

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.

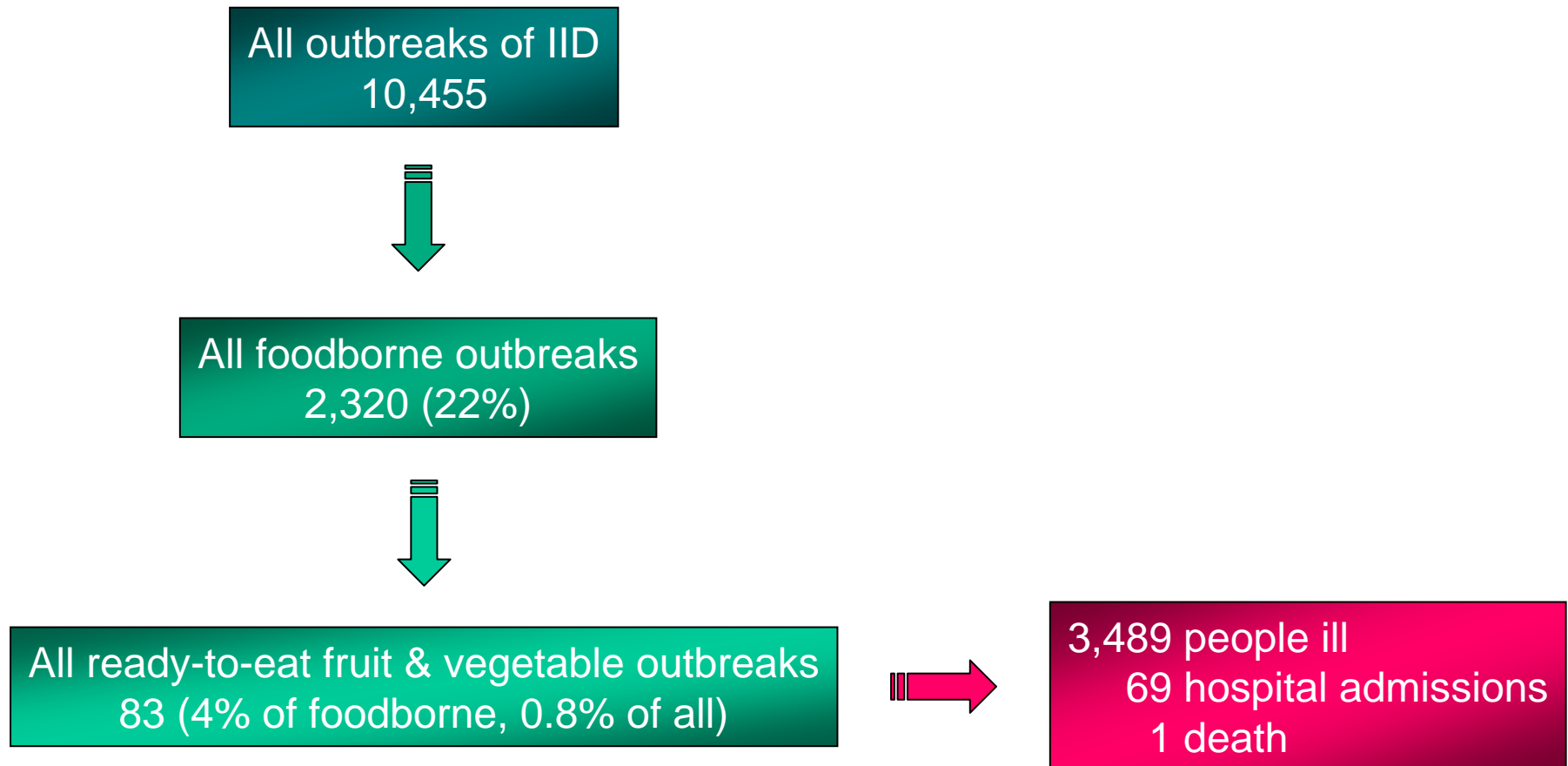
Little CL & Gillespie IA. J Appl Micro. 2008. Article published online 4 April 2008.

- 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.

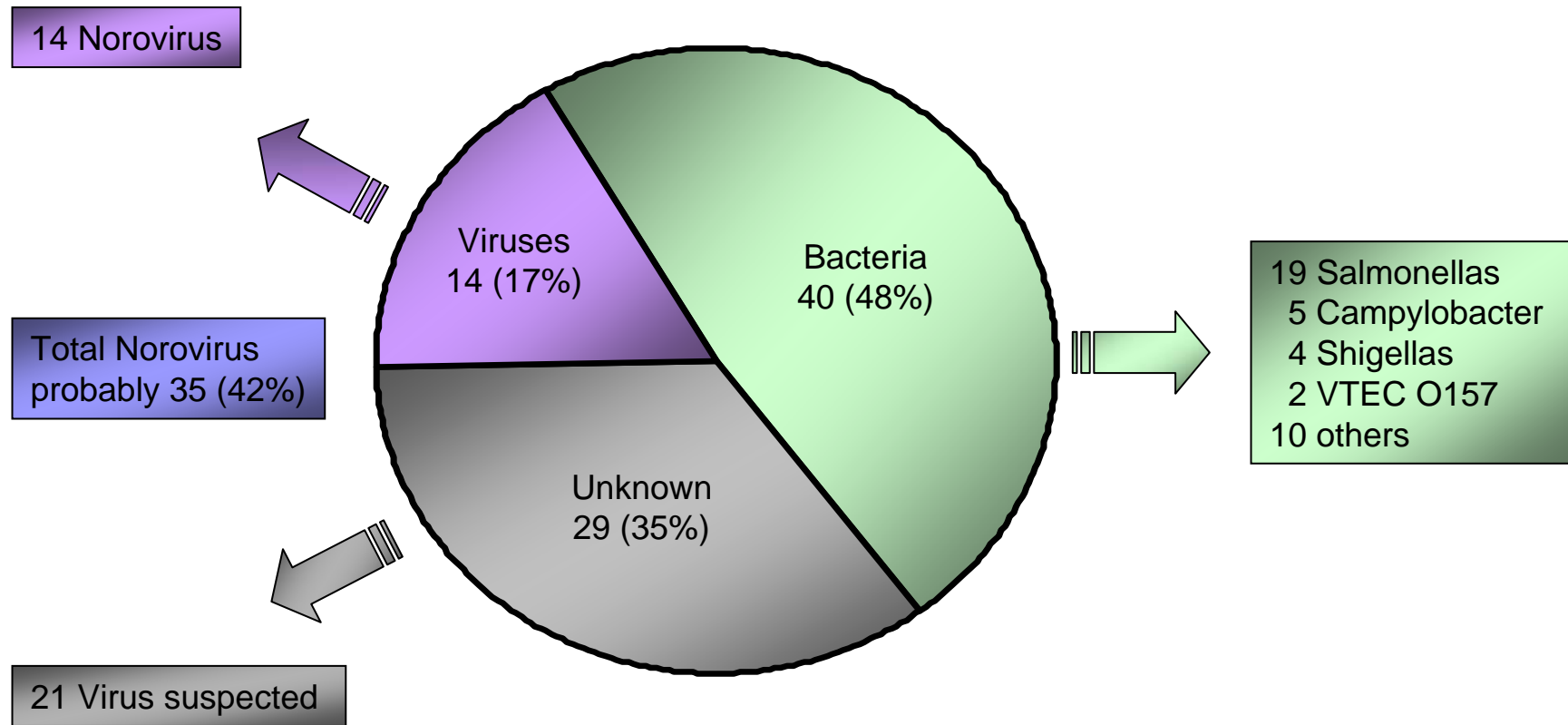
Ready-to-eat fruit and vegetables.

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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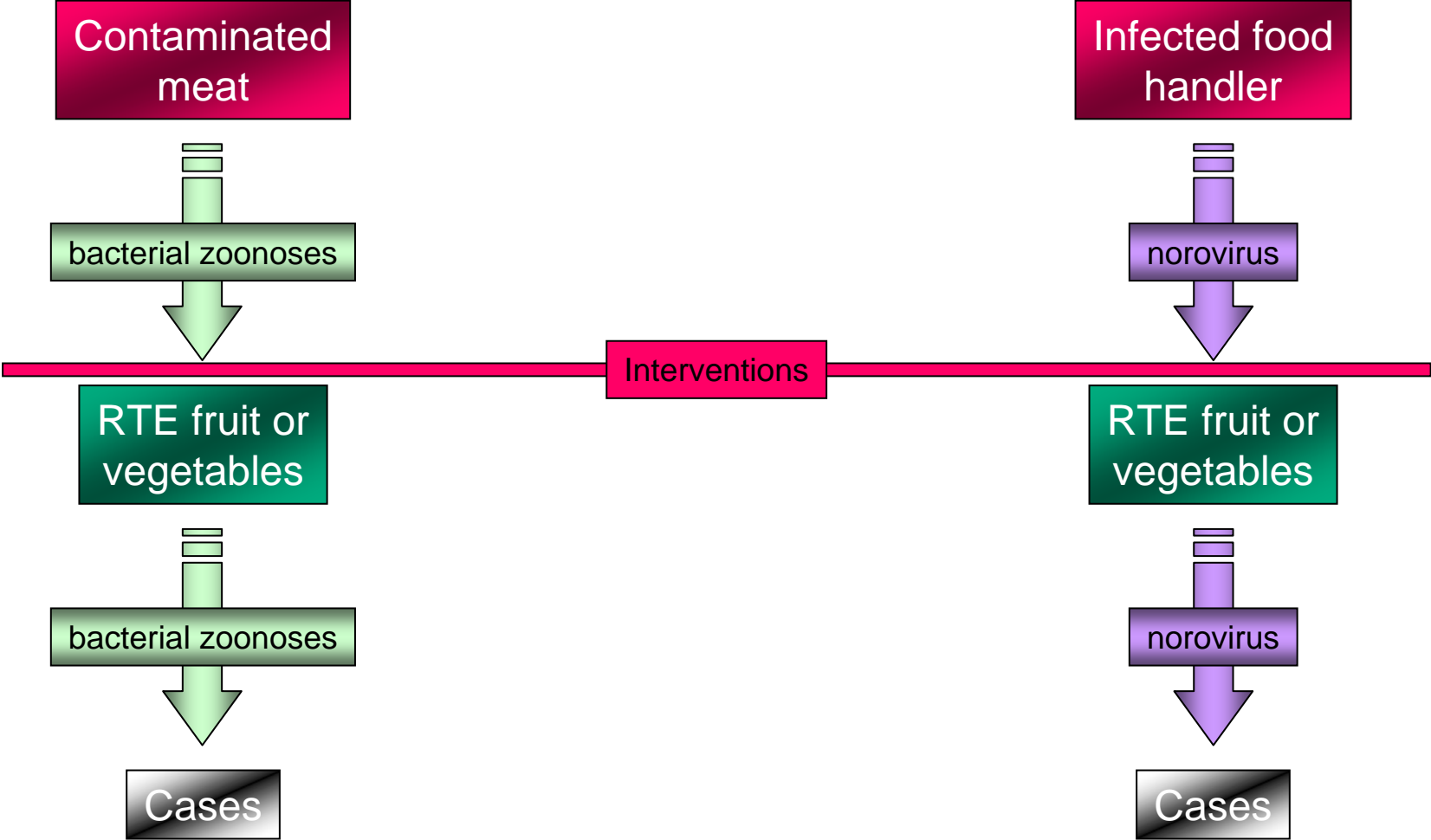
Ready-to-eat fruit and vegetables.

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 _L)	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.



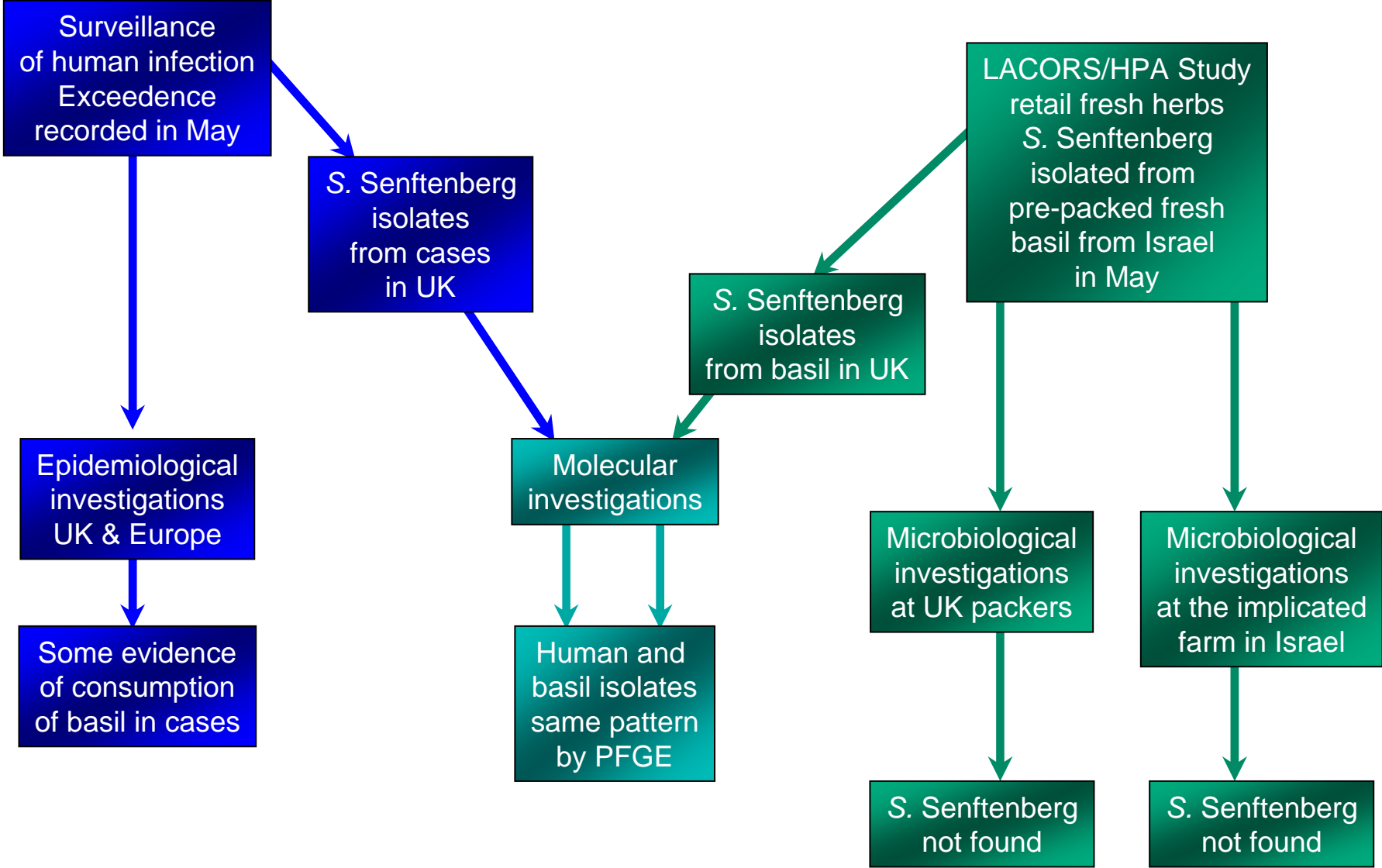
Food Microbiology:

- 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:

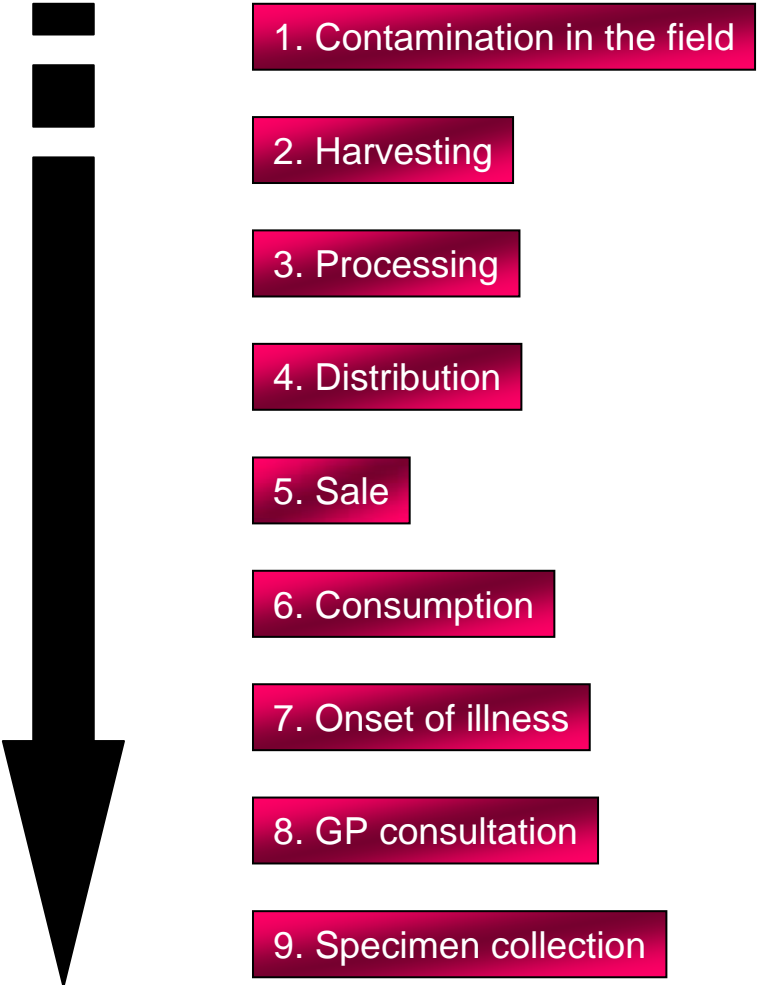
- Outbreak strain of *S. Senftenberg* has PFGE profile SSFTXB.0014;
- Molecular results for isolates from cases are indistinguishable from basil isolates.

Salmonella Senftenberg 2007.



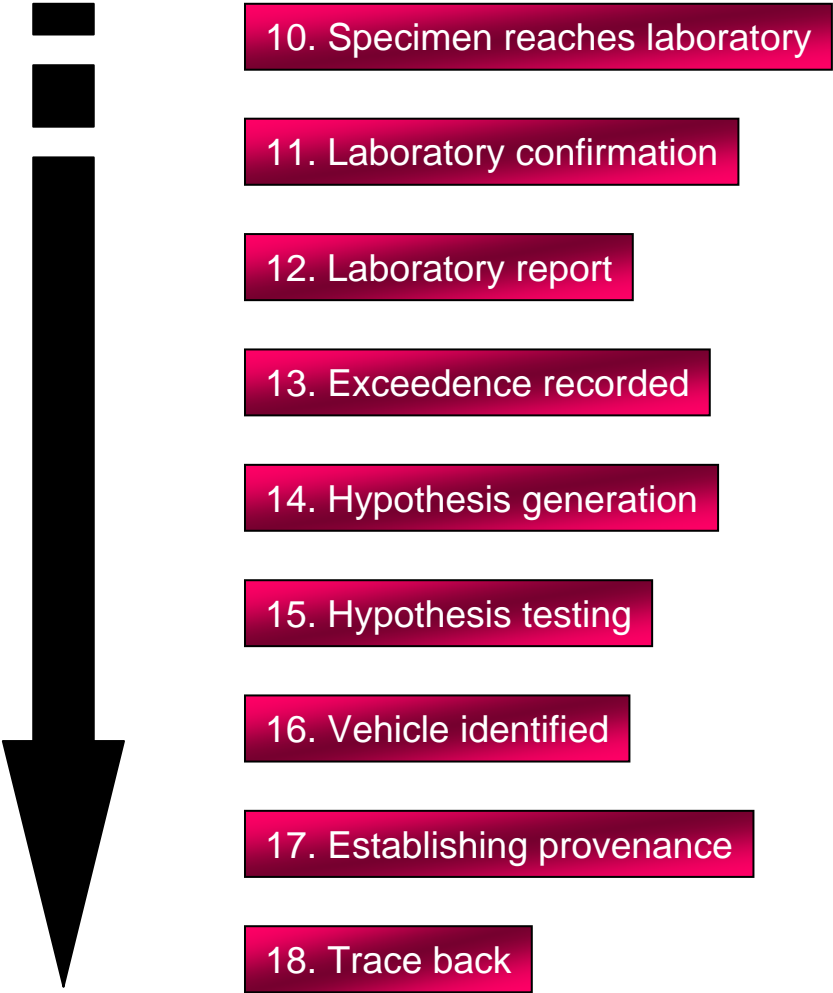
Outbreaks linked to contamination during production or distribution.

Timeline.



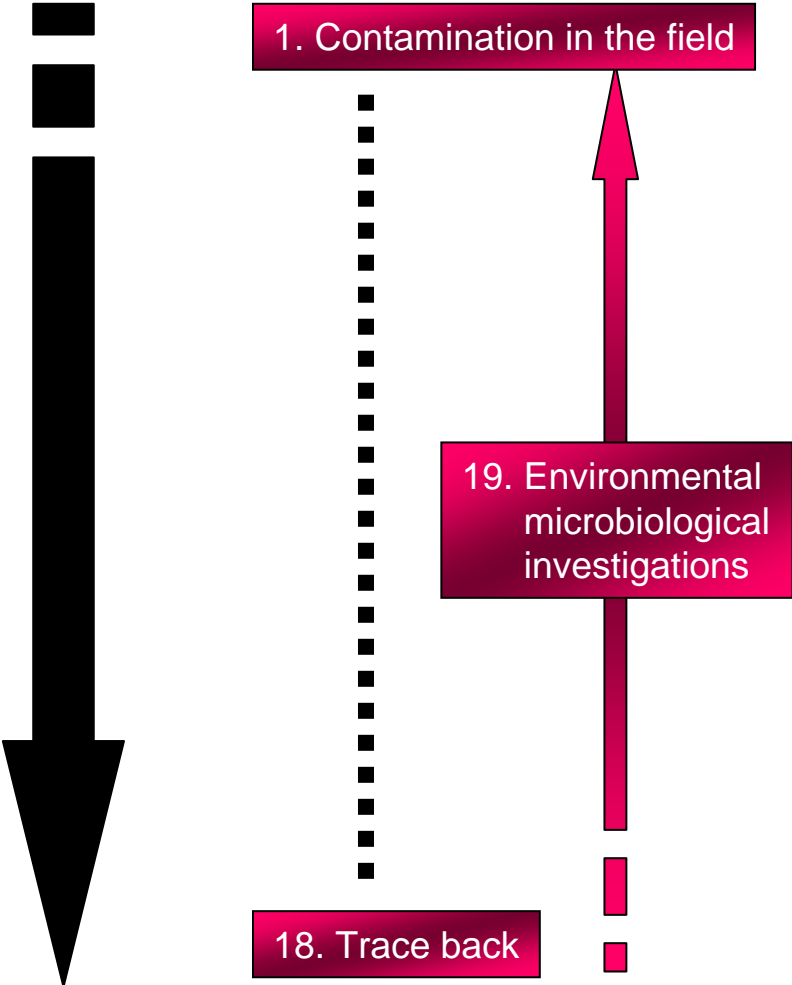
Outbreaks linked to contamination during production or distribution.

Timeline.



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.

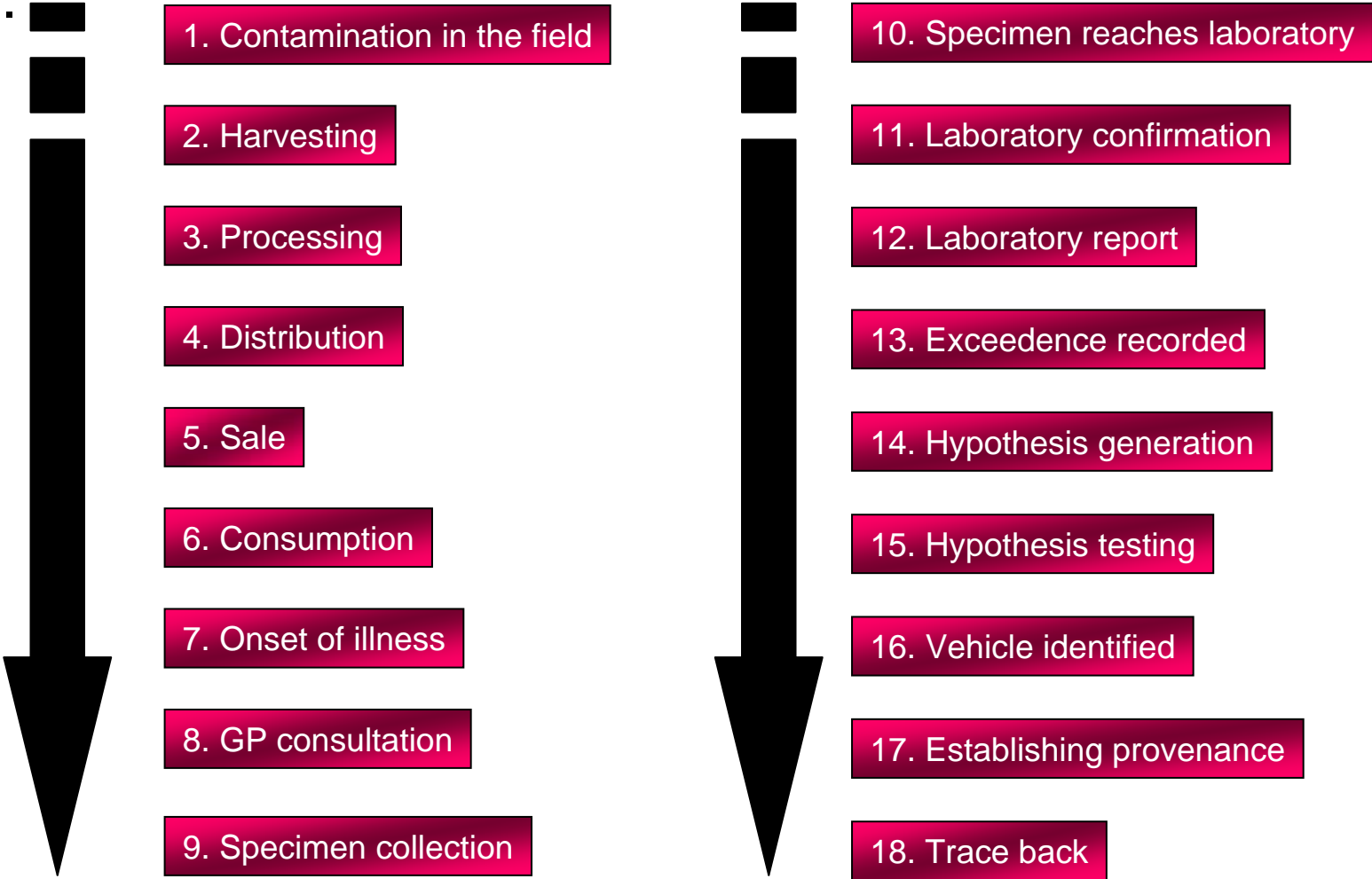
Outbreaks linked to contamination during production or distribution.

Discussion points – S. Senftenberg outbreak:

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

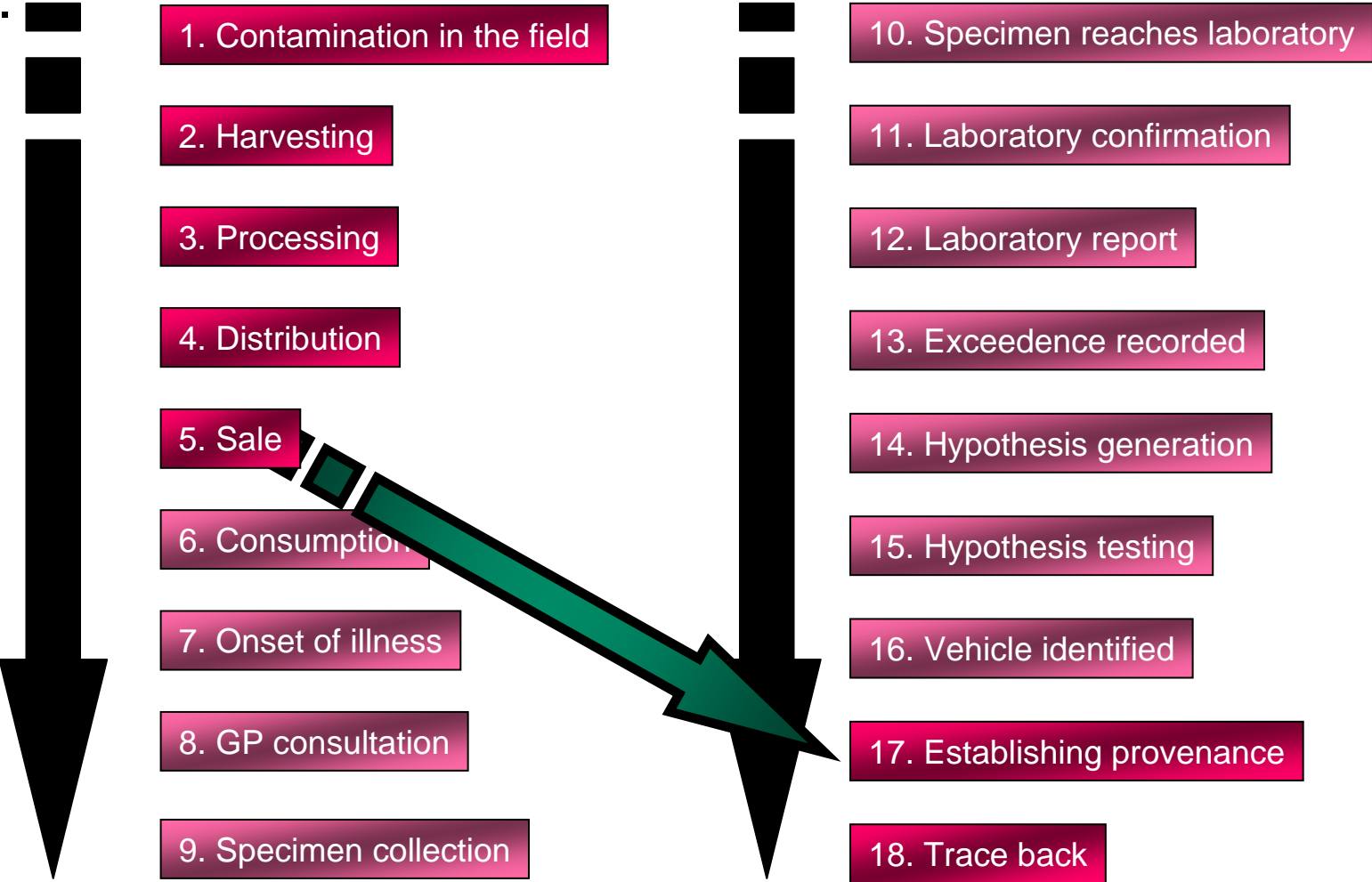
Outbreaks linked to contamination during production or distribution.

Timeline.



Outbreaks linked to contamination during production or distribution.

Timeline.



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

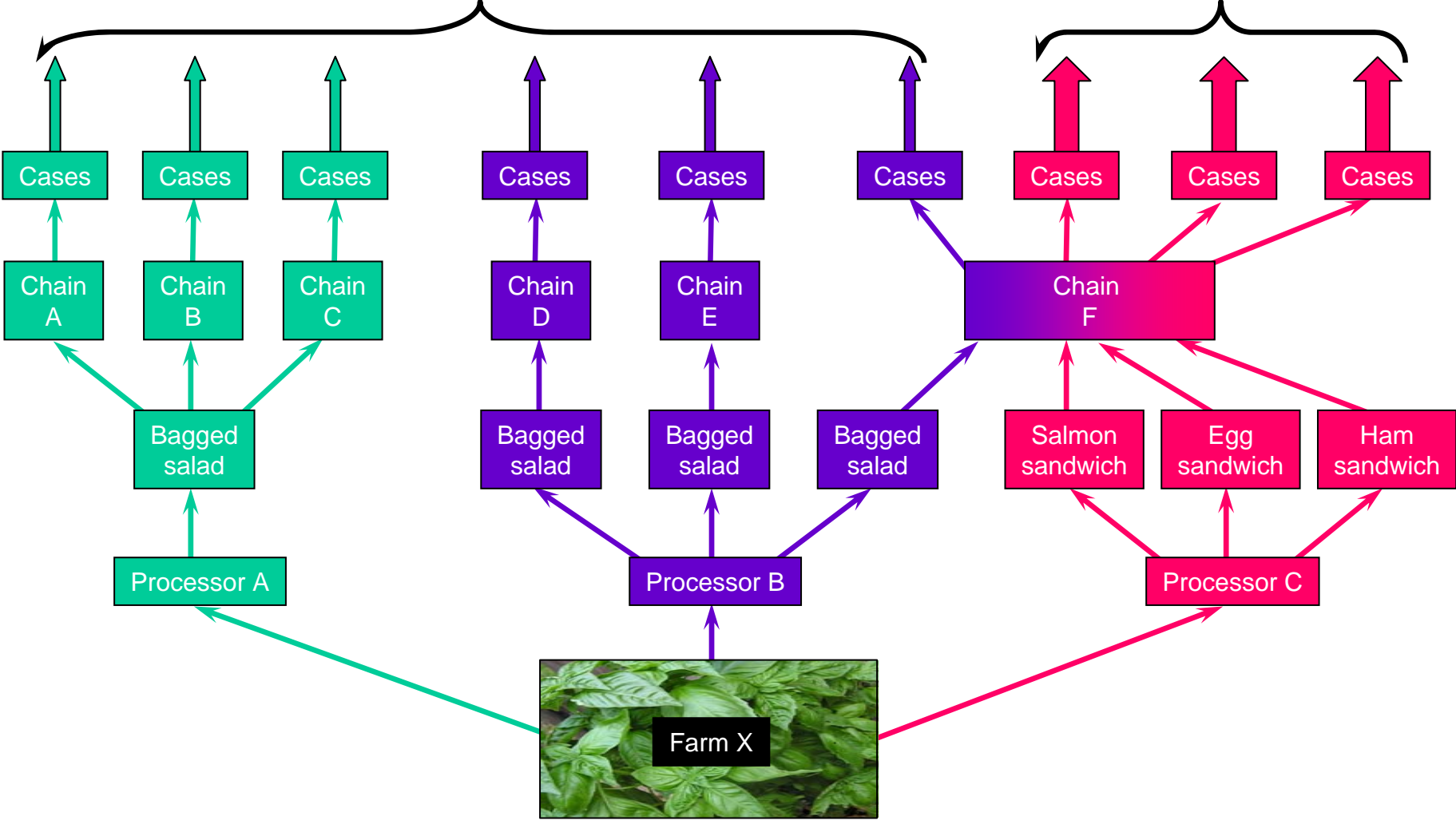
Outbreaks linked to contamination during production or distribution.

Weaker signals

Strong signals

Two Thirds

One Third



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.