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Lessons Learned from the Canadian Listeriosis Outbreak

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BMH BDM
Bureau des dangers microbiens

Objectives

- ✓ Review the microbiology of *Listeria* and listeriosis
- ✓ Discuss control of listeria in the environment
- ✓ Review lessons learned and future challenges
- ✓ Discuss recent large Canadian outbreak

Hosted by Paul Webber
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Federal food safety responsibilities are shared

Production — *Processing/Distribution/Retail/Food Service* — *Consumers*

On-farm Food Safety Programs | Policy and Standards | **Surveillance/ Early Warning** | Education and Outreach | Inspection and Enforcement | Public Health Surveillance

HC
AAFC
CFIA
PHAC

Primary Responsibilities

AAFC	HC	CFIA	PHAC
•Contributes to research and development of on-farm food safety programs	•Establishes food safety policy and standards •Conducts health risk assessments •Informs Canadians about potential risk to their health •Safety of veterinary drugs and pesticides	•Design and delivery of federal food inspection programs •Monitors industry's compliance with Acts and regulations •Undertakes enforcement action as necessary	•Public health surveillance •Leads foodborne illness outbreak investigations with P/T public health officials

Why listeriosis remains an issue?

Widespread in environment, hardy

Psychrotrophic

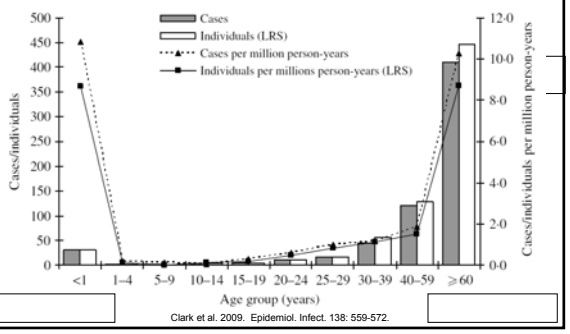
High case-fatality rate

Background: Listeriosis

- **Listeriosis is a rare, but severe foodborne illness**
  - **Cases per million*** of listeriosis each year
  - 2.2 hospitalizations per million population
  - Case-fatality rate is high
- **High-risk populations include**:
  - Pregnant woman/fetuses/neonates
  - Elderly persons
  - Immunocompromised individuals
- **Many foods associated with illness**

Age distribution and rates of infection:

Years 1995-2003



Clark et al. 2009. Epidemiol. Infect. 138: 559-572.

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Canadian Outbreaks of Listeriosis

- **Cabbage (1981)**
  - Coleslaw was vehicle, but contaminated with manure: serotype **4b**
- **Imitation crab meat (2000):** serotype **1/2b**
- **Whipping cream (2001)** - flat whipping cream positive for Lm- serotype **1/2a**
- **Cheese-ripening solution (2002)**
  - Lm - serotype **4b** isolated from reconstituted *Penicillium / Brevibacteria* ripening solution
- **Cheese (2002)**
  - Filter and UV-treated well-water suspected source of Lm serotype **4b**
- **Heat-treated & firm cheese (2002):** serotype **1/2a**
- **Cheese outbreak (2008):** serotype **1/2a**
- **Deli-meat (2008):** serotype **1/2a**

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Economic impact of listeriosis

- ✓ Thorn Apple Valley (Jan, 1999) – 35 million pounds of ready-to-eat deli meat
- ✓ Bil Mar Foods (Feb, 1999) – 33.1 million pounds of hot dogs
- ✓ Wampler (Oct, 2002) – 27.4 million pounds of ready-to-eat turkey and chicken
- ✓ Maple Leaf (2008) – 1.38 million Kg from Eastern Canada; 390,000 kg from Western Canada

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Listeriosis Surveillance

- **1990-1999** - Listeriosis (all types) national notifiable disease (NND)
- **2000** - Listeriosis removed from NND
- **2001 -** ***Listeriosis Reference Service created***
- Listeriosis remained reportable in all P/T, except QC (added in 2004)
- **2006** - Invasive listeriosis added to NND
- **2009 -** Listeriosis officially reinstated as a nationally notifiable diseases
- **2010** *Listeria monocytogenes* added to NESP organism list

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Challenges of Listeriosis: Implications on Surveillance

- **Majority of cases are sporadic**
  - further complicated when geographically dispersed
  - definite link to outbreak not always possible
  - what is true rate of unreported illness due to non-invasive strains?
- **Long incubation period**
  - can be up to 70 days
  - traceback and/or source attribution difficult or impossible to do
- **Listeriosis**
  - mainly high-risk populations
  - elderly may be predisposed (versus younger population)
  - food behaviours and consumption patterns not well known in higher risk groups

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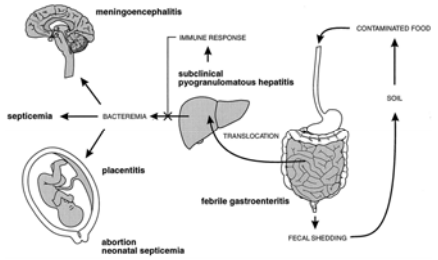
Why listeriosis remains an issue?



Vazquez-Boland, J. A. et al. 2001. Clin. Microbiol. Rev. 14(3):584-640

Clinical Microbiology Reviews

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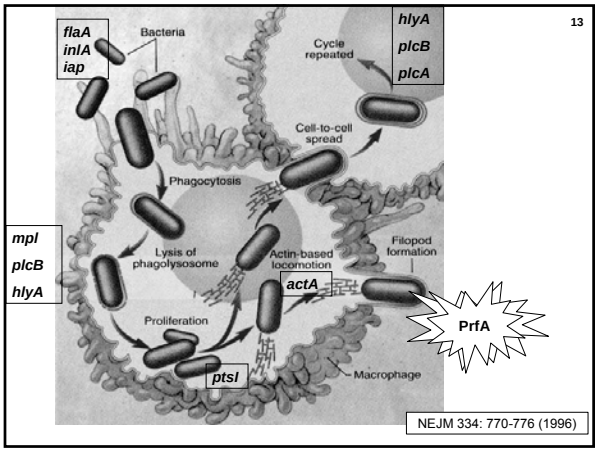

NEJM 334: 770-776 (1996)

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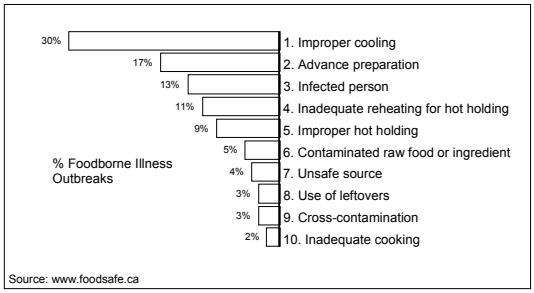
Top Ten Improper Food Handling Practices = foodservice establishment outbreaks!!!



Source: www.foodsafe.ca

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Top 10 Factors Contributing to US Foodborne Illness 1998-2002

Food at room temperatures for several hours – 29%
Hand (i.e., no glove) contact by food handler – 25%
Inadequate cleaning of equipment – 22%
Handling by infected person or carrier – 20%
Inadequate cold-holding temperature – 19%
Cross contamination from raw animal products – 12%
Insufficient cooking – 12%
Raw ingredients contaminated by animal or environment – 11%
Slow cooling – 11%
Inadequate holding time or wrong temperature – 10%

Source: CDC 2006 MMWR 55:1-34

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Consumer Exposure to *Listeria* during Food Consumption

- Amounts and frequency of consumption of a food
- Frequency and levels of *L. monocytogenes* in ready-to-eat food
- Potential to support growth of *L. monocytogenes* in food during refrigerated storage
- Refrigerated storage temperature
- Duration of refrigerated storage before consumption
- All related directly or indirectly to the immune status of the individual

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How does *Listeria* get into Foods?

- The environment (1.3-7.3%)
- Ruminant farms (5.9-33%)
- Raw foods
- Food processing environments (<0.1 to > 30%)
- Ready-to-eat foods (0.17-4.7%)

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Barriers and Challenges to the Control of *Listeria*

- The microorganism is commonly found in the environment, including food processing, distribution, retail environments, and in the home
- Because *L. monocytogenes* is everywhere it can easily enter processing plants via raw foods, humans, equipment, vehicles, shoes, etc.
- ***Once inside a processing plant, L. monocytogenes can establish itself and persist for long periods of time***
- It can grow in many foods during refrigerated storage

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Examples of persistence in food operations

Food	Time	Country
Cheese	4 years	Switzerland
Cheese, blue veined	7 years	Sweden
Ice cream	7 years	Finland
Smoked mussels	3 years	New Zealand
Cold smoked salmon	4 years	Denmark
Pâté	2 years	UK
Jellied pork tongue & rillettes	8 years	France
Cooked poultry	1 year	Ireland
Cooked poultry	12 years	USA

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Investigations have revealed…

- ✓ More than one strain of *Listeria monocytogenes* can exist in a food processing environment…family sticks together!
- ✓ Certain strains persist for months or years…they don't want to leave!
- ✓ Not always obvious how they arrive either…dust (construction, etc.), manure, …even good ol' butter…

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Testing for *Listeria*: W5…

Contact versus non-contact surfaces…

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Where is the greatest risk?

- ✓ Environmental, equipment or people…the greatest risk is after the lethality step (i.e., just before and during packaging)

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Non-food contact surfaces include…

- ✓ Drains and aerosols
- ✓ Standing water
- ✓ Cracks in floors and walls
- ✓ Smokehouses
- ✓ Floors in heavily-trafficked areas
- ✓ Tires on fork-lift trucks
- ✓ Food and wheel baths that are not in "good shape"
- ✓ High-pressure hoses
- ✓ Cleaning tools (mops, squeegees, brushes, etc.)
- ✓ Trash cans

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Non-food contact surfaces include…

- ✓ Under-side of conveyor belts
- ✓ Hollow rollers
- ✓ Roller guards, bearings, etc.
- ✓ Chill tanks
- ✓ Refrigerators, cold rooms
- ✓ Ice makers
- ✓ Overhead pipes
- ✓ Drip pans
- ✓ Wet insulation
- ✓ Maintenance tools, dust from construction, air filtration

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Food contact surfaces include…

- ✓ Chill brines
- ✓ Containers
- ✓ Racks for transportation
- ✓ Conveyor belts
- ✓ ***Slicers, dicers, shredders, blenders, etc.***
- ✓ Table and equipment used to assemble/package product
- ✓ Packaging equipment
- ✓ Hand tools, gloves, aprons, etc.
- ✓ Metal surfaces with gaps (bad welding, etc.)
- ✓ Food residue sites and other hard to clean areas

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When to sample?

- ✓ Before the start of food production
- ✓ During production of food commodities
- ✓ At end of production line (end-product testing)

…always keep in mind…

…if *Listeria* is there….we'll find it!

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Things to think about…

- ✓ Environmental sampling is more sensitive for assessing control than end-product testing
- ✓ Testing finished product offers no clue as to how contamination occurred…but it does tell you that you have a problem…
- ✓ Environmental sampling provides useful information needed to help avoid end-product contamination
- ✓ Testing for *Listeria* species can be more conservative (i.e., not looking for pathogen), but may lead to greater assurance of controlling *L. monocytogenes* (i.e., academia vs. industry?)

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Testing: the Who of W5?

- ✓ Knowledge of aseptic technique, microbiology and issues therein…do not just "go through the motions"…
- ✓ Experience in environmental sampling very important
- ✓ Experience and familiarity with plant equipment
- ✓ Familiarity with production and flow inside plant environment

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Testing: the what of W5?

- ✓ Indicator organisms (i.e., *Listeria*-like)
- ✓ Indicators like *Listeria* species
- ✓ The pathogen itself (*Listeria monocytogenes*)

Considerations:

i- indicators may be better and safer
ii- indicators occur more frequently than the pathogen
iii- faster turnaround times for indicator tests versus pathogen-specific assays

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Test and/or monitor for *Listeria*?

- ✓ Regulations…always good to comply
- ✓ Recalls can ruin business…bad press lingers
- ✓ Consumer demands
- ✓ **Warning system in place to reduce (and avoid) problems**
- ✓ **Helps to verify HACCP and SOPs for plant production**

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Usefulness of end-product testing?

…aka…addressing the WHY?

- ✓ You found *Listeria* on a contact (or non-contact) surface
- ✓ Compliance with regulations
- ✓ Verification of monitoring program(s)

Remember…

- *Listeria* is NOT uniformly spread
- Lot should be held until negative result for representative sample being tested
- Do you have a corrective action plan should product be *Listeria* positive?

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What we knew by 1992…

- ✓ Some plant layouts were unacceptable…
  - ✓ Including problems associated with older plants
- ✓ *Listeria* will continue to enter plant environments
- ✓ *Listeria* on floors increases risk of positive packaging lines
- ✓ Importance of harborage sites in equipment
- ✓ Air, people, packaging materials, etc. are rarely sources of *L. monocytogenes*
- ✓ Contamination is typically limited to one line

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What we knew by 1992…

- ✓ Rinsing equipment during production is detrimental to *Listeria* control
- ✓ It is much easier to maintain control than to regain control
- ✓ Must continually strive for zero positive!
- ✓ *Listeria* CAN be controlled in RTE operations

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Q: Do you have a transient or resident problem?

Transient

- removed by cleaning and sanitizing
- limited amount of food is exposed

Resident

- become established in one or more sites, multiply and persist over time (e.g., months, years)
- numerous lots of food can be exposed

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Two conditions can lead to contamination of multiple lots of food by resident strains

Biofilm production

Harborage sites or niches

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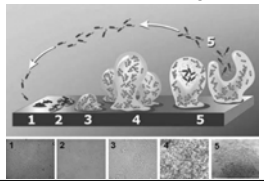
Biofilms…what a mess!

- ✓ Microorganisms are embedded in a matrix of organic polymers produced by the cells…perfect protection…
- ✓ Biofilms provide favorable conditions for growth and survival (e.g., resistance to disinfectants)



Images from http://www.primary-plus.com/10-healthy-topics-for-2010/; http://www.textbookofbacteriology.net/normalflora_2.html

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Biofilms…what a mess!

- ✓ Biofilms and niches are of greatest concern when located after a kill step (e.g., cooking)
- ✓ The processing environment typically appears clean and acceptable
- ✓ Microbial sampling is necessary to detect a biofilm or niche
- ✓ Lm can attach and form biofilms on a variety of surfaces (stainless steel, polymers, rubber gaskets)

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Examples of niches

- ✓ Inside hollow rollers for conveyors
- ✓ Hydraulic oils and bearing greases
- ✓ Inside hollow supports for equipment
- ✓ Between two layers of material

Non-foodgrade lubricants reduced the amount of *L. monocytogenes* better ($p<0.05$) than food-grade lubricants, but use of food-grade lubricants is required in food contact areas.

VTT Technical Research Centre of Finland (2007).

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How to sample?

- ✓ ***Swabs***
- ✓ ***Sponges***
- ✓ Mop strings
- ✓ Sweepings from floor
- ✓ Product fines
- ✓ Residue on filters
- ✓ Anything appropriate to the situation

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Zone 1
Product contact surfaces:

Conveyors, tables, racks, vats, tanks, utensils, filling and packaging machines

Zone 2
Non-product contact surfaces in close proximity to product:

Exterior of equipment, refrigeration units, floors

Zone 3
Telephones, forklifts, walls, drains

Zone 4
Locker rooms, cafeteria, hallways

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Two different approaches to monitoring production facility

Sampling product as it is processed

versus

Sampling the environment

Time from final processed food to cleaning to sampling?

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Can we get some control here?

Strategies for control

1. Eliminate biofilms and niches that can lead to unacceptable microbial contamination.
2. Use a sampling program that can assess in a timely manner whether the environment is under control.

   Goal: to detect a problem, if one exists

Strategies for control

- ✓ Prevention of establishment and growth in niches that can lead to RTE contamination
- ✓ Implementation of sampling plan
- ✓ Rapid and effective response to positives
- ✓ *Verification (follow-up) plan*
- ✓ *Problem and trends (short-term assessment)*
- ✓ *Long term assessment*

Practical highlights for *Listeria* control:

Research versus real-life…

Parameter	Minimum	Maximum	Optimal	Can survive (but not grow)
Temperature (ºC)	-1.5 to +3	45	30 to 37	-18
pH	4.2 to 4.3	9.4 to 9.5	7.0	3.3 to 4.2
Water activity	0.90 to 0.93	>0.99	0.97	<0.90
Salt (%)	<0.5	12 to 16	N/A	≥20

pH 5 to 5.5 and water activity <0.95

pH <5 and any water activity

water activity ≤0.92 at any pH

Commodity dependent!

Letters in Applied Microbiology 1992, **15**, 197–201

The effect of acid shock on the heat resistance of *Listeria monocytogenes*

J.M. FARBER & F. PAGOTTO* *Microbiology Research Division, Bureau of Microbial Hazards, Food Directorate, Health and Welfare Canada, Ottawa, Ontario, K1A OL2 and *Biology Department, University of Ottawa, Ottawa, Ontario, K1N 6N5, Canada*

FS/162: received 7 May 1992 and accepted 17 June 1992

FARBER, J.M. & PAGOTTO, F. 1992. The effect of acid shock on the heat resistance of *Listeria monocytogenes*. *Letters in Applied Microbiology* **15**, 197–201.

The effect of acid shock on the heat resistance of *Listeria monocytogenes* was investigated. After growth for 24 h at 30°C in tryptic soy broth containing 0·6% yeast extract, cell culture suspensions of *L. monocytogenes* were acidified with HCl or acetic acid over various time periods before being heated in whole milk to a temperature of 58°C. When cells were acid-shocked immediately with HCl for 1, 2 or 4 h, those acid-shocked for 1 h demonstrated the largest increase in thermotolerance as compared to control cells, when heated at 58°C in whole milk. In fact, cells acid-shocked for longer than 1 h with HCl demonstrated in some instances a

What is Lm control anyways?

- ✓ Having in place proper steps/procedures to destroy Lm (pasteurization/cooking) – listeriocidal is preferred ☺
- ✓ Being able to identify sources of contamination – being the detective, always assume everything is contaminated ☺
- ✓ Having in place a procedure to eliminate and/or reduce contamination sources – ideally want pre-processing and post-processing control since Lm is a smart bug and will find a way to get in and stay in ☺

☺ Franco's Thoughts ☺

Cleaning

- ❖ High pressure hoses for drains?
- ❖ Compressed air for equipment?
- ❖ Wet mid-shift cleaning?
- ❖ Stacking?

Cleaning tools

- ❖ Mixing'n'matching tools?
- ❖ Daily sanitization of tools?
- ❖ Storage
- ❖ ***"re-usable" cloths/sponges?***

…I found Listeria…now what?

- ❖ Rotation of sanitizers?
- ❖ Sanitizer biology (contact time, [], Tº, etc.)
- ❖ Listeria "hot spot"? What is the "norm"?

☺ Franco's Thoughts ☺

Letters in Applied Microbiology 1995, **20**, 195–198

The inhibitory properties of various sponges on *Listeria* spp.

E.F. Daley, F. Pagotto and J.M. Farber
Microbiology Research Division, Health Canada, Banting Research Centre, Ottawa, Canada

FS/228: received 20 June 1994 and accepted 21 October 1994

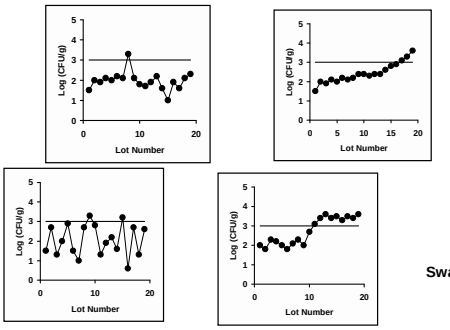
E.F. DALEY, F. PAGOTTO AND J.M. FARBER. 1995. Various retail and environmental sponges were tested for inhibitory properties against *Listeria* species and several other bacterial genera. Sterile sponges, unrinsed and rinsed in sterile distilled water or sterile neutralizing buffer, were placed on seeded plates of tryptic soy agar with 0·6% yeast extract. Plates were incubated at 30°C for 24 h and zones of inhibition measured.

The Systems Plus environmental sponge and the Technical Service Consultants Ltd sponge (sTc)© proved to be the only sponges which consistently demonstrated no inhibitory

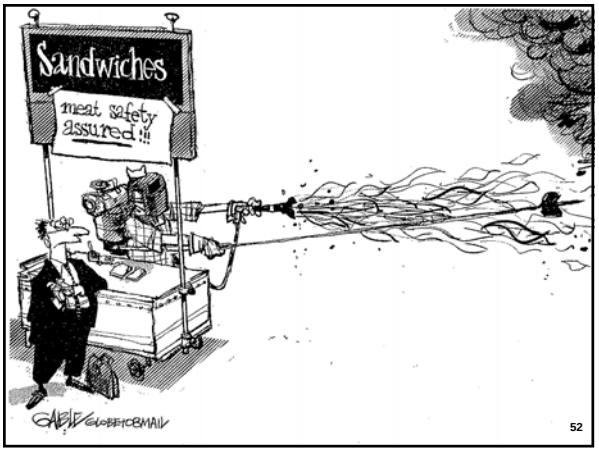
Reducing the Risk of Listeriosis

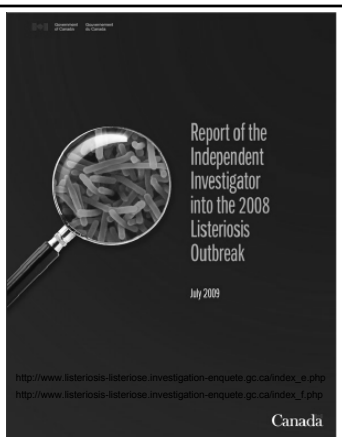
- Avoiding cross-contamination (sanitation)
- Incorporating ingredients that inhibit the growth of *Listeria* (e.g., lactate and diacetate)
- Processes that inhibits growth during shelf life, e.g., low moisture, high acidity, freezing
- Ingredients that can inactivate listeriae (e.g., nisin, growth inhibitor packaging, dipping products)
- Processes that can inactivate listeriae (e.g., cooking, steam heat or hot water)

Trend Analysis: Helping Process Control



Swanson, 2009





Changes to HC's *Listeria* Policy - Managing Risks

HC is currently reviewing its policy on "*Listeria monocytogenes* in Ready-to-Eat (RTE) Foods":

- Applies to all high-risk RTE foods (i.e., dairy, produce, fish and seafood, meats); in both federally-registered and non-registered sectors

Specific policy changes include:

- Updated operational and sampling guidelines to enhance the ability to detect *L. monocytogenes*
- Potential for new end-product compliance criteria consistent with Codex

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Proposed HC Criteria

New end-product compliance criteria have been developed to be in-line with the International Codex Alimentarius standards:

Categories	Action level for Lm	Nature of concern	Level of priority
1) RTE foods in which growth of Lm can occur until the end of shelf life	Detected in 125 g (5 x 25g)	Health Risk 1	**High**
2A) RTE foods in which a limited potential for growth of Lm to levels not greater than 100 CFU/g can occur until the end of shelf life	>100 CFU/g	Health Risk 2	**Medium -Low**
2B) RTE foods in which growth of LM cannot occur until the end of shelf life			**Low**

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Wide variety of food matrices lead to different challenges

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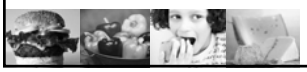
Summer 2008 Canadian listeriosis outbreak



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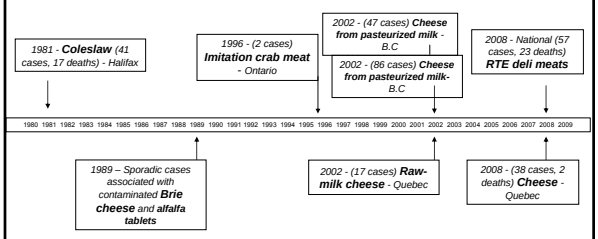
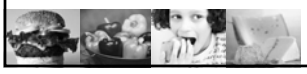
Foodborne *Listeriosis* Outbreaks in Canada





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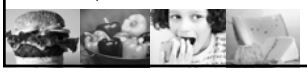
Common *Listeria* Serotypes in Canada

Serotype	Blood (%)	CSF and brain tissue (%)	Specimens associated with pregnancy and miscarriage (%)	Stools (%)	Total by serotype (%)
1/2a	253 (45.8)	45 (52.3)	1 (12.5)	6 (21.4)	48
1/2b	82 (14.9)	11 (12.8)	0	0	15
1/2c	5 (0.9)	1 (1.2)	1 (12.5)	0	1
4b	160 (30.0)	22 (25.6)	6 (75)	22 (78.6)	32
Others	52 (9)	7 (8.1)	0	0	4
Total	552	86	8	28	-

Clark et al., 2009



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Canadian Listeriosis Outbreak

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In 2008, a national outbreak of foodborne listeriosis resulted in 57 confirmed cases in 7 provinces, with a total of 23 deaths

2008 Listeriosis Outbreak - Key Facts

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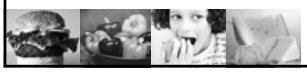
- The 2008 listeriosis outbreak was identified following three weeks of higher than expected case reports of listeriosis in Ontario
- On August 6, 2008, the Toronto Public Health Unit informed CFIA of two listeriosis cases at a Toronto nursing home
- Following a food safety investigation led by CFIA, the source of the *Listeria* was linked to Establishment 97B (Maple Leaf Foods Canada) RTE meat products
- Eventually seven provinces were implicated in the outbreak



Case Exposures to RTE Meat Products

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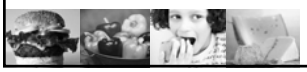
Number of confirmed cases of listeriosis with likely exposure to Maple Leaf Food deli meat products during their exposure period			
	No. of confirmed cases		
	Yes	No	Unknown/No Info
Ate/likely ate deli meat (n=X)	50	4	3
Ate/likely ate deli meat supplied by MLF (n=X)	36*	5	16

* Public health inspectors were able to verify product information for 27 of the 50 cases who consumed deli meat. Public health inspectors verified that the institutions where these 27 cases consumed deli meat had served deli meat produced by Maple Leaf Establishment 97B. Among the remaining 23 cases who reported eating deli meat, 9 cases reported eating Maple Leaf brand products, but it was not verified whether or not these products originated from Maple Leaf Establishment 97B.

PHAC (2009)



Geographic Distribution

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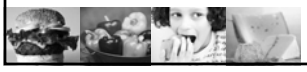
Province	Confirmed	Deaths	Probable
Alberta	2	1	
British Columbia	5	2	
Manitoba	1	0	
New Brunswick	1	1	
Ontario	41	16	2
Quebec	5	2	
Saskatchewan	2	1	
Total	57	23	2*

* PFGE results were not available for 2 cases

PHAC (2009/10)



Descriptive Epidemiology

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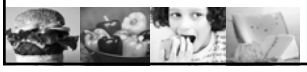
Mean age	75
Median age	78
Age range	29-98
Female	67%
Immunocompromised*	100%
Institutional exposure**	84%

* Prior health status was known for 31 of the 57 cases and all 31 cases had underlying conditions.
**Residents, inpatients or outpatients of institutions in the 70 days prior to their illness.

PHAC (2009)



Public Health Actions

- **August 17, 2008** – **Recall** →CFIA and ML Foods warned the public not to serve or consume **Sure Slice Roast Beef and Corned Beef,** because these products may be contaminated with Lm
- **August 19, 2008** – **Recall** → CFIA and ML Foods warned the public not to serve or consume **any RTE deli meat products** produced at facility # 97B because they may be contaminated with Lm
- **August 24, 2008** – **Recall** → ML Foods voluntarily recalled **all products** manufactured at facility #97B in Toronto
- **August 24, 2008** – **Facility Closure** →Toronto ML facility #97B was shut down and disinfection of the entire plant commenced

Environmental Investigation

- Maple Leaf Foods Establishment 97B had several production lines that produced a variety of ready-to-eat meat products, including Sure Slice brand products which were distributed nationally
- The Sure Slice brand included 6 different types of deli-meats and was marketed primarily to hotels, restaurants and institutions including hospitals and homes for the aged

The Strain

- Three distinct, but highly-related strains, may have been involved in the outbreak
- Two isolates were found to harbour a 50 kbp putative mobile genomic island encoding translocation and efflux functions, that have not been observed in other *Listeria* genomes

Gilmour et al., 2010; BMC Genomics

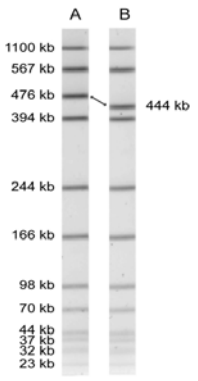
Reference Outbreak Strain

- Serotype 1/2a
- PFGE type (LAMACI.0040, LMAAI.0001)
- Ribotype (DUP-1045)
- Lineage II
- Clonal complex 8; ST 120
- Related to ECIII

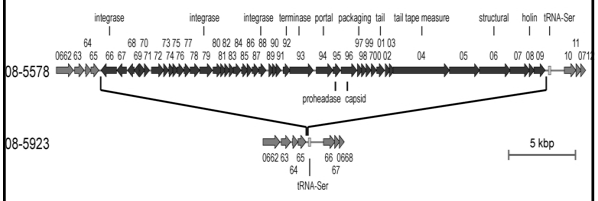
PFGE (AscI) variation detected by PulseNet Canada

a) LMACI.0040

b) LMACI.0001

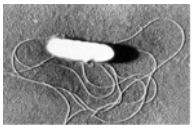


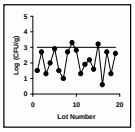
Prophage accounts for PFGE variation

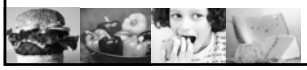


Trend Analysis - Expectations

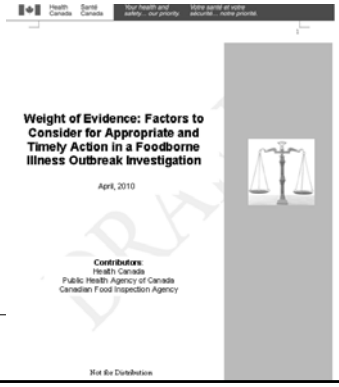
- ✓ **Before 2008 Outbreak** – Tracking the number of positive sites and making sure that everyone was sanitized
- ✓ **NOW:** Daily, scientific analysis to look for repeat patterns and root causes, complete management oversight and quarantine procedures





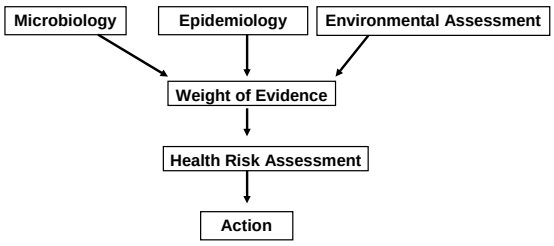


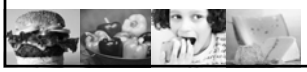
Weight of Evidence

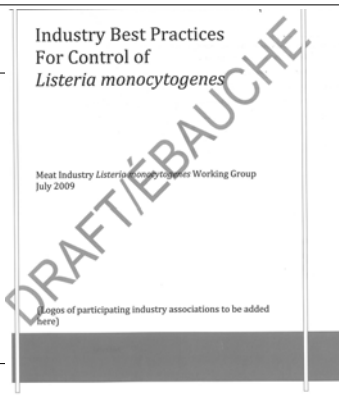


Weight of Evidence

The simplified process of decision-making is, as follows:







Useful information

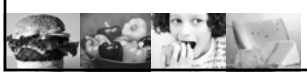
Conference for Food Protection. 2006. Voluntary guidelines of sanitation practices standard operating procedures and good retail practices to minimize contamination and growth of *Listeria monocytogenes* within food establishments. Available at: http://www.foodprotect.org/pdf/2006CFPLmInterventionvoluntaryguidelines.pdf

Cutter, et al. 2006. Control of *Listeria monocytogenes* in retail establishments. Publications Distribution Center, The Pennsylvania State University. Available at: http://www.afdo.org/afdo/upload/Control%20of%20Listeria%20in%20Retail%20Estab%20-%208.06.pdf

Houben, J. H. and Eckenhausen, F. 2006. Surface pasteurization of vacuum-sealed precooked ready-to-eat meat products. J. Food Prot. 69:459–468.

CCFH. 2007. Microbiological criteria for *Listeria monocytogenes* in ready-to-eat foods. Available at: ftp://ftp.fao.org/codex/ccfh39/fh39_06e.pdf

International Commission on Microbiological Specifications of Foods (ICMSF). 2002. Microorganisms in Foods 7: Microbiological Testing in Food Safety Management. Kluwer Academic/Plenum Publishers, New York. Available at: http://www.icmsf.iit.edu/main/home.html



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Risk assessment of *Listeria monocytogenes* in ready-to-eat foods

www.who.int INTERPRETATIVE SUMMARY

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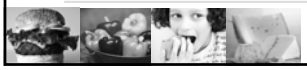
GUIDELINES ON THE APPLICATION OF GENERAL PRINCIPLES OF FOOD HYGIENE TO THE CONTROL OF *LISTERIA MONOCYTOGENES* IN FOODS

CAC/GL 61 - 2007

☺ … Upcoming Teleclasses… ☺

28 Sep. 10	*(Free Teleclass)* Voices of CHICA - part 2 Speaker: Community and Hospital Infection Control Association of Canada Board Members and Guests
30 Sep. 10	Prevention of Mother to Child Transmission of HIV Speaker: Dr. Kay Libbus, University of Missouri
13 Oct. 10	*(South Pacific Teleclass)* Infection Control in the Tropics Speaker: Claire Boardman, VICNISS, Australia
21 Oct. 10	Methods of Monitoring Hand Hygiene Frequency and Compliance Speaker: Dr. John Boyce, Hospital of St. Raphael
28 Oct. 10	Implementing Mandatory Vaccination for Healthcare Workers Speaker: Dr. Keith Woeltje, Washington University School of Medicine
04 Nov. 10	Using Social Marketing to Prevent Healthcare Associated Infection Speaker: Dr. Hugo Sax, University of Geneva Hospitals, Switzerland



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