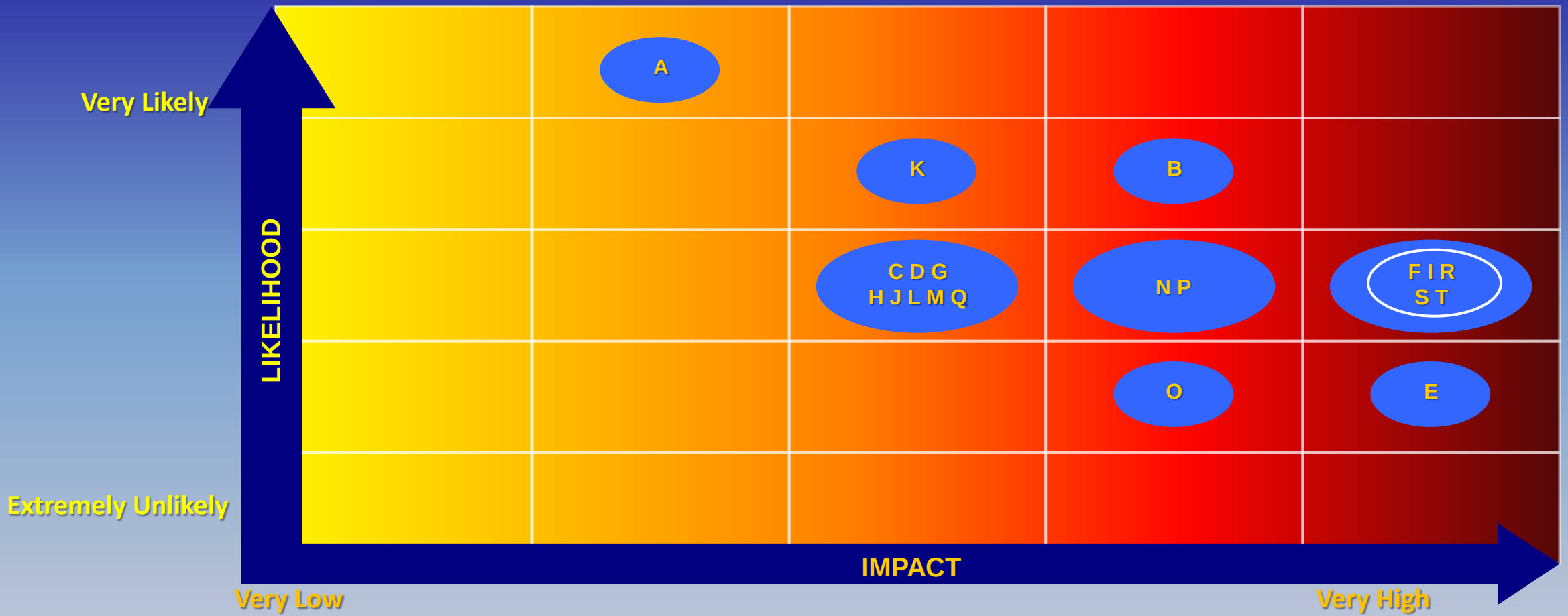
DCU Business School

Join @ www.emii.ie

Expert:
Risk Perception

NRA 2017

National Risk Matrix 2017



A. Storm ***
B. Flooding ***
C. Snow ***
D. Low Temp. ***
E. Tsunami ***
F. Infectious Disease ***
G. Terrorist Incident ***
H. Animal Disease ***
I. Food Contamination ***
J. Loss of Critical Infrastructure ***
K. Rail Accident ***
l. Aviation Accident ***
M. Maritime Accident ***
N. Transport Hub ***
P. Hazmat **
O. Industrial Incident **
Q. Fire ***
R. Nuclear Incident (Abroad) ***
S. Disruption to Energy Supply ***
T: Network & Information Security/Cyber Incident **

Risk Assessment Confidence Levels: *** High Confidence ** Moderate Confidence * Low Confidence

Likelihood – Food Contamination

Rating	Classification	Average Recurrence Interval
3	Unlikely	10 - 100 years between occurrences

Food Contamination	5 Very High Impact
People	Deaths greater than 1 in 20,000 people for population of interest OR Critical injuries/illness greater than 1 in 20,000
Environment	Very heavy contamination, widespread effects of extended duration
Economic	Greater than 8% of Annual Budget
Social Consideration should be given to: Infrastructure; Community Services; Utilities; Evacuation/ Quarantine; Property/Housing; Supplies: Food, Water, Medicines; Civil Unrest; Public dissatisfaction	Community unable to function without significant support

Confidence Level - Food Contamination

Confidence Level	Criteria
High ***	Assessment based on expert knowledge of the issue and/or reliable, relevant, current data. Consistent agreement among assessors.

Public Perception (2018)

Data Collection

- Survey completed online using "Qualtrics"
- 6,497 responses* received
- Data collected over a two month period between 14th November 2017 & 17th January 2018

*Note – some respondents did not answer all questions

Demographics

Characteristic	
Gender (4490n)	
Female	70.6% (3171n)
Age (4383n)	
Mean (SD)	45.06 (11.89)
Min, Max	18, 92
Lives in (4487n)	
City	16.8% (755n)
Suburbs or outskirts of a city	21.9% (982n)
Town	21.8% (979n)
Village	9.6% (431n)
Rural area	29.9% (1304n)
Own vs Rent Home (4477n)	
Own Home	77.7% (3479n)
Household Income	
Income Below 30,000	12.2% (532n)
Income 30,000-70,000	53.5% (2328n)
Income Over 70,000	34.3% (1491n)

Characteristic	
Adults (age >18) living at the address (4446n)	
Mode	2
Range (min, max)	1 - 9
Children (age <18) living at the address (4408n)	
Mode	0
Mean	0.85
Range (min, max)	0 - 7
Highest Qualification (4435n)	
Leaving Cert.	17.5% (777n)
Bachelor's degree or higher diploma	32.5% (1443n)
Master degree or post-graduate diploma	27.9% (1239n)
Work (4427n)	
Full-time	73.9% (3272n)

Food Contamination: Likelihood & Impact

Food Contamination	Code	Percent
Extremely Unlikely	1	19.5%
Very Unlikely	2	20.7%
Unlikely	3	41.6%
Likely	4	14.6%
Very Likely	5	3.6%

n = 6007

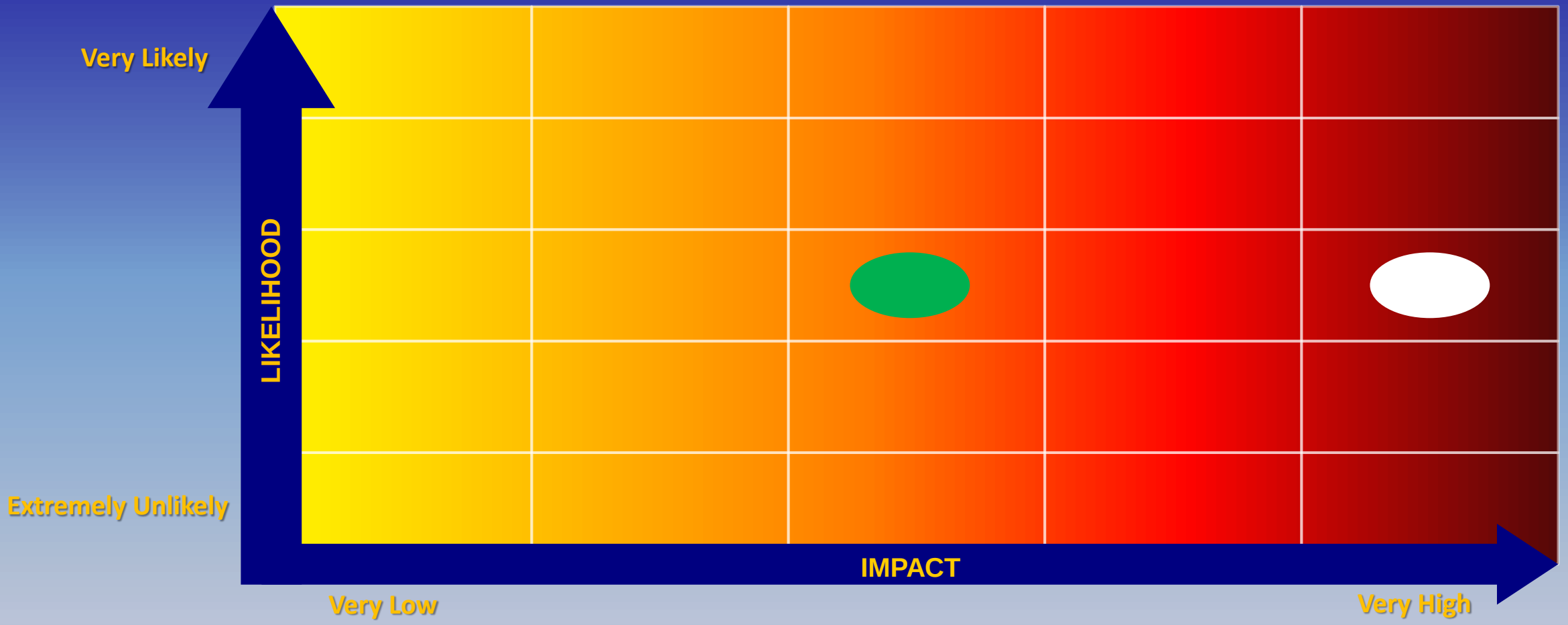
Food Contamination	Code	Percent
Very Low Impact	1	13.0%
Low Impact	2	18.4%
Moderate Impact	3	29.7%
High Impact	4	26.3%
Very High Impact	5	12.6%

n = 5466

Food Contamination: Risk Rating

	Likelihood	Impact	Risk Rating
N	6007	5466	5466
Mean	2.62	3.07	8.04
Mode	3	3	9

Public V Expert Risk Rating: Food Contamination

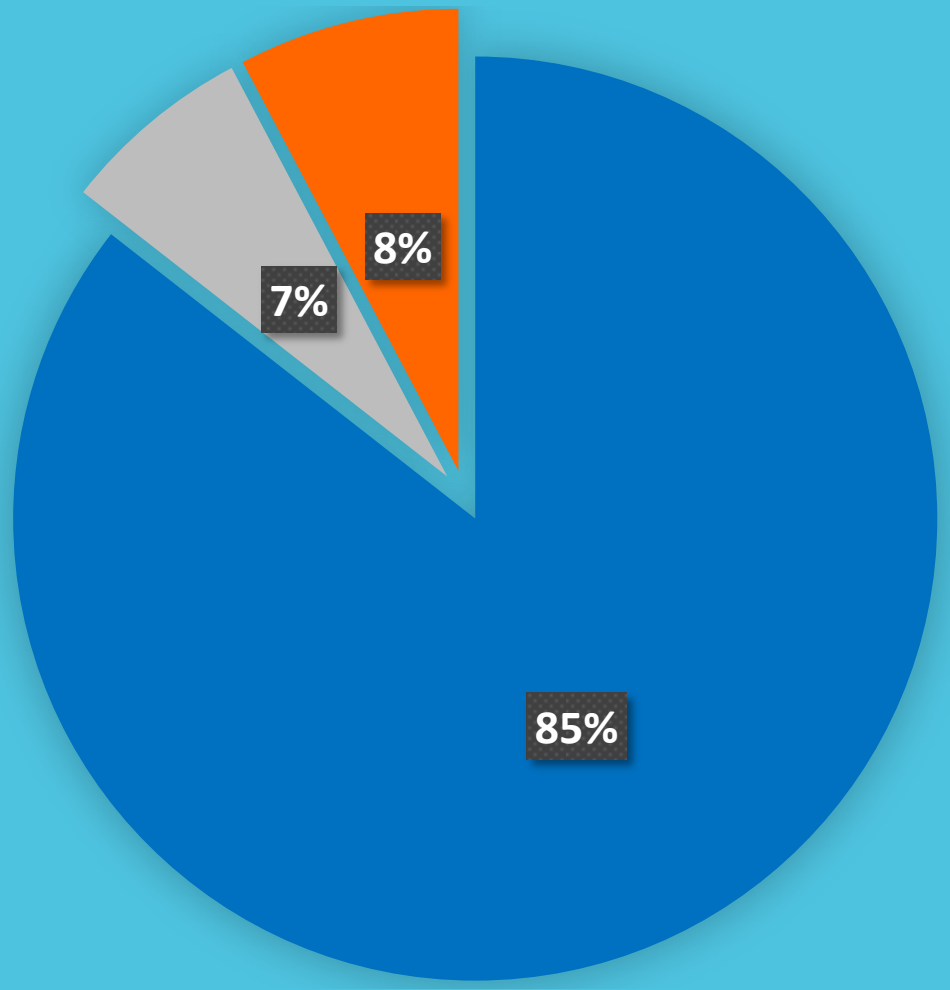


Public

Expert - NRA

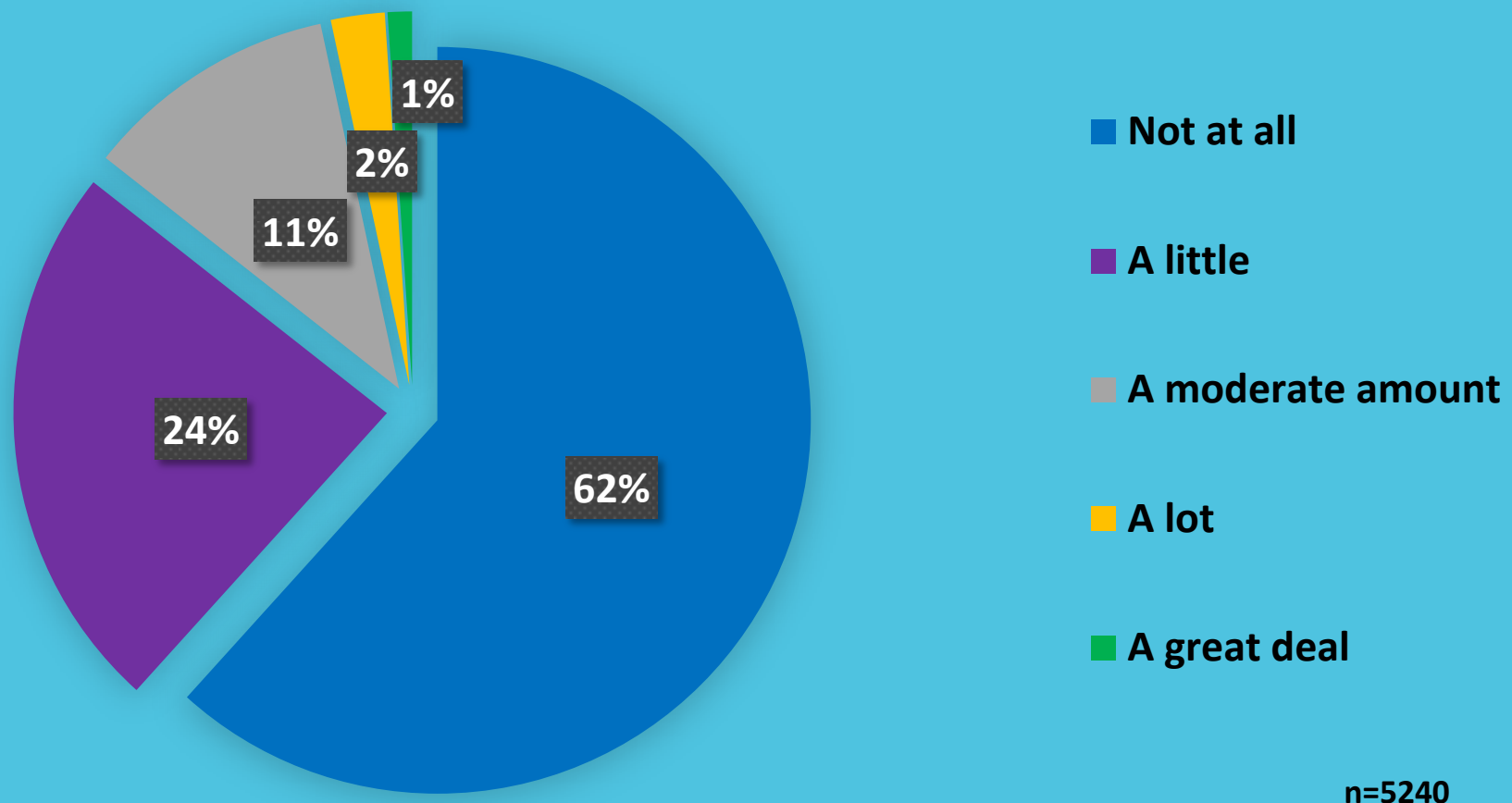
Public Perception: Experience, Worry & Preparedness

Experience of Food Contamination



n=5357

Food Contamination: Worry



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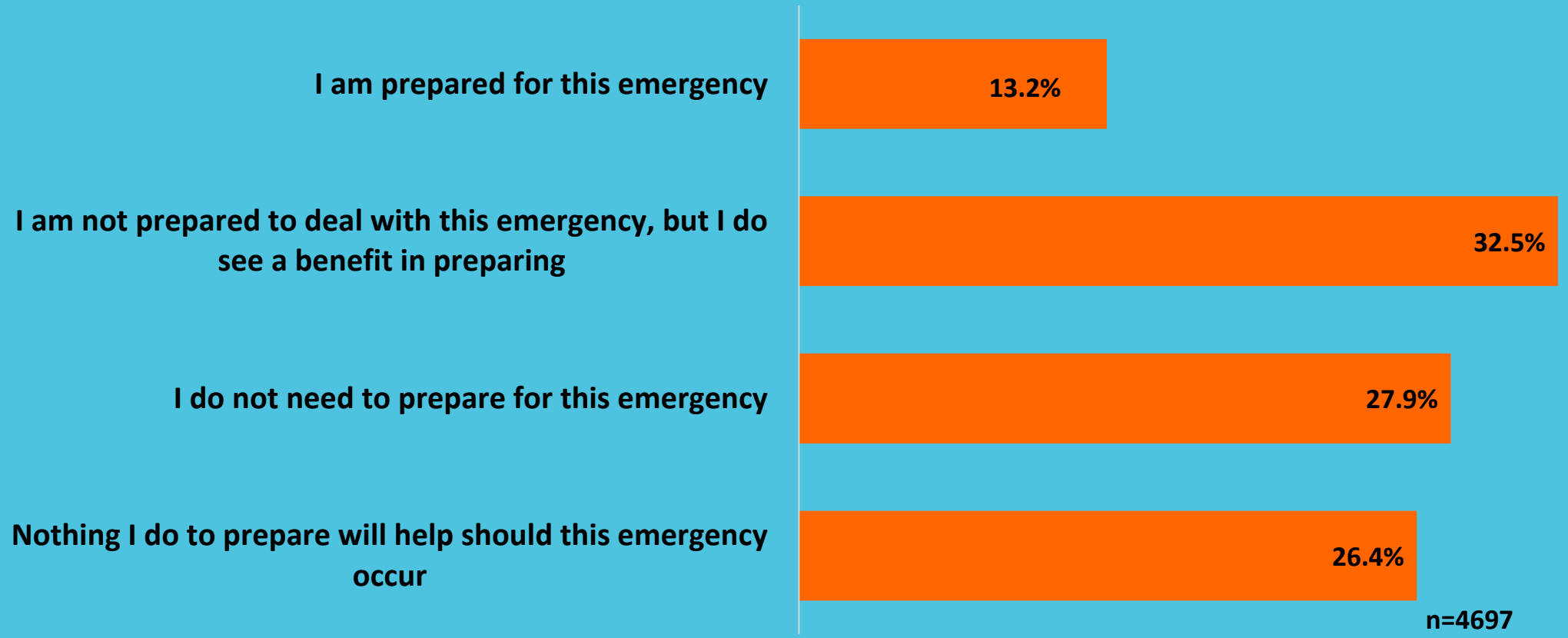
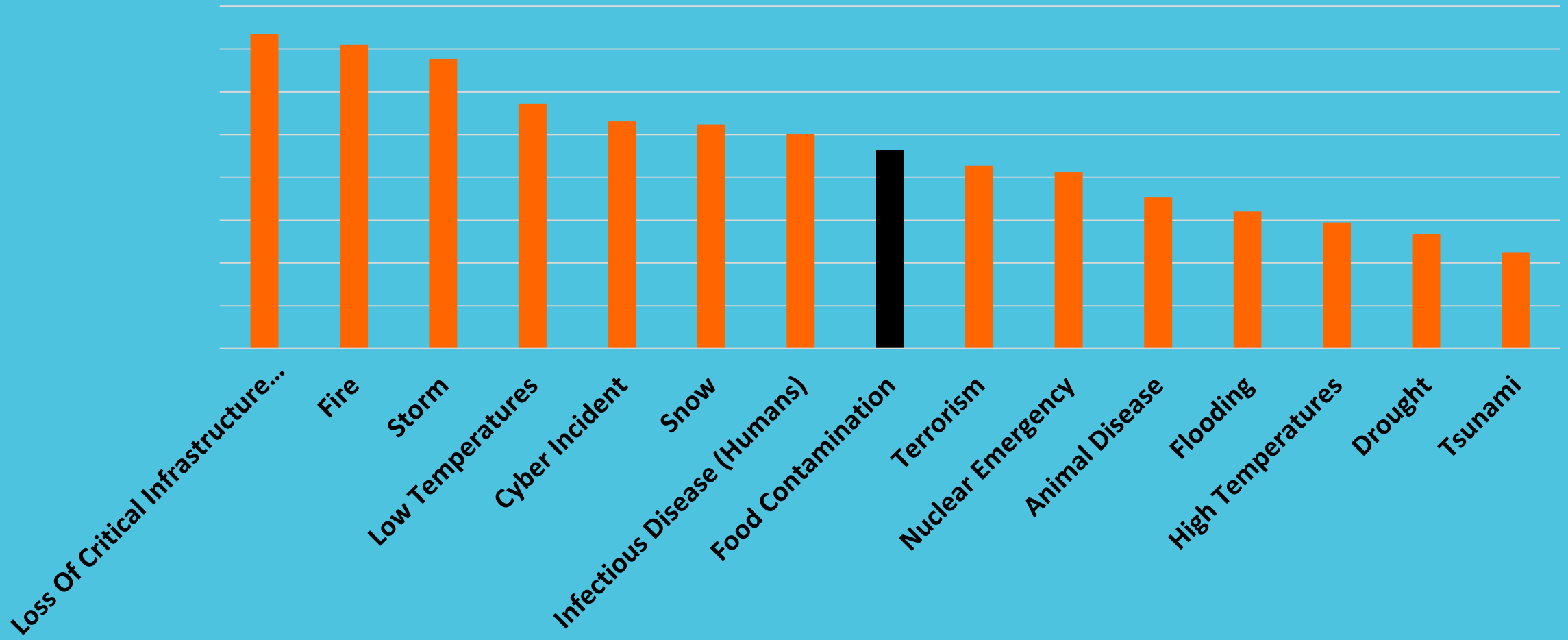
Food Contamination: Preparedness



Finally: Relative Risk



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Food Emergencies: The Investigative Framework

Dr Patricia Garvey

Dr Lois O’Connor

Join @ www.emii.ie

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Health Protection Surveillance Centre

September 2018

Health Protection Surveillance Centre

To improve the health of the Irish population by provision of the best possible information on disease including infectious diseases through surveillance and independent advice, epidemiological investigation, research and training.

Health Protection Surveillance Centre

Six Functions

- Surveillance of communicable diseases
- Operational support
- Training
- Research
- Policy advice
- Public Information www.hpsc.ie

What is an outbreak?

- Occurrence of more cases of disease than expected
  - over a particular period of time (TIME)
  - in a given area (PLACE)
  - among a specific group of people (PERSON)

Why do we investigate an outbreak?

- Responsible for much illness and death
- Identify the source and eliminate it
- Minimise human harm
- Prevent future outbreaks
- Evaluate existing prevention strategies
- Describe new diseases and learn more about known diseases
- Improve surveillance and outbreak detection

Are Foodborne Disease Outbreaks Common?

- In developed countries, 90% of all outbreaks are gastrointestinal
- Majority are viral
- Only a small minority are shown to be foodborne in nature

Country	Year	Outbreaks	Cases
Ireland (IID)	2015	315	3086
Ireland (Foodborne)	2015	6	24
US (Foodborne)	2015	902	15,202

Outbreak Agents

- Bacterial
  - Salmonella, *E. coli*, Campylobacter, Listeria etc.
- Viral
  - Norovirus, Hepatitis A
- Parasitic
  - Cryptosporidium, Trichinella, Giardia, etc.
- Toxins
  - *C. botulinum, S.aureus, B. cereus, C. perfringens*, algae, shellfish poisoning
- Chemical
  - heavy metals, organic compounds etc.

Routes of Food Contamination

- Contamination of raw food or failure to eliminate contamination of raw food
  - Farming practice/abattoir practice/zoonotic problems
  - Pasteurisation failure
  - Undercooking, inadequate cooling

- Contamination during food preparation
  - Infected food handler
  - Environmental contamination
  - Cross contamination (from raw or processed ingredients)

- Contamination after food preparation
  - Infected food handler
  - Inadequate storage, cooling or reheating
  - Environmental contamination
  - Cross contamination from raw food

What are the Elements of a Foodborne Outbreak Investigation?

- Epidemiological investigation

  Cases, distribution - who, when, where relationships
- Laboratory investigation

  Pathogen identification
- Environmental investigation

  Premises, physical environment, food, water

Steps of an outbreak investigation

- Confirm outbreak and diagnosis
- Define a case
- Identify cases & obtain information
- Describe cases in time, place, person
- Develop hypothesis
- Test hypothesis - analytical epidemiology
- Conduct additional investigations
- Communicate results
- Implement control measures

Communication

Control measures

Detection of an outbreak

- Systematic surveillance
  - Disease notifications (laboratory or clinical)
- Non-statutory laboratory/clinical surveillance
- Detection of additional cases during investigation of a sporadic case
- An alert clinician
- General public
- Media

Outbreak Notification

- Under S.I. No. 707, all outbreaks of disease are notifiable to the Medical Officer of Health regardless of whether the specific pathogen implicated is notifiable or not.
- Moreover, unusual clusters or changing patterns of illness are also notifiable. It is not necessary for a pathogen to have been identified before an outbreak is notified.

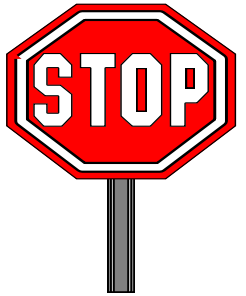
Confirm outbreak

Is this an outbreak?

- More cases than expected?
- Surveillance data
- Surveys: hospitals, labs, physicians

Caution!

- Seasonal variations
- Notification artefacts
- Diagnostic bias (new technique)
- Diagnostic errors (pseudo-outbreaks)



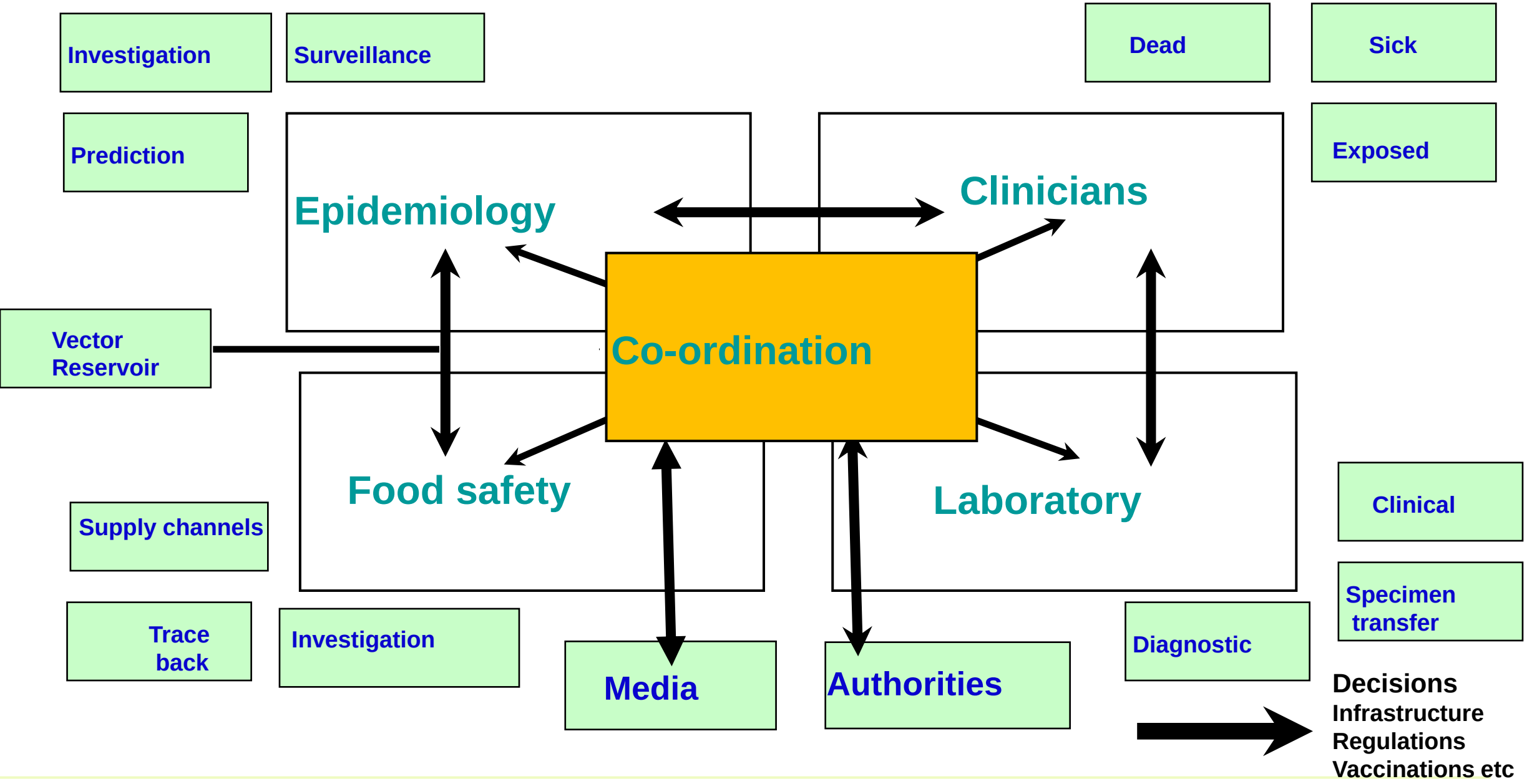
Outbreak Control Team

Multidisciplinary

- Public Health Physicians
- Environmental Health Officers
- Clinical Microbiologist
- Food Safety Authority
- Reference Laboratories

Roles

- Coordinate all activities
- Liaison
- Media
- Maintain a record of investigation
- Produce reports


Investigation
Surveillance
Dead
Sick
Prediction
Exposed
Epidemiology
Clinicians
Co-ordination
Vector
Reservoir
Food safety
Laboratory
Supply channels
Clinical
Specimen
transfer
Trace
back
Investigation
Media
Authorities
Diagnostic
Decisions
Infrastructure
Regulations
Vaccinations etc

Confirm diagnosis

- Laboratory confirmation
  - culture and/or PCR
  - serology
  - typing
  - detection of toxins
- Discuss/meet with attending physicians
- Contact the laboratories

Not always necessary to confirm <u>all</u> the cases but confirm a proportion throughout the outbreak

Case definition

- Standard set of criteria for deciding whether an individual should be classified as suffering from the disease (or health condition) under investigation
- Criteria
  - clinical and/or biological criteria
  - time
  - place
  - Person
- Case definition can be adjusted if new information becomes available

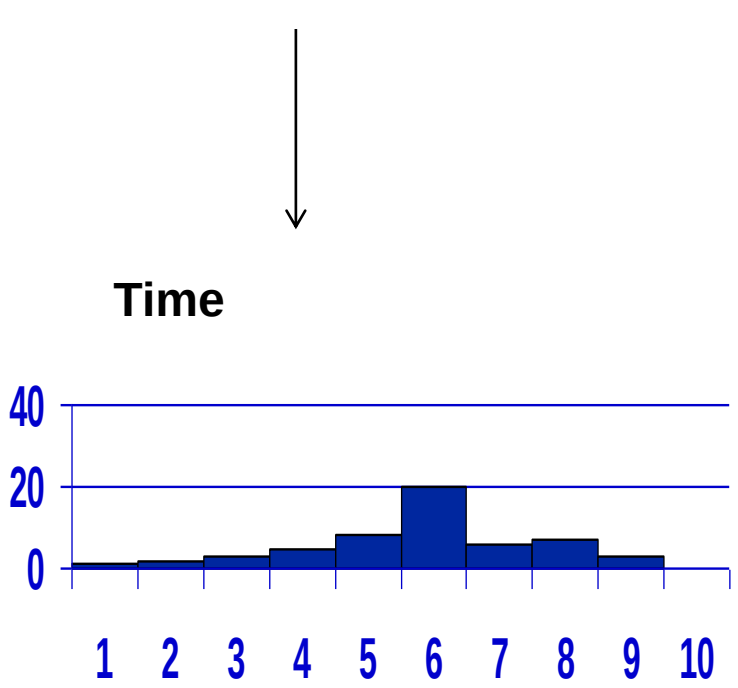
Identify cases and obtain information

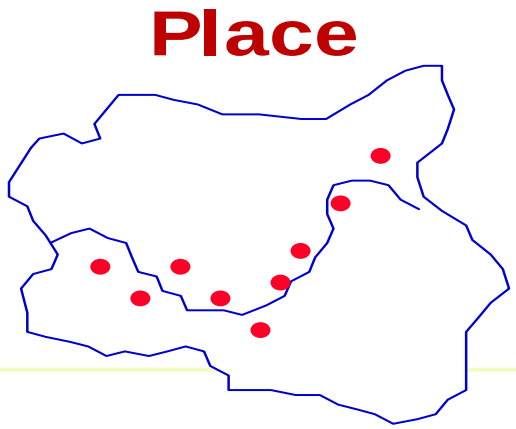
- Case finding
  - Notifications
  - Hospitals, GPs, Laboratories
  - Schools
  - Workplaces, etc.
- Data collection form
  - Identifying information
  - Patient demographics
  - Clinical information
  - Risk factor/exposure information

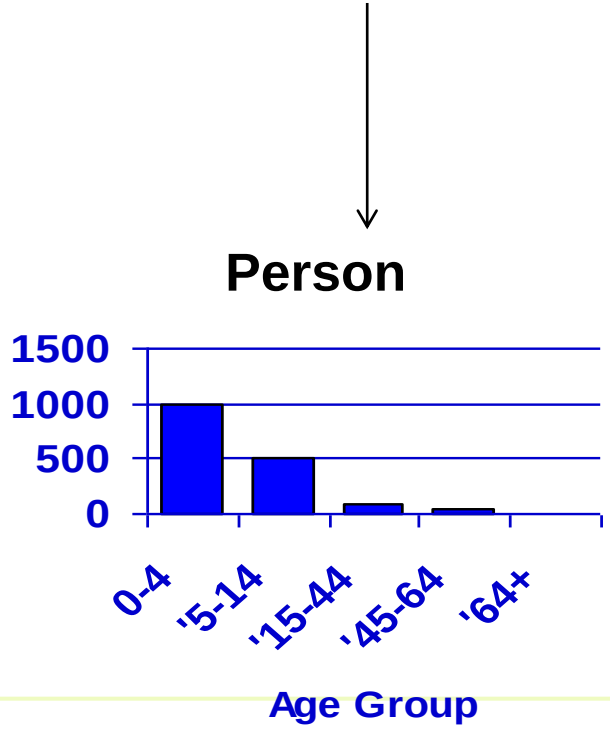
Descriptive Epidemiology

Describe cases by time, place and person

- **When** did they become ill?
- **Where** do they live?
- **Who** are the cases?

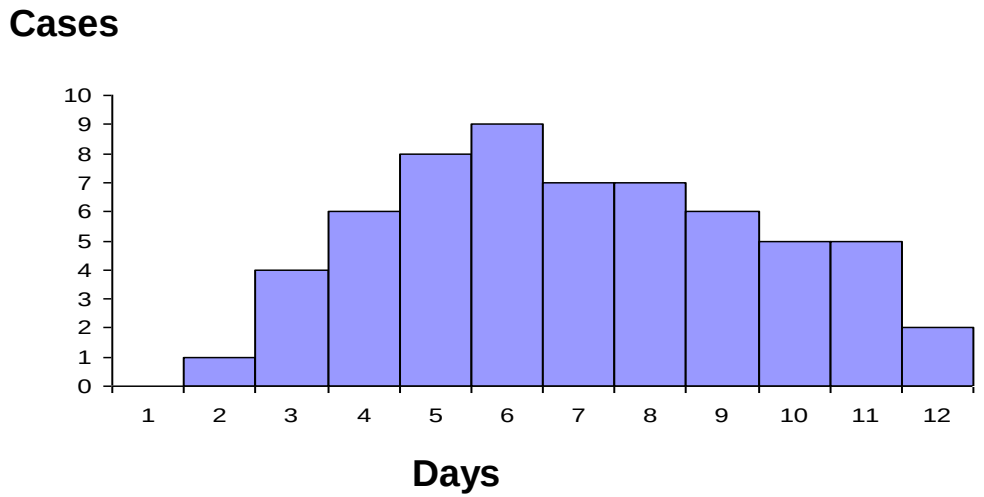






Time - Epidemic curve

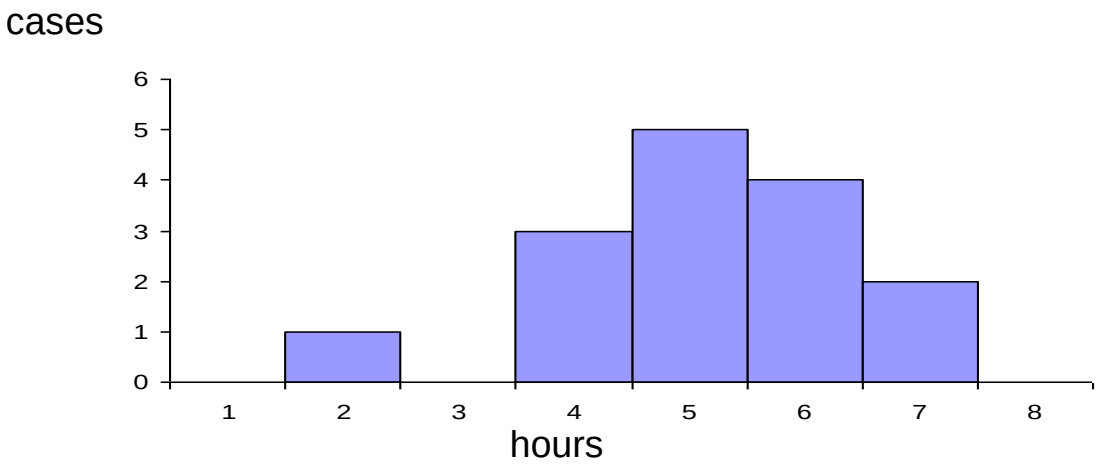
- Describe
  - start
  - peak(s) - number & duration
  - end
  - atypical cases (outliers)



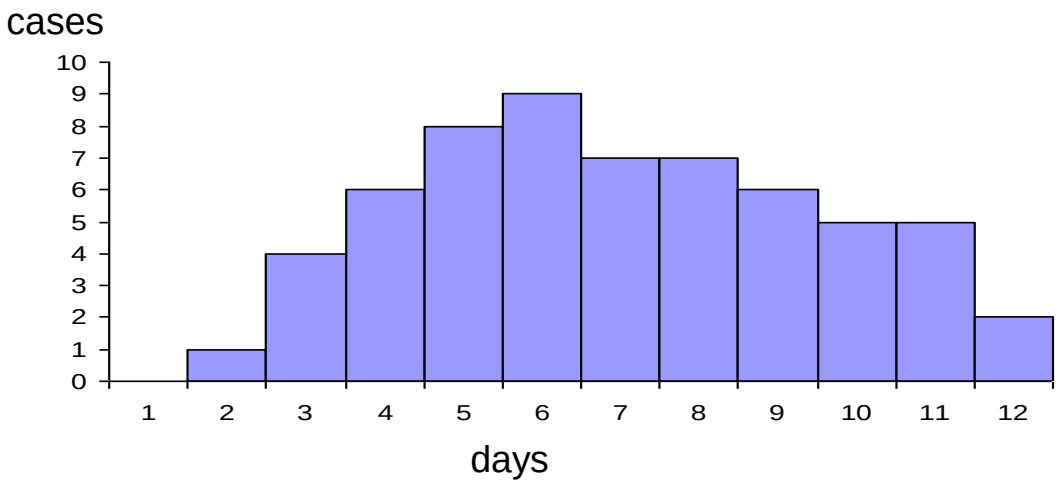
- Helps to develop hypotheses
  - incubation period
  - etiological agent
  - type of source
  - type of transmission
  - time of exposure

Examples of Epidemic curves

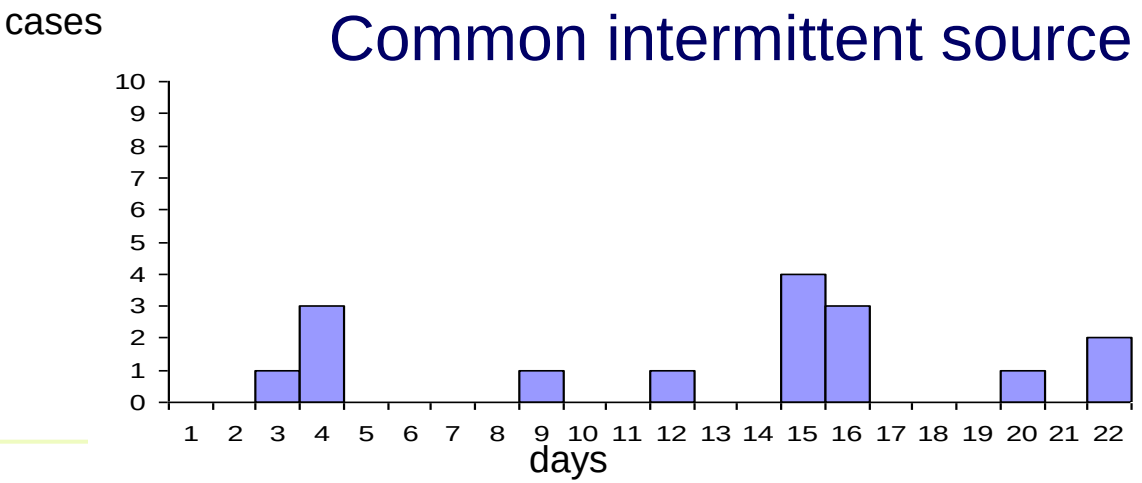
Common point source



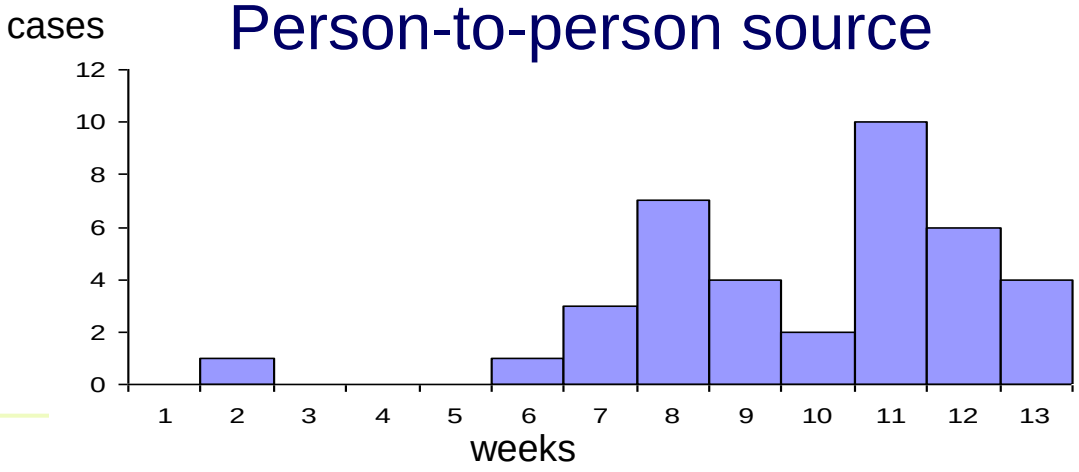
Common persistent source



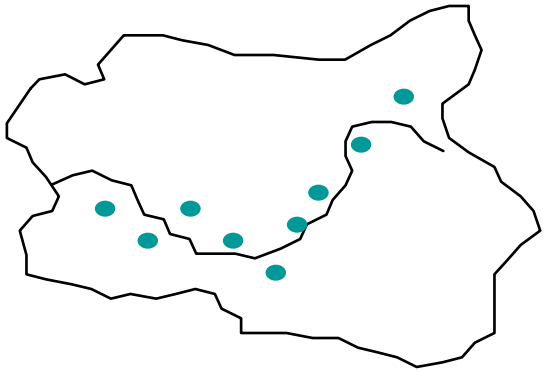
Common intermittent source



Person-to-person source

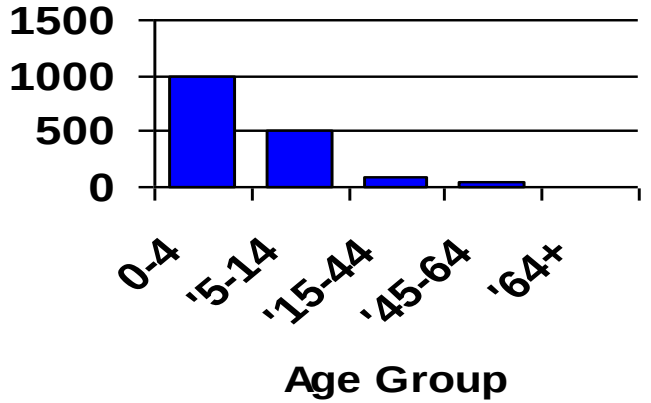


Place



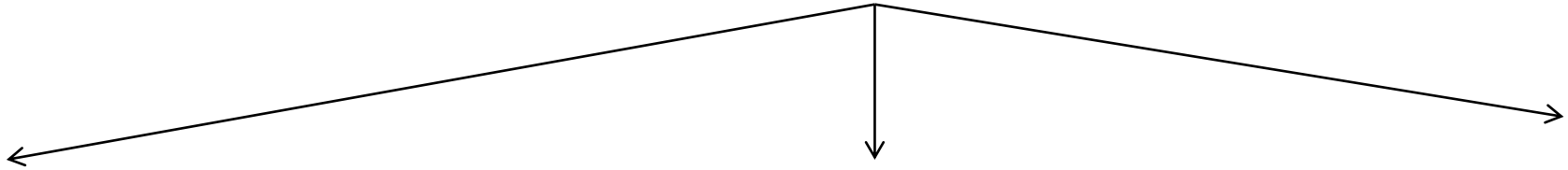
- Place of residence
- Place of possible exposure
  - work
  - meals
  - travel routes
  - day-care
  - leisure activities
- Maps
  - identify an area at risk

Person

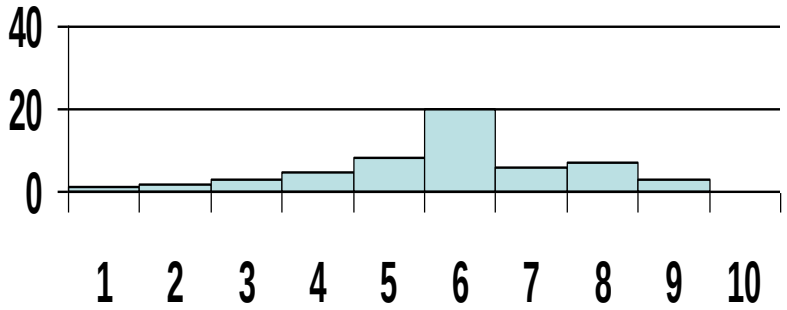


- Distribution of cases (numerator)
  - age
  - sex
  - occupation, etc.
- Distribution of these variables in the population (denominator)
- Attack rates

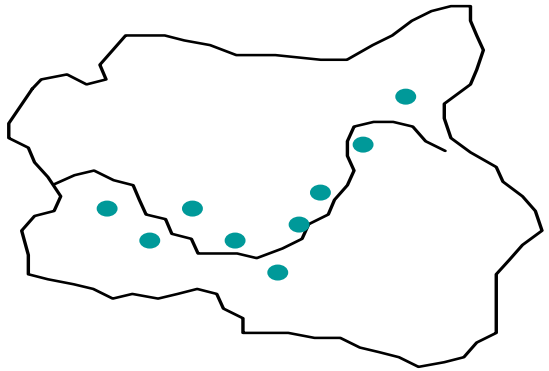
Hypotheses generation



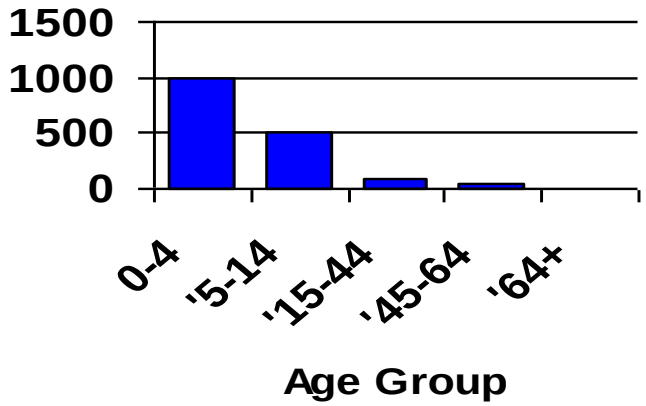
Time



Place



Person

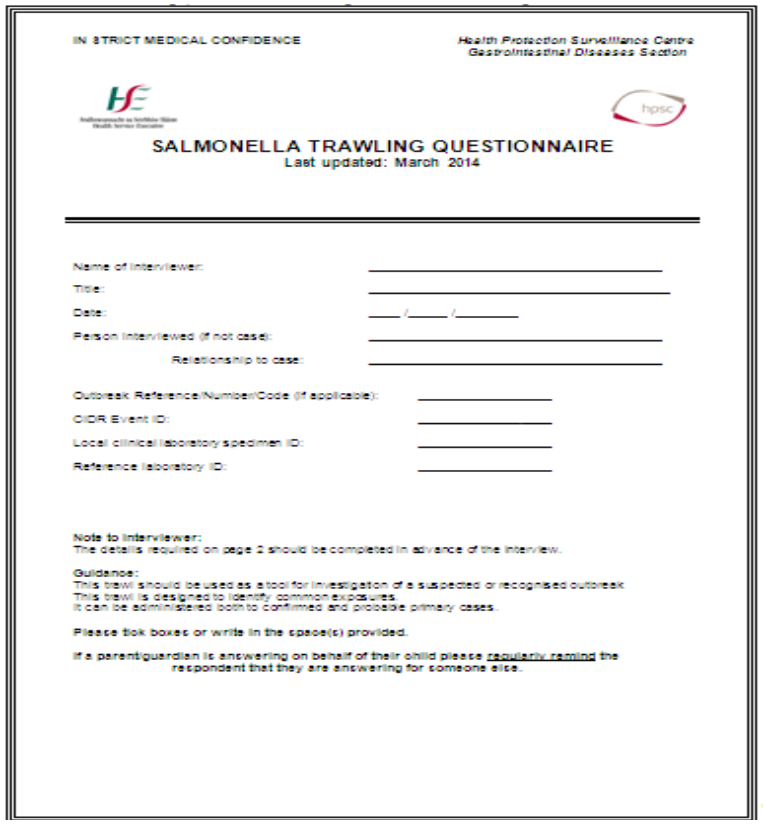


Develop hypotheses

- Vehicle?
- Source?
- At risk?
- Pathogen?
- Transmission?

Tools for Hypothesis Generation in Ireland
Trawling Questionnaires

Salmonella



IN STRICT MEDICAL CONFIDENCE

Health Protection Surveillance Centre
Gastrointestinal Diseases Section

SALMONELLA TRAWLING QUESTIONNAIRE
Last updated: March 2014

Name of interviewer: _____
Title: _____
Date: ___/___/_____
Person interviewed (if not case): _____
Relationship to case: _____

Outbreak Reference/Number/Code (if applicable): _____
CIDR Event ID: _____
Local clinical laboratory specimen ID: _____
Reference laboratory ID: _____

Note to interviewer:
The details required on page 2 should be completed in advance of the interview.

Guidance:
This trawl should be used as a tool for investigation of a suspected or recognised outbreak.
This trawl is designed to identify common exposures.
It can be administered both to confirmed and probable primary cases.

Please tick boxes or write in the space(s) provided.

If a parent/guardian is answering on behalf of their child please regularly remind the respondent that they are answering for someone else.

VTEC

IN STRICT MEDICAL CONFIDENCE

Health Protection Surveillance Centre
Gastrointestinal Diseases Section

VTEC TRAWLING QUESTIONNAIRE
Last updated: March 2014

Name of interviewer: _____
Title: _____
Date: ___/___/_____
Person interviewed (if not case): _____
Relationship to case: _____

Outbreak Reference Number/Code (if applicable): _____
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Generic IID

INFECTIOUS INTESTINAL DISEASE
INVESTIGATION FORM

This questionnaire may be applied by environmental health or public health personnel:
- to investigate potentially linked cases of infectious intestinal disease
- as a preliminary questionnaire in the investigation of outbreaks
- for complaints of individual cases of gastrointestinal illness in the absence of disease confirmation
- for investigation of disease notifications for which no disease-specific questionnaire exists

GENERAL INFORMATION

Case reference no. (e.g. Event ID): _____ Outbreak code: _____ Local Health Office: _____
Reported by: _____ Date of report: __/__/____
Interview: Personal ☐ Telephone ☐ Other ☐ Specify other: _____
Person interviewed (if not case): _____ Relationship to case: _____
Name of interviewer: _____ Date and time (24 hr clock) of interview: __/__/____ __:__

PATIENT DETAILS

First Name: _____ Surname: _____
Date of Birth: __/__/____ Age: ____ Sex: Male ☐ Female ☐
Home Address: _____
_____
_____
Other address (for visitors to the area, please enclose address of holiday accommodation): _____
_____
Home phone no.: _____ Mobile or other contact telephone no.: _____
GP name: _____ GP phone no.: _____
GP address: _____
_____

Information collected on Trawling Questionnaires

- WATER
- TRAVEL –FOREIGN AND DOMESTIC
- ANIMAL EXPOSURES –FARM, PET, WILDLIFE
- OUTDOOR ACTIVITIES
- EATING OUT
- READY-TO-EAT -TAKE OUT, SANDWICH BARS, ETC
- FOOD EXPOSURES
    - PORK AND PORK PRODUCTS
    - POULTRY
    - BEEF, LAMB & OTHER MEAT
    - FISH/SEAFOOD
    - EGGS/DAIRY
    - SALAD VEGETABLES
    - OTHER FRESH PRODUCE
    - OTHER SALAD INGREDIENTS
    - HERBS AND SPICES
    - FRUIT
    - SNACKS
    - SAUCES, PICKLES or DIPS
- SHOPS

Sample page from questionnaire

FRESH PRODUCE:

50. In the **7 DAYS** before you became ill, did you eat any **raw salad vegetables either at home or outside the home?**
[Prompt: don't forget salad items in sandwiches, in juices and smoothies, as crudités, burgers, kebabs, at home, in restaurants/cafes, etc]

SALAD VEGETABLES	Yes	No	Unk	Describe, e.g. organic or not, variety, shape, colour, if relevant	Packaging/presentation, e.g. wrapped/loose/tray/bag, whole/halved/sliced, 6-pack/3-pack, etc	Brand and where purchased/eaten, e.g. name restaurant/café, supermarket, local store, farmers market, homegrown, etc
Lettuce, e.g. ball-headed like iceberg, loose leaved, bagged lettuce leaves, etc						
Other salad leaves, (specify chard, rocket, baby beet leaves, spinach, lambs lettuce, watercress, etc)						
Tomatoes						
Cucumber						
Peppers						
Onion/shallots						
Spring onion						
Radish						
Pre-made deli style salads either from an open salad bar or pre-packed, (specify bean-based, pasta-based, carrot- based, potato-based, coleslaw, cous-cous based etc)						
Other						

Hypotheses generation

- Apply trawling questionnaire
  - -face-to-face or telephone interview (or online)
- Record and analyse information in spreadsheet/database
- Review data for common exposures
- Followed by analytical study and/or microbiological investigation

- Novel hypothesis generation tools, e.g. loyalty cards, etc.

Test hypotheses

→Analytical studies

Key feature is a **comparison group**

- Cohort study
  - Attack rate in exposed group
  - Attack rate in unexposed group
- Case-Control study
  - Odds of exposure in cases
  - Odds of exposure in control

Sources of data for comparison

- General population –random selection
- Survey panelists
- Food consumption surveys
- Case-case approach
- Commercial sales data

Additional investigations

- Microbiological investigation
- Environmental investigation
- Veterinarian investigation
- Trace back investigations (origin of foods)

The Role of Primary and Reference Laboratories in Outbreak Investigations

- Detection of clusters and outbreaks
- Outrule links with unrelated cases
- Confirm link between suspected source and human cases

Examples of laboratory methods to type micro-organisms

- Serotyping
- Phage typing
- Molecular typing, e.g. PFGE, MLVA
- Sequencing (WGS, NGS, etc)

Implement control measures

- Commence immediately outbreak is identified
- At first - general measures
- According to findings – more specific measures

Aim - To protect persons at risk and prevent future outbreaks

- Controlling the source of the pathogen
- Interrupting /blocking the mode of transmission
- Control of distant cases – inter/national alerts
- Modifying the host response/defence
- Risk group protection

Communication

- OCT
- Media
- Affected population
- Wider public health community
- General public

Outbreak Report

- Detailed report at the end
  - communicate public health messages
  - provide recommendations
  - influence public health policy
  - training tool
  - legal proceedings

The reality....

time

Outbreak suspected

Confirmation

Site visit

Case definition

Recommendations

Report
Publication

Organize Data

Confirm Diagnosis

Descriptive
Epidemiology

Form Outbreak
Control Team

Line list

Analytical
Epidemiology

Control measures

Communication

SURVEILLANCE AND OUTBREAK REPORTS

Investigation and management of an outbreak of *Salmonella* Typhimurium DT8 associated with duck eggs, Ireland 2009 to 2011

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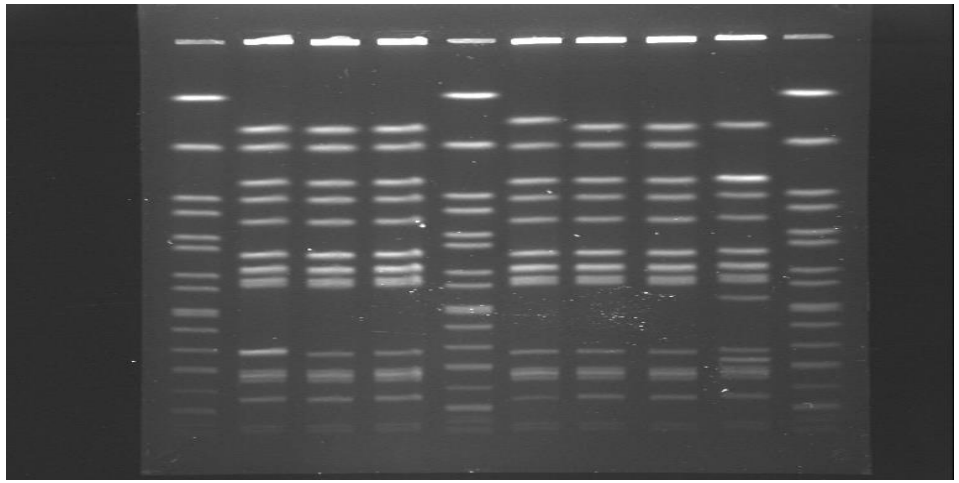
DT8 outbreak case definition

PFGE



MLVA

2-10-NA-12-212

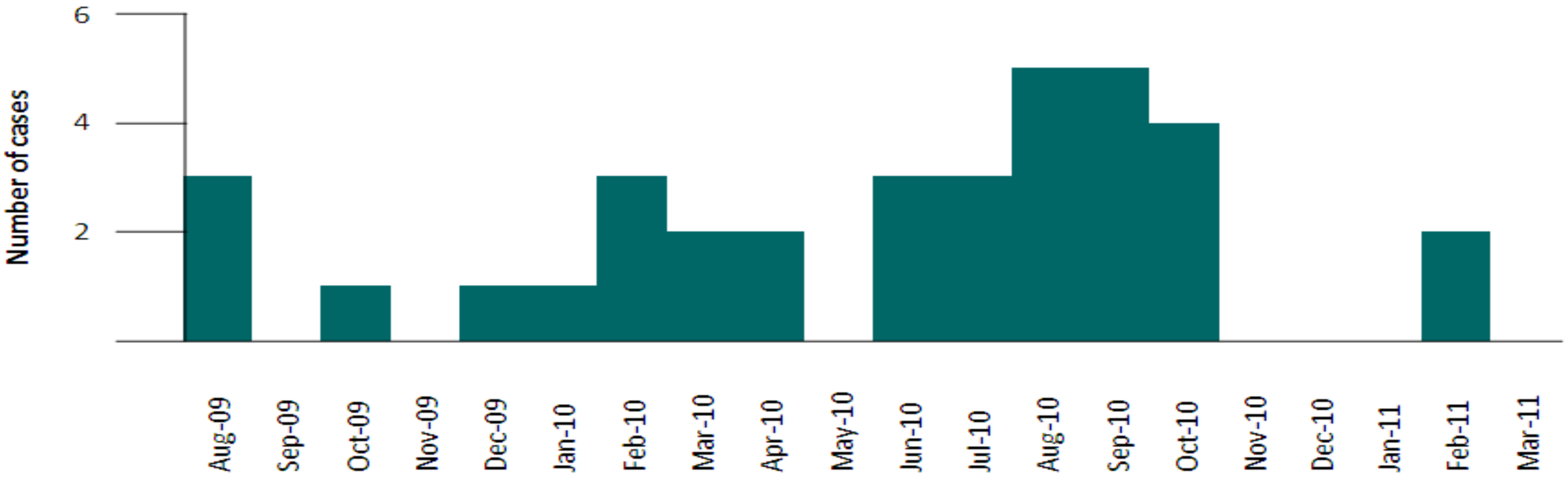
or closely related pattern

Lab data source: NSSLRL, Galway

A **confirmed** case was defined as a person who had a laboratory-confirmed infection with *Salmonella* Typhimurium DT8 (MLVA pattern 2-10-NA-12-212 or a closed related pattern) and who had a date of onset after August 1st 2009.

Garvey et al. 2012. Investigation and management of an outbreak of *SalmonellaTyphimurium DT8 associated with duck* eggs, Ireland 2009 to 2011 http://www.eurosurveillance.org/images/dynamic/EE/V18N16/art20454.pdf

Distribution of DT8 outbreak cases by month of onset



Garvey et al. 2012. Investigation and management of an outbreak of *SalmonellaTyphimurium DT8 associated with duck* eggs, Ireland 2009 to 2011 http://www.eurosurveillance.org/images/dynamic/EE/V18N16/art20454.pdf

Trawling questionnaires indicated higher than expected consumption of duck eggs

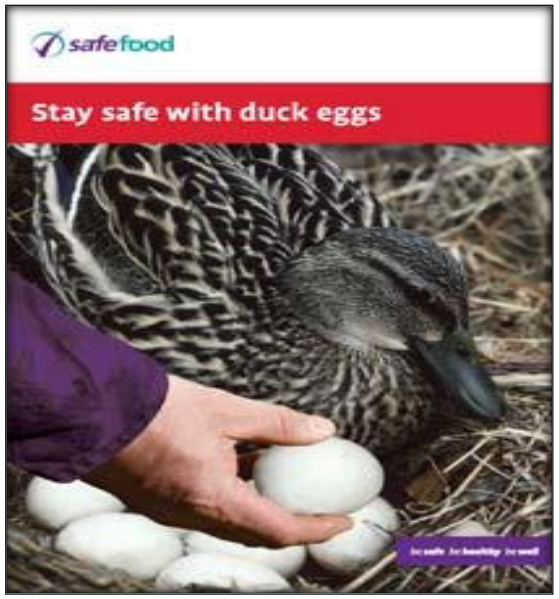
Exposure to duck eggs	Number of cases
Consumed duck eggs	18
Possible contact with duck eggs	4
Presumed secondary case	1
No duck egg exposure reported	9
Duck egg exposure unknown	3

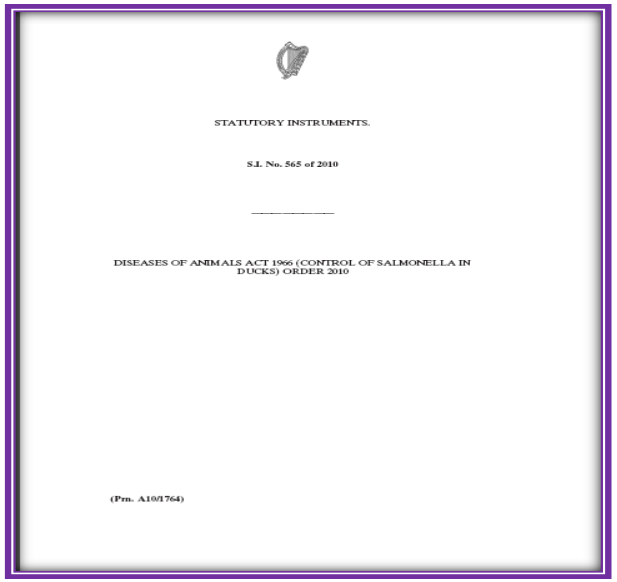
Known duck egg exposure explained 23 of 32 (72%) cases.

Traceback by EHS and DAFM and microbiological investigations provided evidence implicating several duck flocks

Control Measures

1. Advice for consumers
   I. Press releases (n=3) advising thorough cooking
   II. Point-of sale notices (FSAI)
   III. Public information campaign with postcards by Safefood
2. For positive flocks (DAFM)
   I. Movement of birds restricted
   II. Voluntary cull initially
   III. Duck house cleansing and disinfection
   IV. New birds to be sourced from salmonella negative flocks
3. DAFM Code of practice introduced in summer 2010
   I. Traceability
   II. Disease control
   III. Biosecurity
   IV. Testing
4. DAFM Guidelines for backyard producers in October 2010
5. Legislation **SI 565 of 2010**
   I. Legal basis for salmonella controls in all duck flocks which trade for profit





STATUTORY INSTRUMENTS.

S.I. No. 565 of 2010

DISEASES OF ANIMALS ACT 1966 (CONTROL OF SALMONELLA IN DUCKS) ORDER 2010

(Prn. A10/1764)

Outbreak of hepatitis A infection associated with the consumption of frozen berries, Ireland, 2013 - linked to an international outbreak

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11. The members of the Outbreak Control Team are listed at the end of the article

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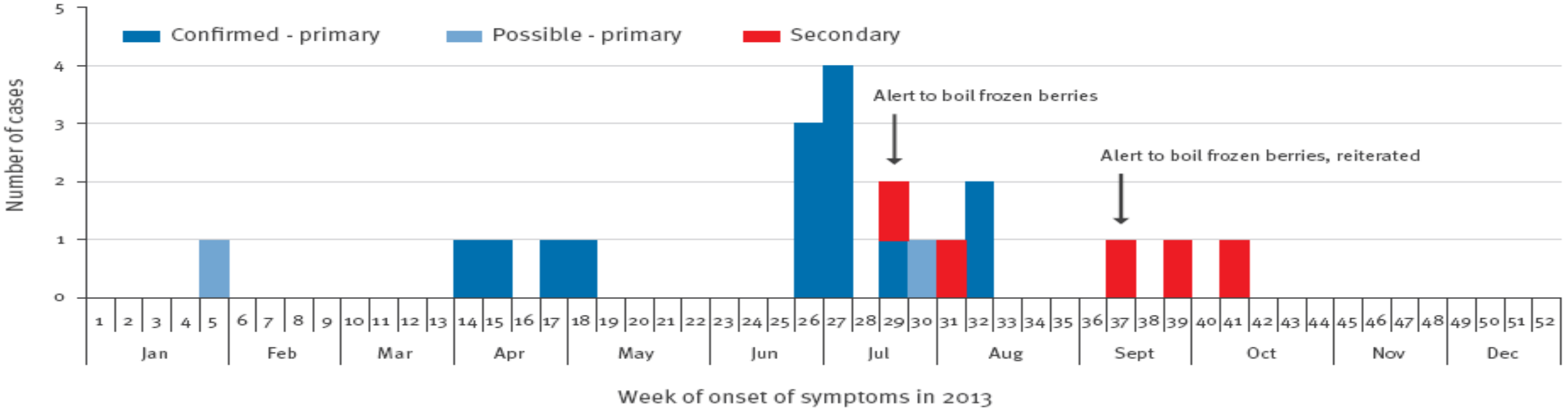
Fitzgerald M, Thornton L, O'Gorman J, O'Connor L, Garvey P, Boland M, Part AM, Rogalska J, Coughlan H, MacDiarmada J, Heslin J, Canny M, Finnegan P, Moran J, O'Flanagan D, on behalf of the Hepatitis A Outbreak Control Team. Outbreak of hepatitis A infection associated with the consumption of frozen berries, Ireland, 2013 - linked to an international outbreak. Euro Surveill. 2014;19(43):pii=20942. Available online: http://www.eurosurveillance.org/ViewArticle.aspx?ArticleId=20942

Distribution of hepatitis A outbreak cases by week of onset of symptoms, Ireland, 2013 (n=21)



Fitzgerald M, et al. Euro Surveill. 2014;19(43):pii=20942. Available online: http://www.eurosurveillance.org/ViewArticle.aspx?ArticleId=20942

Analytical epidemiology –Case Control Study Findings

Food exposures among hepatitis A subgenotype IA cases (n = 11) and controls (n = 42), Ireland, 2013

Exposure Total	Cases			Controls			Crude mOR	95% CI	p value
	Total[a]	Exposed	%	Total	Exposed	%			
Individual products									
Cheesecake[b]	10	4	40	42	4	10	12	1.3–114	0.026
Celery	11	6	55	42	7	17	4.0	1.2–16	0.026
Whole frozen berries	10	4	40	42	4	10	9.5	1.0–89	0.031
Yoghurt A[b]	10	4	40	42	3	7	6.6	1.2–37	0.048
Fresh blueberries	11	9	82	42	22	52	4.1	0.79–21	0.093
Ice cream[b]	11	2	18	42	1	2	7.3	0.66–81	0.105
Yoghurts[b,c]	10	5	50	42	9	21	3.1	0.77–12	0.112
Smoothies[b]	9	4	44	42	9	21	3.1	0.67–14	0.151
Fresh berries	11	10	91	42	33	79	3.4	0.30–38	0.321
Grouped products									
Cheesecake or yoghurt A	10	6	60	42	7	17	5.3	1.3–22	0.023
Whole frozen berries or yoghurt A	10	6	60	42	7	17	7.0	1.4–37	0.02
Cheesecake or whole frozen berries	10	7	70	42	7	17	14	1.7–122	0.014
Cheesecake or whole frozen berries or yoghurt A	10	8	80	42	10	24	8.1	1.6–40	0.011
Cheesecake or whole frozen berries or yoghurt A or smoothies[d]	11	10	91	42	16	38	12	1.5–94	0.02

CI: confidence interval;.mOR: matched odds ratio.

[a] Cases with available information.

[b] These products contained frozen berries.

[c] Includes yoghurt A and other yoghurts containing frozen berries.

[d] No change when ice-cream was added to this combination.

Hepatitis A outbreak summary

- 21 outbreak cases
- Concurrent outbreaks in other European countries
- In analytical epidemiological study, cases were more likely than controls to have eaten berry cheesecake, whole frozen berries, yoghurt containing frozen berries or raw celery.
- Among cases, 91% had consumed at least one of four products containing frozen berries.
- Sixteen food samples tested were all negative for HAV, and source of berries not identified (see also European Food Safety Authority, 2014. Tracing of food items in connection to the multinational hepatitis A virus outbreak in Europe. EFSA Journal 2014;12(9):3821, 186 pp. doi:10.2903/j.efsa.2014.3821)
- As products containing frozen berries were implicated in the outbreak, the public were advised to heat-treat frozen berries before consumption.

Fitzgerald M, et al. Euro Surveill. 2014;19(43):pii=20942. Available online: http://www.eurosurveillance.org/ViewArticle.aspx?ArticleId=20942

International Health Regulations

- To prevent, protect against, control and provide a public health response to the international spread of disease
- Member States must notify the WHO of public health emergencies of international concern (PHEICs),
- Extraordinary events that pose a public health risk through the international spread of disease to the rest of the world
- Public Health Emergencies
  - Health impact (seriousness)
  - Unexpected nature
- International concern
  - Risk of international spread
  - International response (restrictions to travel or trade)

International Perspectives

- ECDC:
  - Surveillance of ID in Europe
  - Through surveillance networks
  - Provision of technical and scientific expertise
  - Support the networking activities of competent bodies
- EFSA:
  - Assess risks associated with the food chain in Europe
  - Communicate risks openly based on independent scientific advice of scientific expert panels

European Food Safety Authority

EUROPEAN CENTRE FOR DISEASE PREVENTION AND CONTROL

JOINT ECDC–EFSA RAPID OUTBREAK ASSESSMENT

Multi-country outbreak of *Listeria monocytogenes* serogroup IVb, multi-locus sequence type 6, infections linked to frozen corn and possibly to other frozen vegetables – first update

3 July 2018

Confirmed outbreak case

A laboratory-confirmed listeriosis patient with symptom onset on or after 1 January 2015 (date of sampling or date of receipt by the reference laboratory if date of onset is not available)

AND

- Fulfilling the additional laboratory criterion: with *L. monocytogenes* having ≤7 core-genome Multi-locus Sequence Typing (cgMLST) allelic differences from the outbreak isolate FI 122265 based on cgMLST analysis (assembly uploaded to EPIS UI-444 as IVb_MLST6_122265_S3_L001_R_q30w20.fasta). The cgMLST scheme is either that of Moura or Ruppitsch, or a respective scheme [11,14].

OR

- Fulfilling the additional laboratory criterion: with *L. monocytogenes* within a five SNP cluster from the outbreak isolate FI 122265 based on SNP analysis (assembly uploaded to EPIS UI-444 as IVb_MLST6_122265_S3_L001_R_q30w20.fasta).

Probable outbreak case

A laboratory-confirmed listeriosis patient with symptom onset on or after 1 January 2015 (date of sampling or date of receipt by the reference laboratory if date of onset is not available)

AND

- Fulfilling the additional laboratory criteria: with an isolate of *L. monocytogenes* serogroup IVb and with PFGE indistinguishable from the profile AscI.0003-ApaI.0070 (TESSy) (uploaded to EPIS as UI-444: BioNumerics.PFGE.AscI.0003-ApaI.00070.zip).

A second PFGE profile was described from non-human isolates matching the outbreak genomic profile. The analysis of the profile in on-going to determine the reference type.

Exclusion criteria

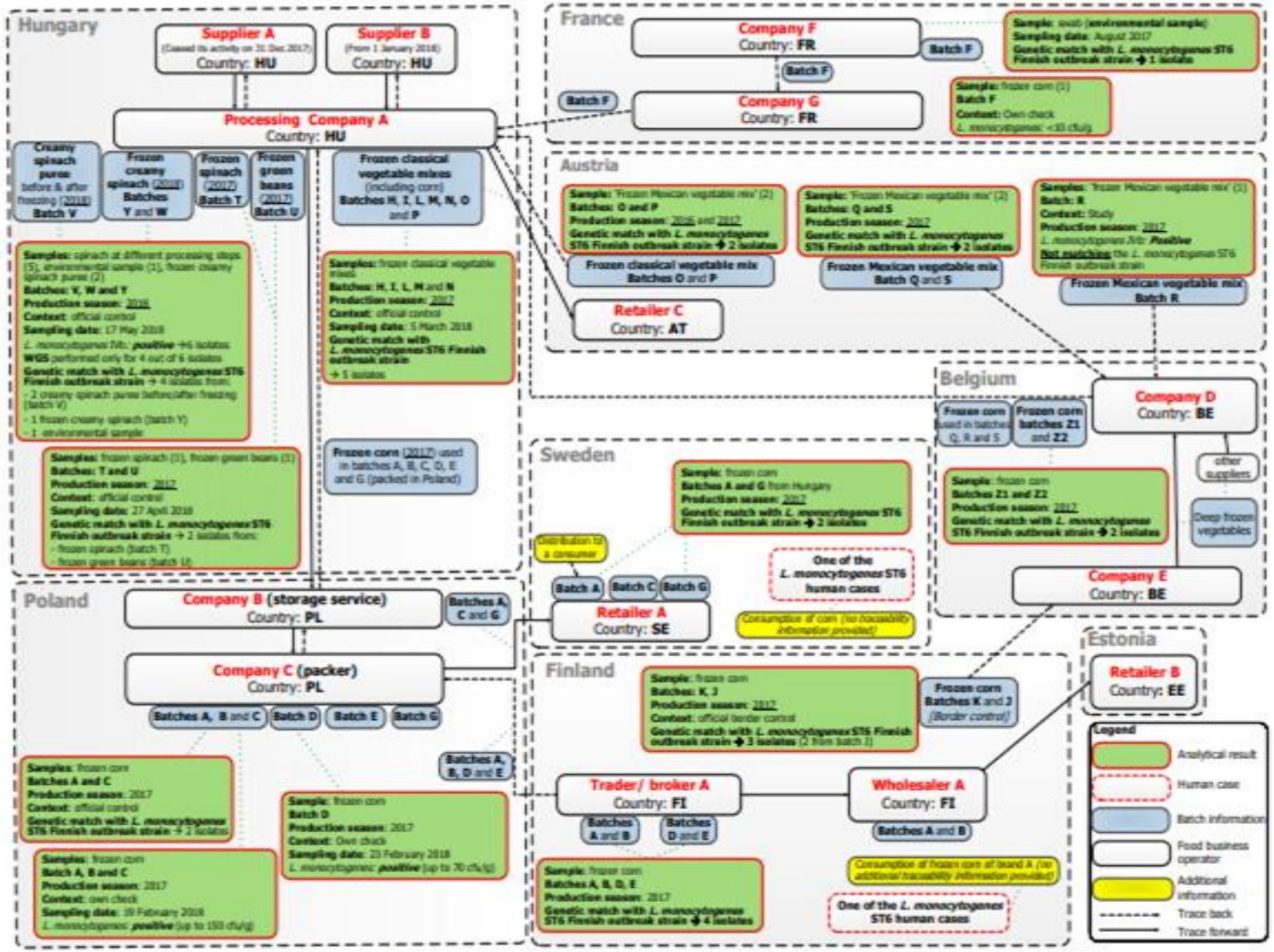
Cases with travel history outside of the EU/EEA in the 30 days before disease onset.

Table 1. *Listeria monocytogenes* IVb, ST6 confirmed outbreak cases by country and year, EU 2015–2018 (as of 15 June 2018)

Country	Confirmed cases (No. of deaths)				Total number of cases	Total number of deaths
	2015	2016	2017	2018		
Austria	0	2 (1)	0	0	2	1
Denmark	0	0	2	2 (1)	4	1
Finland	0	4	10 (2)	9	23	2
Sweden	0	3 (1)	3 (1)	1 (1)	7	3
United Kingdom	1	2	2 (2)	6	11	2
Total	**1 (0)**	**11 (2)**	**17 (5)**	**18 (2)**	**47**	**9**

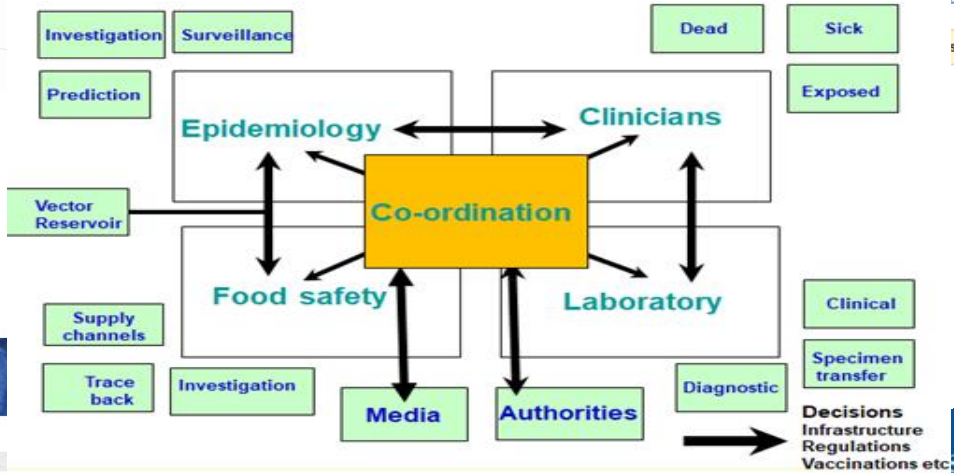
France, Germany, Ireland, Italy Luxembourg, the Netherlands, Norway and Portugal report no human isolates matching the European outbreak strain.

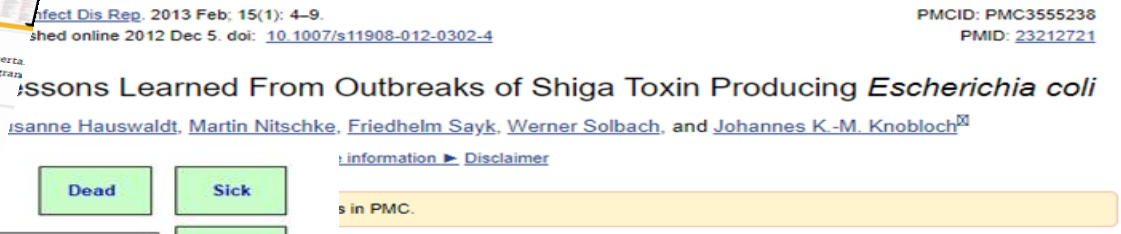
Figure 3. Graphical representation of traceability and testing information available in RASFF or provided to EFSA by Member States, as of 29 June 2018

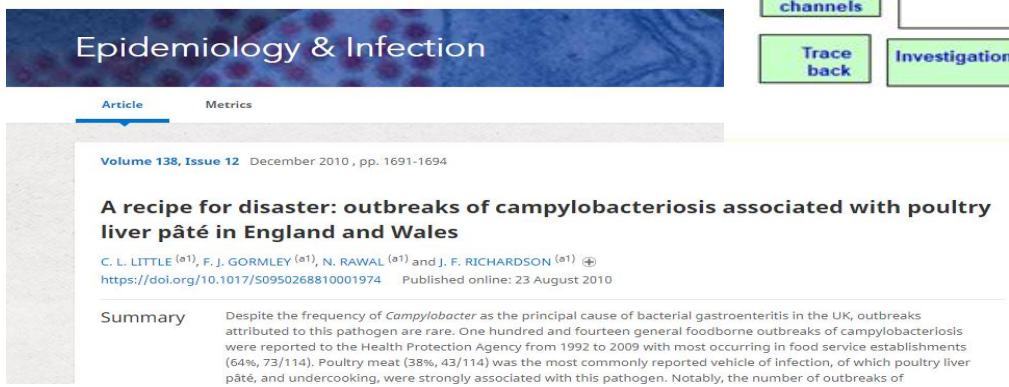


Note: cfu/g: colony-forming unit per gram. AT: Austria, BE: Belgium, EE: Estonia, FI: Finland, FR: France; HU: Hungary, PL: Poland, SE: Sweden

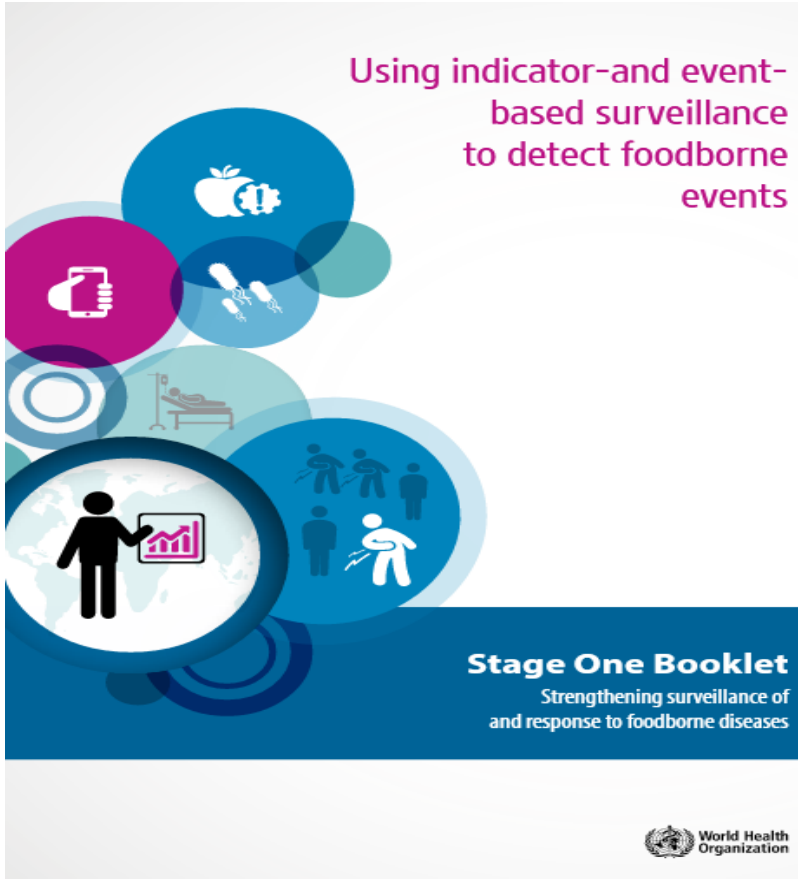
Conclusions

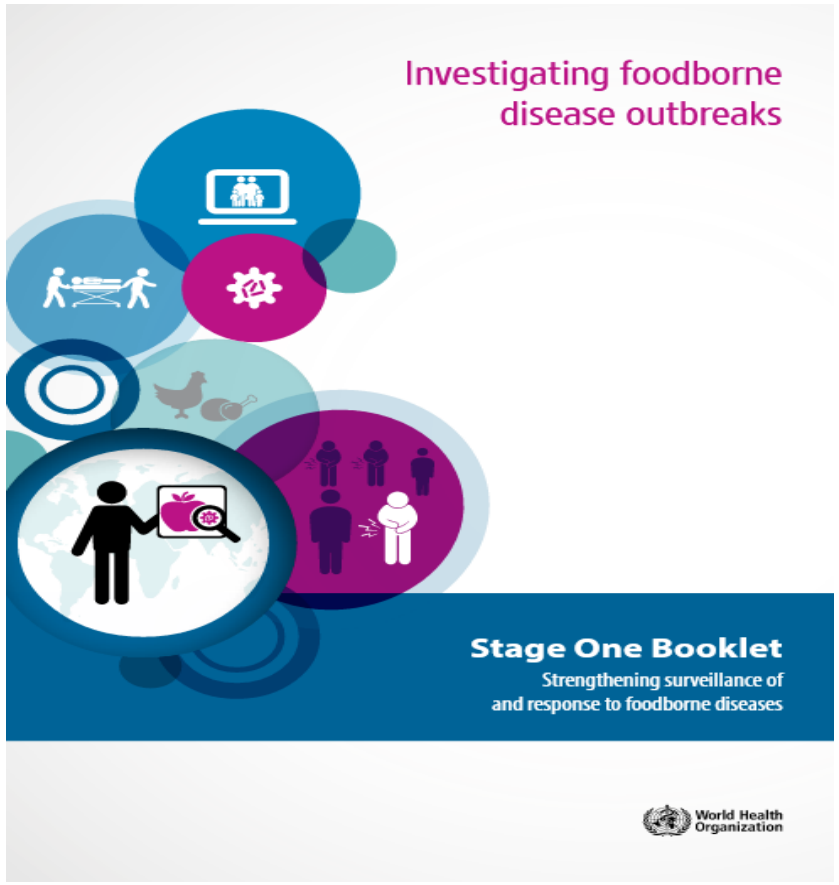


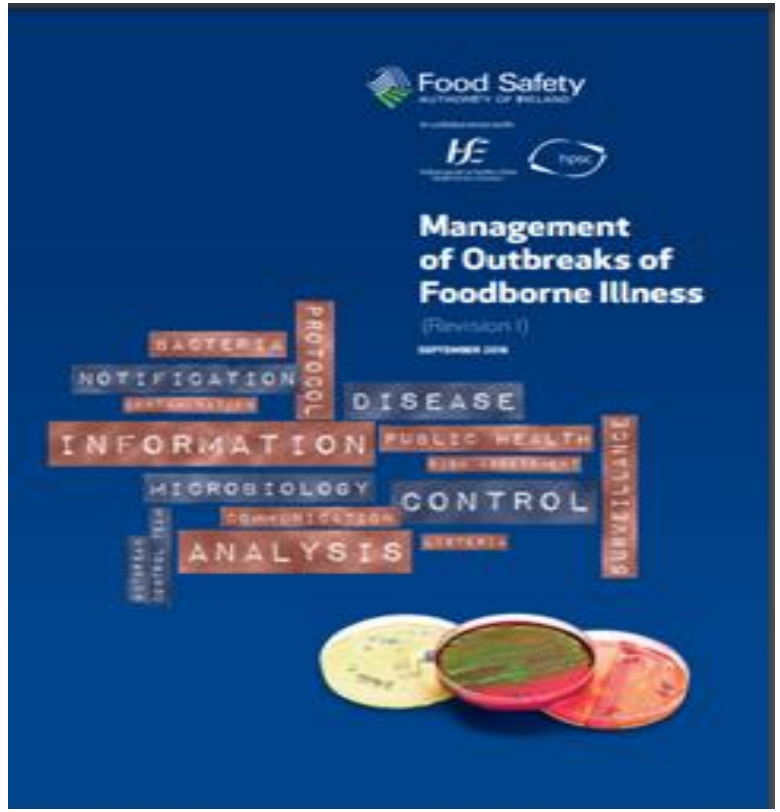




Background Reading







WHO, 2017. Available at http://www.who.int/foodsafety/publications/foodborne_disease/surveillancemanual/en/

FSAI, 2016. Available at https://www.fsai.ie/resources_publications.html

Questions?

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