

# Microbiological Status of Ready-to-Eat Foods.



An update for the  
Advisory Committee on the Microbiological Safety of Food.

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## Introduction.

A consideration of the public health issues arising from the microbiological contamination of ready-to-eat foods, focussing on fresh produce, ie ready-to-eat fruit and vegetables.

# Summary.

Three main issues emerge from our analyses of the surveillance data:

- Listeriosis linked to sandwiches from hospitals;
- Kitchen hygiene:
  - cross-contamination;
  - infected food handlers;
- Geographically dispersed outbreaks attributable to the contamination of ready-to-eat fruit and vegetables with pathogenic micro-organisms during production, processing and distribution.

## Listeriosis linked to sandwiches from hospitals.

- A detailed paper from the HPA on human listeriosis was presented at the December 2007 meeting of the ACMSF.
- Human listeriosis linked to hospital sandwiches: implications for procurement and storage.

HPA. Health Protection Report. 2008; 2 (35): 4-6.

- Microbiological safety of sandwiches from hospitals and other health care establishments in the United Kingdom with a focus on *Listeria monocytogenes* and other *Listeria* species.

Little CL *et al.* J Food Prot. 2008 Feb; 71(2): 309-318.

# Listeriosis linked to sandwiches from hospitals.

Six incidents identified since 1999:

- few affected;
- all pregnant women or elderly immunocompromised;
  - no cases identified in the wider community;
- microbiological investigations yielded indistinguishable strains of *Listeria monocytogenes* in cases, sandwiches and production plants.

# Listeriosis linked to sandwiches from hospitals.

## LACORS/HPA Study:

- 3,249 sandwich samples collected from hospitals and residential care homes in the UK;
- standardised microbiological investigations conducted by Official Food Control Laboratories;
- standardised information collected on management control systems in place in sampled healthcare facilities.

# Listeriosis linked to sandwiches from hospitals.

## LACORS/HPA Study:

- *L. monocytogenes* was detected in 2.7% of samples;
- Presence of *Listeria* spp. and *L. monocytogenes* was associated with:
  - external suppliers;
  - prepacked sandwiches;
  - fillings:
    - poultry meat;
    - **salad vegetables;**
    - soft cheese and/or mayonnaise.

# Listeriosis linked to sandwiches from hospitals.

## LACORS/HPA Study:

- 88.4% of premises had a hazard analysis system in place;
  - 75.5% of these were documented;
  - for samples collected after 01/01/06 - 60.4% of premises complied with HACCP requirements (article 5, regulation (EC) No 852/2004.



# Listeriosis linked to sandwiches from hospitals.

## Discussion points.

- 16 M sandwiches are sold through NHS establishments each year:
  - convenient for patients, their families and staff;
  - a prevalence of 2.7% would result in over 400,000 sandwiches contaminated with *L. monocytogenes* being served each year;
  - it is difficult to ensure good temperature control between point of sale and consumption;
- Levels of *L. monocytogenes* < 100 cfu/g are not usually considered significant except for vulnerable groups:
  - increasing numbers of elderly in the population.

# Listeriosis linked to sandwiches from hospitals.

## Discussion points.

- Manufacturers supplying sandwiches to healthcare establishments should comply with the British Sandwich Association Code of Practice recommended target level of an absence of *L. monocytogenes* in sandwiches at the point of production.
- There is a need for establishments providing food for vulnerable individuals to have properly considered and correctly implemented hazard analysis systems.

# Ready-to-eat fruit and vegetables.

- Prepared salads and public health.

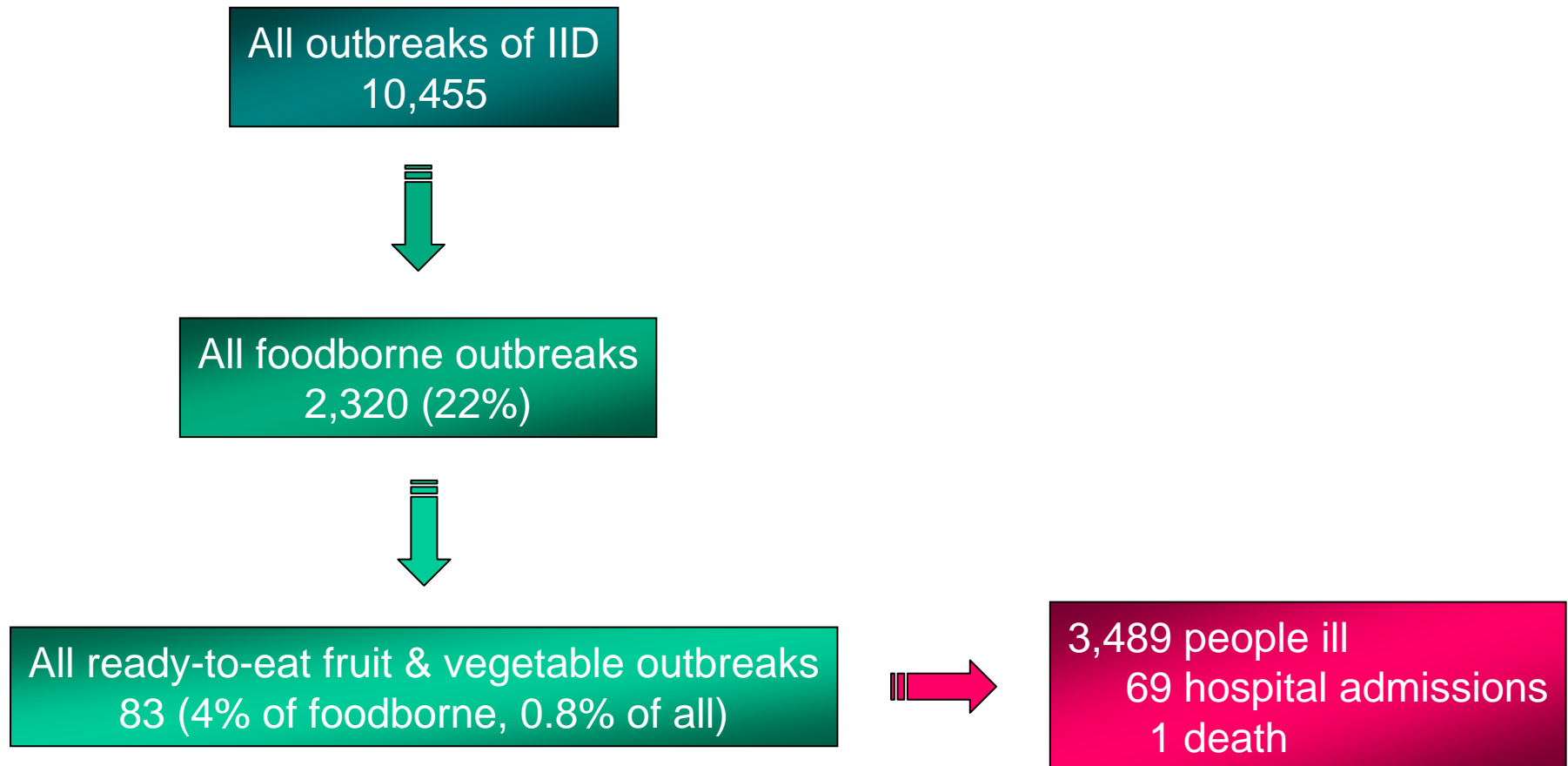
Little CL & Gillespie IA. J Appl Micro. 2008. Article published online 4 April 2008.

- Packed with *Salmonella* – Investigation of an international outbreak of *Salmonella* Senftenberg infection linked to contamination of pre-packed basil.

Pezzoli L *et al.* Foodborne Pathogens & Disease: In Press 2008.

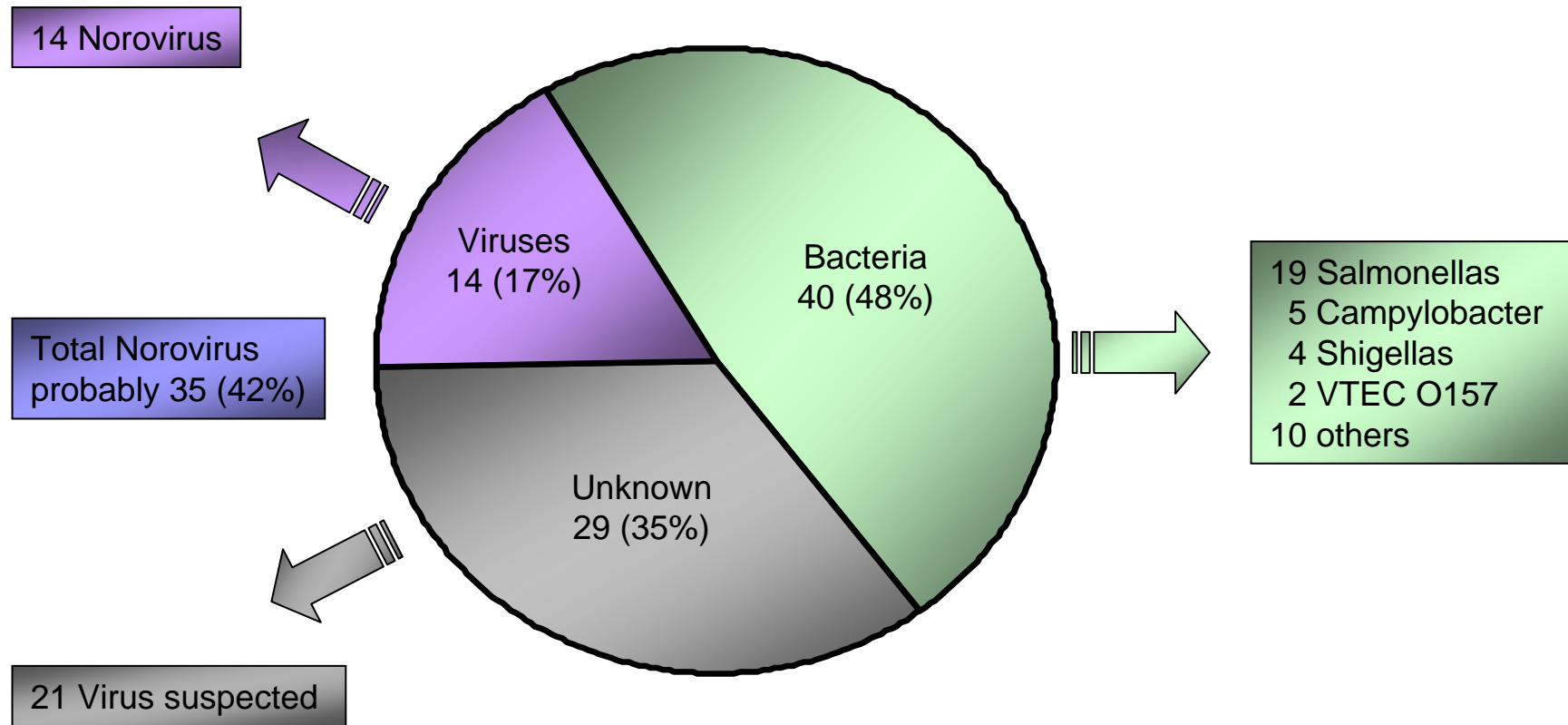
# Ready-to-eat fruit and vegetables.

General outbreaks of IID in England and Wales reported to the HPA Centre for Infections 1992-2007.



# Ready-to-eat fruit and vegetables.

General outbreaks of IID in England and Wales reported to the HPA Centre for Infections 1992-2007 - Aetiology.



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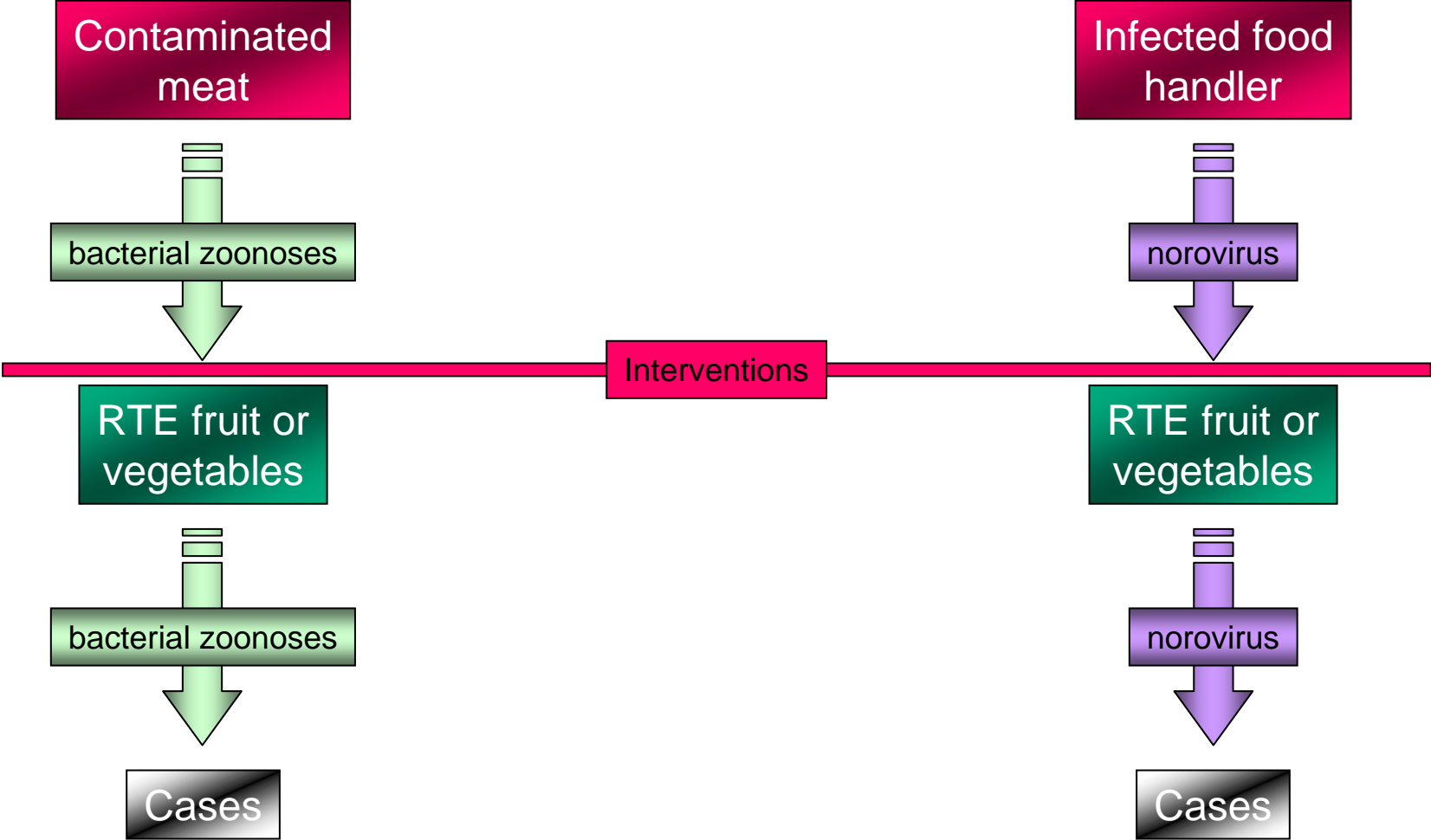
# Ready-to-eat fruit and vegetables.

General outbreaks of IID in England and Wales reported to the HPA Centre for Infections 1992-2007.

- 89% of outbreaks were linked to commercial food service premises, institutions or the workplace.
- 61% were linked to functions.
- EHOs and CCDCs assess the factors that contribute towards transmission of infection:
  - cross-contamination was a factor in 35% of outbreaks;
  - infected food handlers were implicated in 27% of outbreaks.

The most frequent way for ready-to-eat fruit and vegetables to become contaminated with pathogens is through breakdowns in kitchen hygiene.

# Kitchen hygiene.



# Kitchen hygiene.

## Discussion points.

- Surveillance of general outbreaks of IID mainly highlights breakdowns in hygiene in commercial kitchens.
- It is difficult to get a handle on how sporadic infection is transmitted.
- It is likely that ready-to-eat fruit and vegetables are subject to cross-contamination and contamination from infected food handlers in domestic kitchens:
  - raw meat and some eggs are still contaminated with bacteria;
  - millions of people become ill with norovirus each year, many of them must handle food in the home.



# Kitchen hygiene.

## Discussion points.

- When considering the burden of infection attributable to ready-to-eat fruit and vegetables it is necessary to take into account sporadic infection/household outbreaks and unrecognised general outbreaks.
- Interventions should focus on both the commercial and domestic sectors.
- Control of norovirus in the home is difficult.

## Geographically dispersed outbreaks.

| Year | Vehicle of infection | Country of origin  | Pathogen                                                      | Cases |
|------|----------------------|--------------------|---------------------------------------------------------------|-------|
| 2007 | Fresh basil          | Israel             | <i>S. Senftenberg</i>                                         | 48+   |
| 2005 | Lettuce              | Spain              | <i>S. Typhimurium</i> DT104 (ACSSuSpT)                        | 96    |
| 2004 | Lettuce              | Spain              | <i>S. Newport</i>                                             | 375   |
| 2003 | Lettuce              | Spain              | <i>S. Braenderup</i>                                          | 40+   |
| 2001 | Salad leaf (Iceberg) | Spain              | <i>S. Newport</i> PT33                                        | 19    |
| 2000 | Lettuce              | Not Known (Not UK) | <i>S. Typhimurium</i> DT104 (ACSSuSpT)                        | 361   |
| 2000 | Lettuce              | Not Known (Not UK) | <i>S. Typhimurium</i> DT204b (ACGNeKSSuTTmNxCp <sub>L</sub> ) | 294   |
| 1994 | Iceberg lettuce      | Spain              | <i>Shigella sonnei</i>                                        | 218   |

# Geographically dispersed outbreaks.

European outbreaks of infectious intestinal disease (IID) linked to ready-to-eat fruit and vegetables – published papers.

21 outbreaks (includes 8 UK);

- 12 *Salmonella enterica*, 4 Norovirus, 3 *Shigella sonnei*,  
2 Vero-cytotoxin producing *Escherichia coli* (VTEC) O157;
- 11 lettuce, 4 frozen raspberries, also basil, cucumber, baby corn, alfalfa sprouts;
- products from Belgium, Spain, Poland, Sweden, Italy, Israel, Thailand, China, Australia.

Similar outbreaks also reported from USA, Canada, India and Japan.

## *Salmonella* spp. isolated from retail bagged prepared RTE salad vegetables 2001.

- *S. Umbilo* and *S. Durban* were found in 3 and 1 of the salad samples, respectively:
  - contained organic rocket (either as a single ingredient or in a mixture);
  - linked to same grower in Italy.
- *S. Umbilo* contamination was traced directly to the field lizard population at source.

*J Food Protection* 2003; 66: 403-409

# *Salmonella* Newport PT 33 2001.

- *S. Newport* PT33 isolated from 1 sample of Four Leaf salad was a new phage type.
- Contamination of iceberg lettuce, one of the four leaf components, from a grower in Spain.
- 19 cases of *S. Newport* PT33 subsequently identified throughout England & Wales
  - Onset dates 1 – 18 June.
- Outbreak strain of *S. Newport* PT33 isolated from the salad and human cases had a unique plasmid profile.

# Geographically dispersed outbreaks.

Detection of geographically dispersed outbreaks.

- Algorithms applied to laboratory report surveillance data searching for exceedences in reporting above the norm.
  - there needs to be an accumulation of cases;
  - cases have to exceed a threshold to show up against the “background noise;”
  - can only be applied for pathogens where sporadic cases are sampled;
  - the sensitivity of the system is related to the ascertainment of the pathogen.

# *Salmonella* Senftenberg 2007.

## Epidemiology:

- 31 cases, mostly adults;
  - 7 hospitalised (4 with underlying illness; 1 death);
- Onset dates of illness 5 Mar to 20 May;
- All regions in England & Wales.



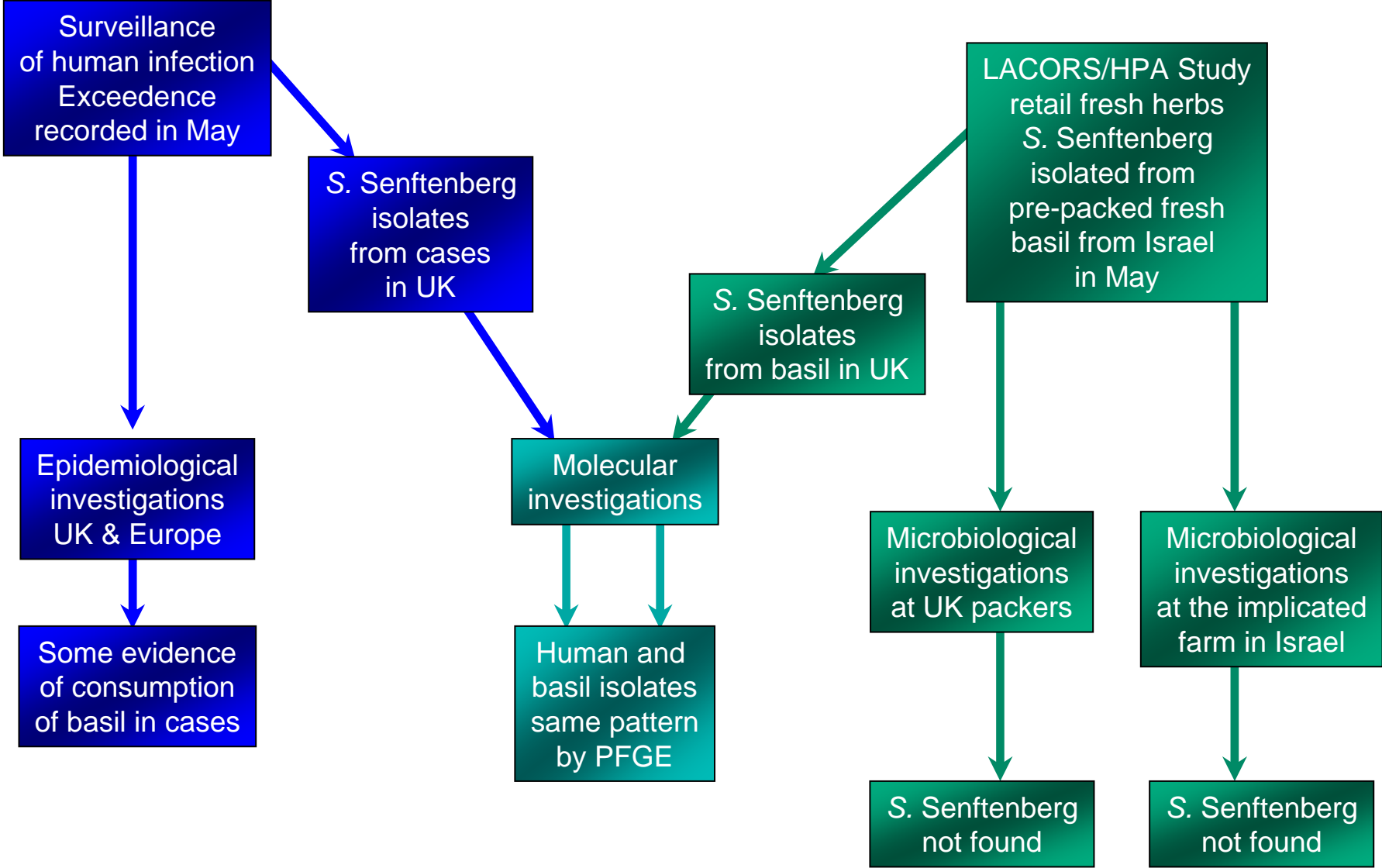
## Food Microbiology:

- HPA/LACORS study of retail fresh herbs started in May 2007;
- Eight samples of pre-packed fresh basil grown in Israel contaminated with *S. Senftenberg*;
  - collected from different regions in England & Wales.

## Molecular Microbiology:

- Outbreak strain of *S. Senftenberg* has PFGE profile SSFTXB.0014;
- Molecular results for isolates from cases are indistinguishable from basil isolates.

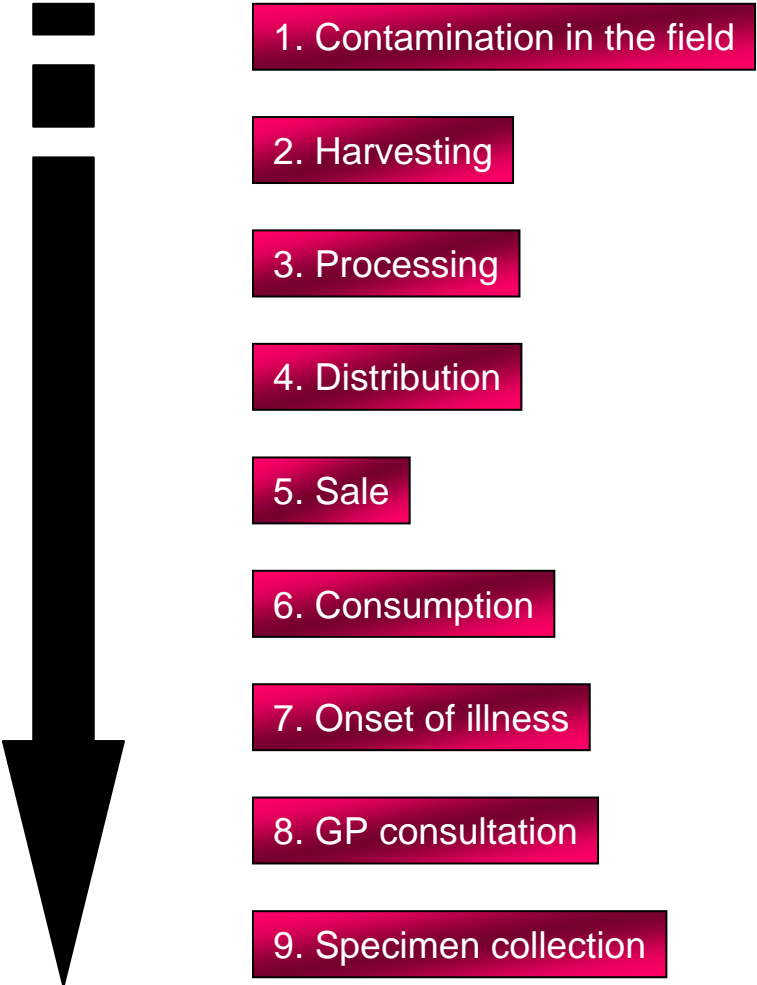
# Salmonella Senftenberg 2007.





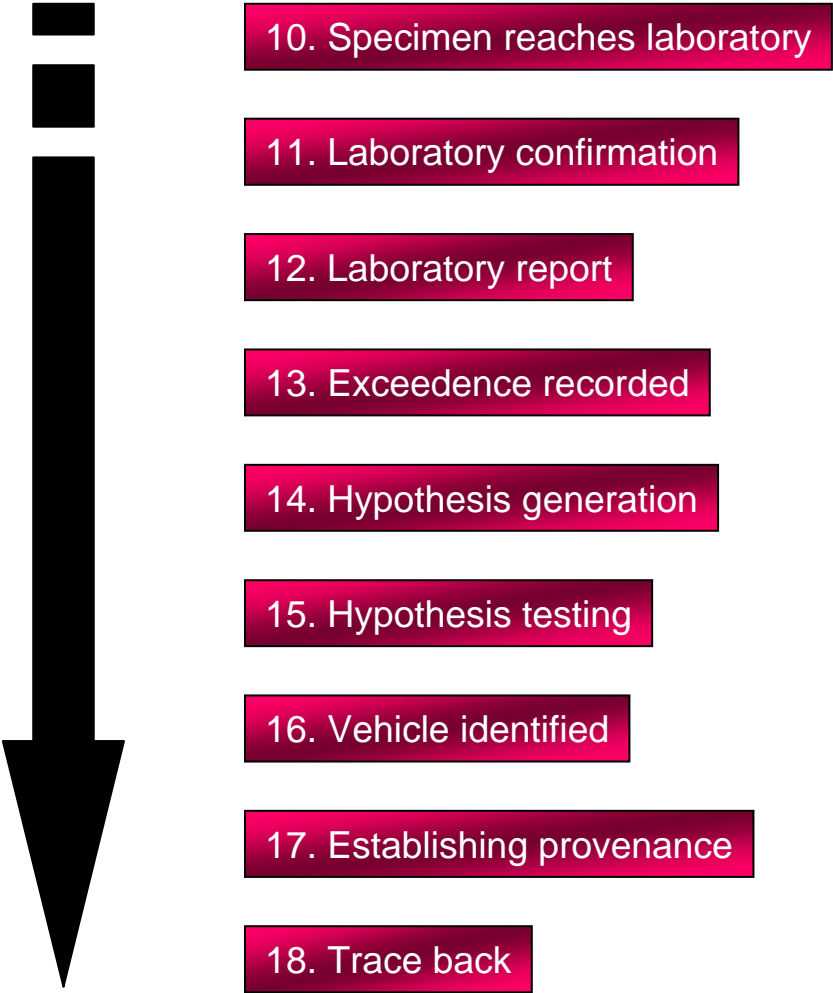
# Outbreaks linked to contamination during production or distribution.

Timeline.



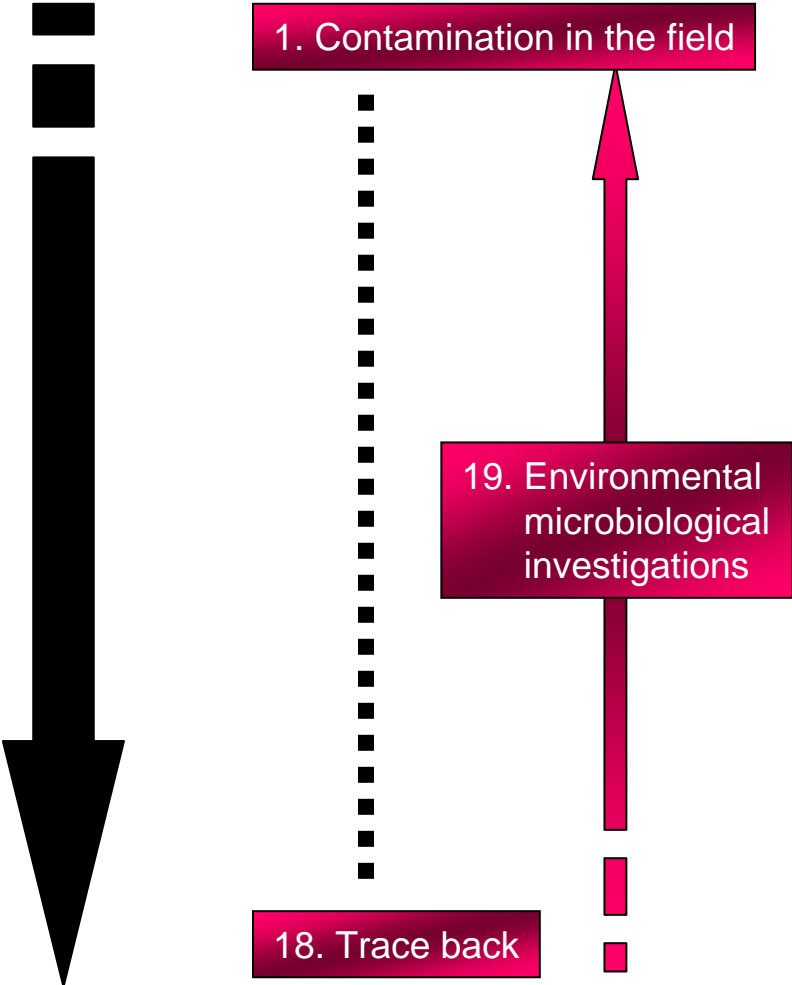
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# Outbreaks linked to contamination during production or distribution.

Timeline.



# Outbreaks linked to contamination during production or distribution.

## Discussion points:

- Surveillance data from the UK, Europe and North America demonstrate that there is a continuing risk to the population of enteric infections transmitted through ready-to-eat fruit and vegetables contaminated during production or distribution.

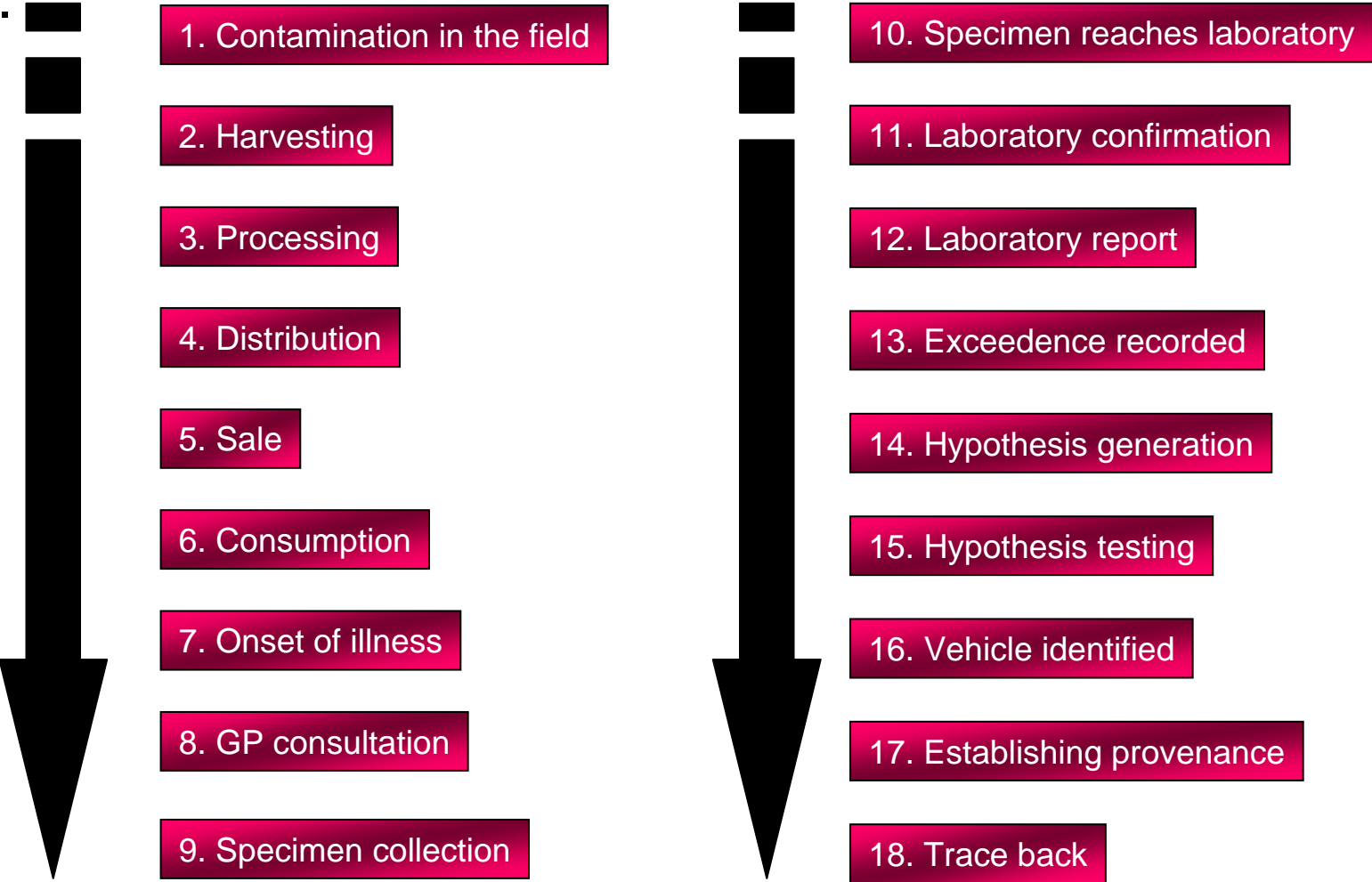
# Outbreaks linked to contamination during production or distribution.

## Discussion points – S. Senftenberg outbreak:

- Eight separate samples were positive for S. Senftenberg;
  - packaging had the required provenance information to enable trace back investigations;

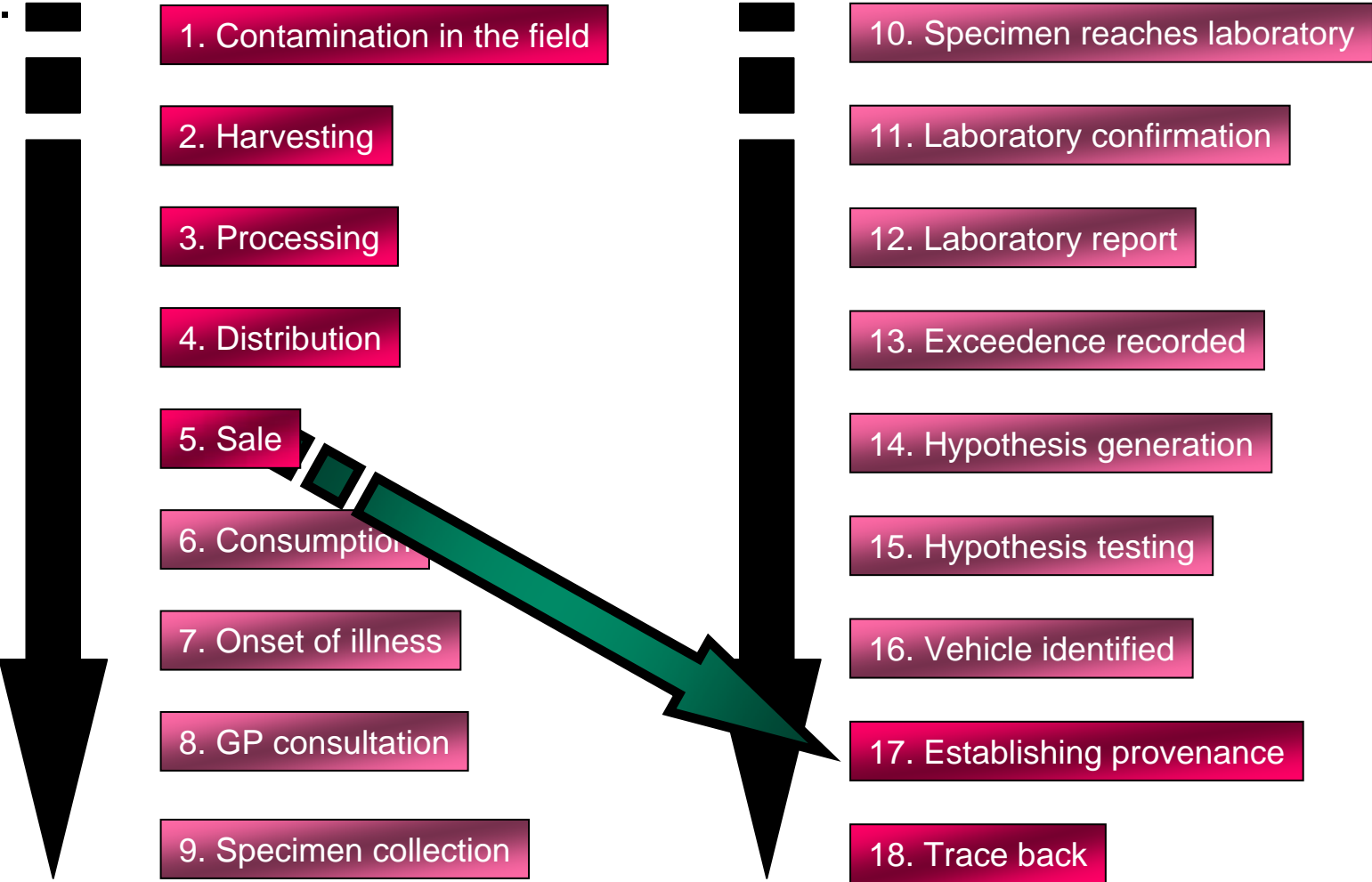
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# Outbreaks linked to contamination during production or distribution.

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# Outbreaks linked to contamination during production or distribution.

## Discussion points – S. Senftenberg outbreak:

- Eight separate samples were positive for S. Senftenberg;
  - packaging had the required provenance information to enable trace back investigations;
  - this cut out 11 steps in the process;
    - time saved – several weeks.



# Outbreaks linked to contamination during production or distribution.

## Discussion points – S. Senftenberg outbreak:

- regulatory authorities and companies collaborated to conduct environmental investigations;
- nothing found;
  - contamination might have been transient event affecting a single crop, we might have simply missed the boat;
  - few have the experience or expertise to establish a sampling regime which will find low level intermittent contamination in the field;
  - incentive;

# Outbreaks linked to contamination during production or distribution.

## Discussion points – *S. Senftenberg* outbreak:

- to find microbiological evidence at steps between the farm and the shop requires application, skill and fortune:
  - investigations need to be timely, well designed and properly conducted ;
    - sampling;
      - numbers and distribution of samples;
      - types of samples;
    - appropriate tests;
  - microbial distribution in the environment;
    - distribution is unlikely to be at high levels or widespread;
    - finding small foci of contamination is difficult;

# Outbreaks linked to contamination during production or distribution.

## Discussion points – S. Senftenberg outbreak:

- chronic problems;
  - S. Umbilo – lizards in the fields;
  - heavy contamination;
- **microbiologists in regulatory authorities and industry understood and acted on microbiological findings;**
  - there has been common acceptance that basil was contaminated with a pathogen that could cause illness in people eating it;

# Outbreaks linked to contamination during production or distribution.

## Discussion points – S. Senftenberg outbreak:

This outbreak shows that contaminated products can sometimes be sold to the public by responsible companies that assiduously implement thoroughly considered and well designed hazard analysis systems.

- Hazard analysis systems are valuable but not **infallible**;
- Absence of microbiological evidence of contamination in the field or along the distribution chain is not the same as **evidence of absence of contamination**;
- The same is true of quality records.

## Outbreaks linked to contamination during production or distribution.

### Discussion points – S. Senftenberg outbreak:

- it was fortuitous that the HPA/LACORS survey was being conducted while contaminated basil was being sold:
  - it was unlikely that contaminated produce would be sampled.
- the case interviews showed the difficulties that people have in remembering their consumption of “minor ingredients.”
  - consumption of other foods is recalled more readily.

# Outbreaks linked to contamination during production or distribution.

## Discussion points – *S. Senftenberg* outbreak:

- We need to consider carefully how we assess evidence and when we act on it. Acquiring microbiological evidence of this quality is only rarely available.
- Waiting for proof runs the risk that outbreaks will grow in size and fatalities will occur:
  - due weight needs to be given to epidemiological evidence;
- The recent outbreak of *S. Saintpaul* in the USA shows that not all ready-to-eat fruit and vegetable outbreaks are short in duration.

# Outbreaks linked to contamination during production or distribution.

## Discussion points.

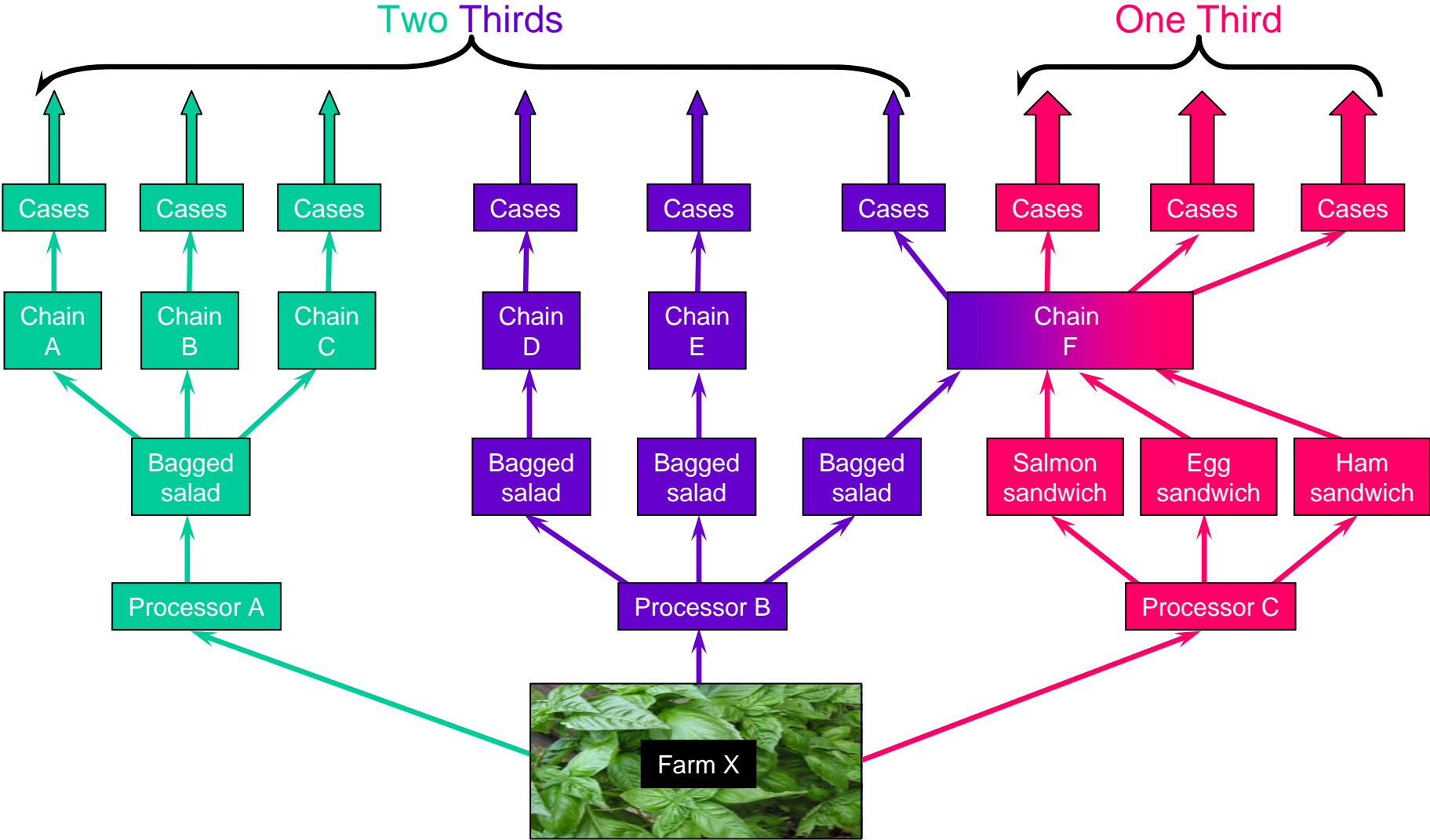
Contamination of ready-to-eat fruit and vegetables can result in outbreaks linked more complex and memorable foods.

| Year | Vehicle of infection      | Country of origin | Pathogen            | Cases |
|------|---------------------------|-------------------|---------------------|-------|
| 2003 | Egg & cress sandwiches    | Not known         | S. Bareilly         | 186   |
| 2006 | Sandwiches & bagged salad | Not known         | S. Ajiobo           | 119   |
| 2007 | Sandwiches                | Not known         | VTEC O157 PT8       | 12    |
| 2008 | Sandwiches                | Not known         | S. Typhimurium U320 | 140   |

# Outbreaks linked to contamination during production or distribution.

## Weaker signals

## Strong signals





# Outbreaks linked to contamination during production or distribution.

## Discussion points.

- When an outbreak is recognised the investigators have no knowledge of the vehicle of infection or its source:
  - there is seldom supporting evidence from other sources;
  - the initial leads can only come from analysing patients' food histories;
  - questions have to be framed in a way that people can respond reliably to;
  - people are more likely to remember eating prepacked salmon sandwiches than watercress or a particular type of lettuce;

# Outbreaks linked to contamination during production or distribution.

## Discussion points.

- sandwiches might not be the only vehicle of infection, just the most memorable one, when such outbreaks occur:
  - the finding that some cases did not eat sandwiches does not mean that sandwiches were not a vehicle of infection;
  - the information should still inform trace back investigations;

# Outbreaks linked to contamination during production or distribution.

Discussion points – VTEC O157 PT8 outbreak 2007.

- Good descriptive epidemiology was used to inform the implicated retailer at an early stage:
  - once the risks were understood, effective action was taken quickly;
  - cases were prevented;
  - supportive microbiological evidence was not obtained.

# Outbreaks linked to contamination during production or distribution.

## Discussion points.

- Controlling outbreaks requires close cooperation between:
  - public health specialists;
  - regulatory authorities;
  - industry.
- We need to work hard to improve the understanding of epidemiological methodology among specialists in:
  - regulatory authorities;
  - industry.

# Outbreaks linked to contamination during production or distribution.

## Discussion points.

- The sharing of information needs to be more comprehensive and timely:
  - These outbreaks will continue to occur;
    - the best systems cannot guarantee microbiological safety;
    - outbreaks in other countries have been large and extended in time;
    - *Salmonella enterica* and VTEC can kill;
  - Government agencies and industry need to work together to ensure effective collaboration and response to outbreaks.