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Listeria monocytogenes
Are Industry Practices Meeting
Current and Future Challenges?
Part 2

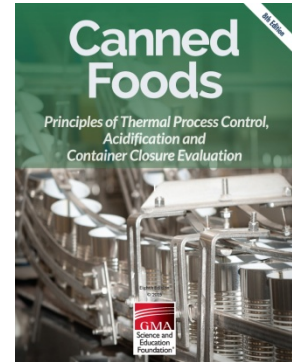
May 24th, 2016

<http://www.gmaonline.org/resources/sef/>

GMA SCIENCE AND EDUCATION FOUNDATION (SEF)

3 PILLARS OF THE FOUNDATION:

- Education – Hands On
- Training – BPCS, CCFS, HACCP, Food Safety Culture, Need-based training
- Research – Support projects, funding agency



*The mission of the foundation is to deliver **innovative research**, **state-of-the art training** and **best-in-class education** programs to the food industry and consumers and, thereby, contributes to the delivery of high quality, safe food and consumer products.*

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GMA SEF LEADERSHIP CIRCLE



SPEAKER INTRODUCTION

Dr. Jennifer McEntire

VP, Science Operation, Grocery Manufacturers Association

Dr. Tim Jackson

Director, Food Safety, Nestle North America

Dr. Reid Ivy

Senior Manager Food Safety, Kraft Heinz Company

Dr. Deann Akins-Lewenthal

Director of Microbiology and Food Safety, ConAgra Foods

Dr. Scott Hood

Director of Global Food Safety, General Mills



Representing the Makers of the World's Favorite Food, Beverage and Consumer Products



Industry Challenges in the Management of *Listeria*

Jennifer McEntire, Ph.D.
VP Science Operations
Grocery Manufacturers Association
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www.gmaonline.org

L. monocytogenes

- Recognized foodborne pathogen for nearly 40 years
 - Sporadic: outbreak = 44:1
- Risk = food + facility + practices
 - Post process contamination
 - Continuous challenges
- GMA Science and Education Foundation / JIFSAN workshop June 2015; Webinar 1 December 2015

FDA Food Advisory Committee- Dec '15

- Wonderful pre-read
 - <http://www.fda.gov/advisorycommittees/committeesmeetingmaterials/foodadvisorycommittee/ucm471769.htm>
- Tackled
 - Ready to eat vs. not ready to eat
 - Support growth vs. not
 - Zone 1 testing
 - Industry reps are non-voting; consumer advocates get a vote
 - GMA, ALP and others submitted comment

Regulatory Standards

- Zone 1 testing for *Listeria* species
 - Awaiting FDA guidance
- Foods that support/ don't support growth
 - Dose response
- Whole Genome Sequencing
 - Cost \$25-100; 4-5 day turnaround

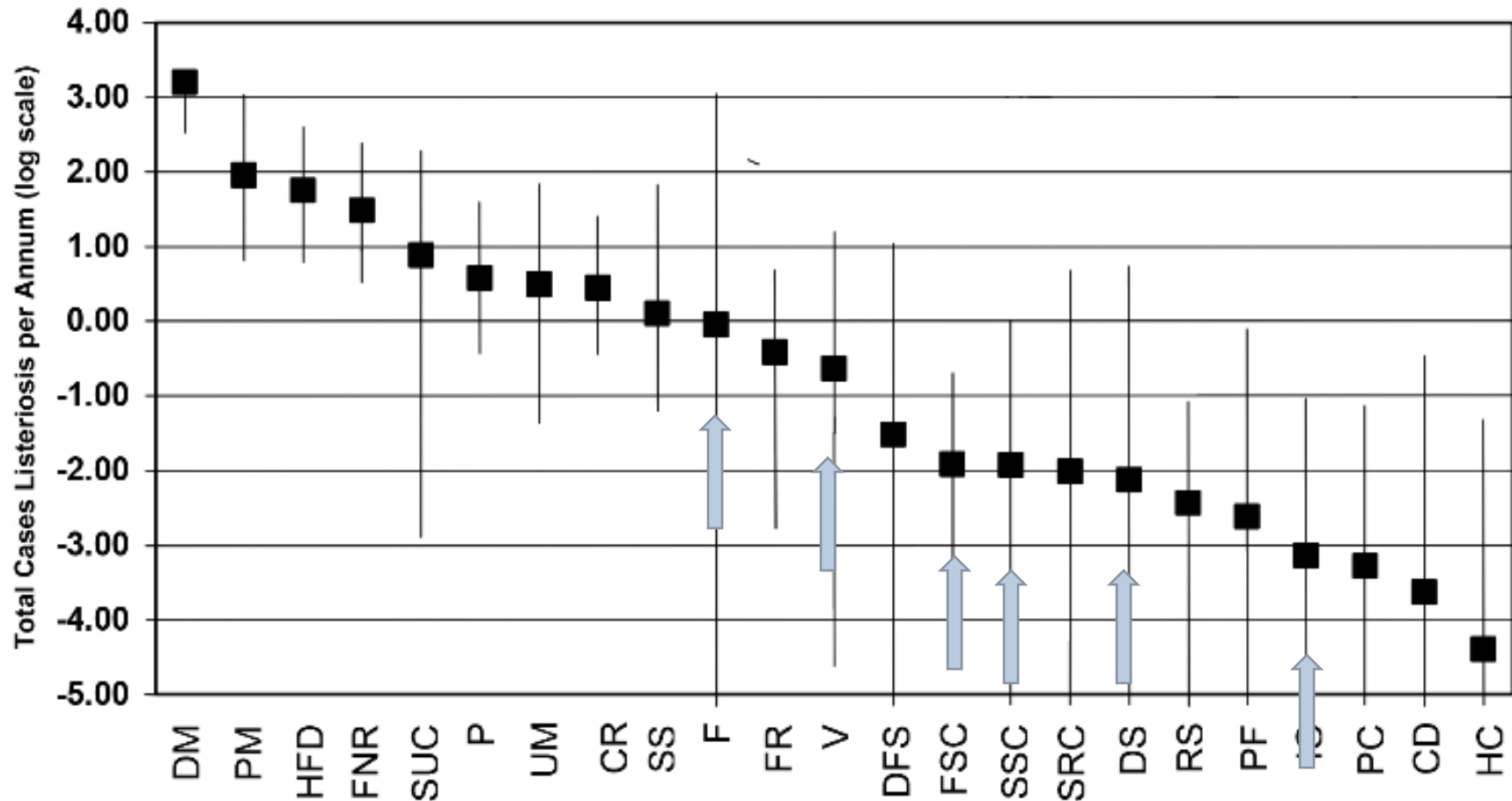


Understanding *Listeria* risk; How we manage *Listeria*

Tim Jackson, Ph.D.

Director of Food Safety
Nestlé North America

A changing risk management paradigm?



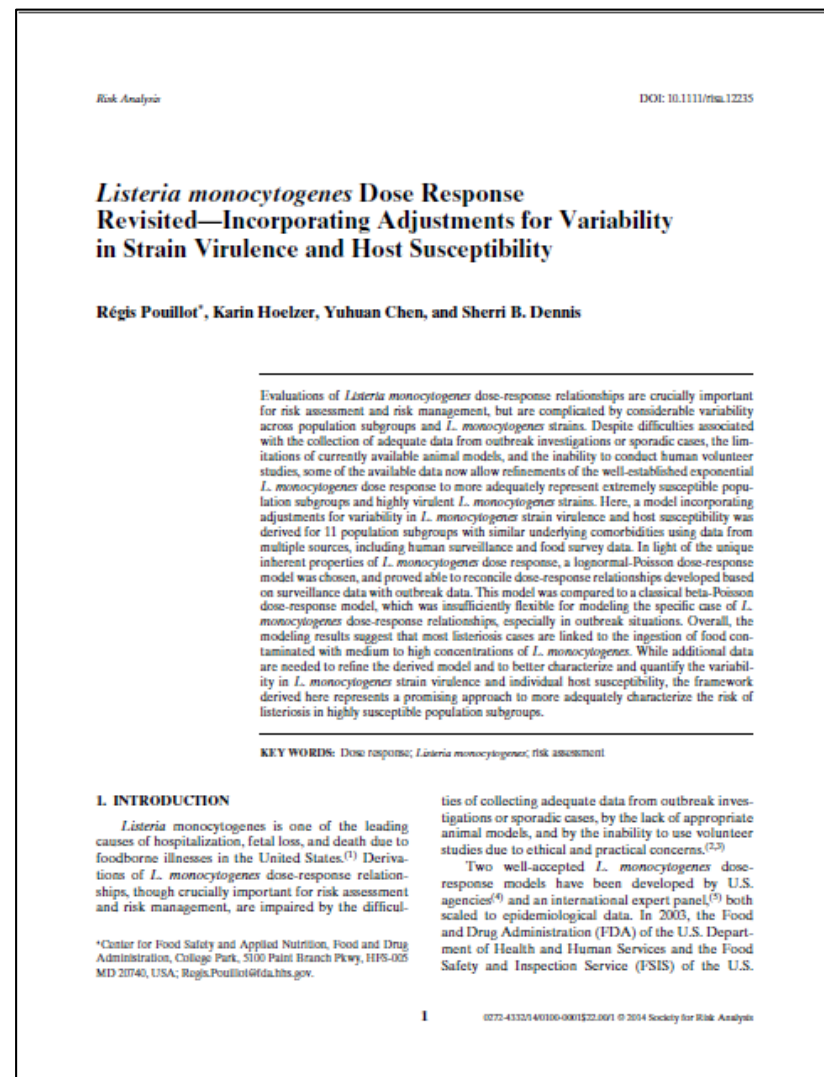
RISK CHARACTERIZATION Figure V-2. Predicted Cases of Listeriosis (log scale)
Associated with Food Categories for the Total United States Population on a per Serving
Basis (page 120 of risk assessment)

<http://www.fda.gov/downloads/Food/FoodScienceResearch/UCM197330.pdf>

A changing risk management paradigm?

- Reassessment of dose-response data to adjust for variation in *L. monocytogenes* strain virulence and host susceptibility for population subgroups.
- Most listeriosis cases are linked to the ingestion of food contaminated with medium to high concentrations of *L. monocytogenes*
- The model predicts the expected number of cases linked to the consumption of 10,000 cfu or less [100g at 100 CFU/g] in 55 out of 1,591 cases, i.e., **3.5% of cases.**

M. Parish 12/16



Blue Bell and Jeni's Ice Cream

HOUSTON★**CHRONICLE**
Monday, June 22, 2015

HOUSTON

Blue Bell, industry, flout listeria guidelines

But guidelines aimed to prevent foodborne illness ignored by many

By Mark Collette | June 21, 2015 | Updated: June 22, 2015 10:49am

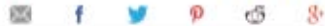


Photo: Brett Coomer, Houston Chronicle

The exterior of Blue Bell Creameries is shown on Tuesday, April 21, 2015, in Brenham. Blue Bell is pulling all of its products from the shelves after more ice cream samples tested positive for Listeria, following an "enhanced sampling program" that found half-gallon containers of Chocolate Chip Cookie Dough Ice Cream produced on March 17 and March 27 contained the bacteria.

Data from Blue Bell sampling (Chen et al., submitted)

- “Product A”, from factory A
 - 2,290 samples of Product A tested
 - all but 13 samples were positive (99.4% positive)
 - Range: <0.03 MPN/g to > 208 MPN/gm
 - Highly consistent low contamination levels
 - 15% below 1 MPN/g
 - 58% below 5 MPN/g
 - 77% below 10 MPN/g
 - 92% below 20 MPN/g
 - 98% below 50 MPN/g
 - 99.8% below 100 MPN/g
 - Four samples > 100 MPN/g (max 208 MPN/g)
 - Opportunities for growth?

Caramel apples (*Listeria monocytogenes* – 2014)

Listeria (Listeriosis)

Listeria (Listeriosis)

Definition & Symptoms

Outbreaks

Commercially Produced, Prepackaged Caramel Apples

Recall & Advice to Consumers

Advice to Consumers en Español

Case Count Maps

Epi Curves

Signs & Symptoms

Key Resources

Oasis Brands, Inc. Cheese +

Wholesome Soy Products, Inc. Sprouts +

Surveillance

Statistics

People at Risk

Prevention

Sources of Infection

Diagnosis & Testing

Treatment & Outcomes

Educational Resources

Publications

CDC > [Listeria \(Listeriosis\)](#) > [Outbreaks](#)

Multistate Outbreak of Listeriosis Linked to Commercially Produced, Prepackaged Caramel Apples

[Recommend](#) [Tweet](#) [Share](#)

Posted January 10, 2015 11:00 AM ET

Highlights

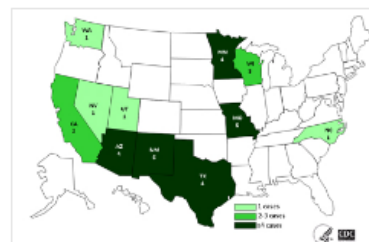
- [Read the Advice to Consumers and Retailers](#) >>
- CDC is collaborating with public health officials in several states and with the [U.S. Food and Drug Administration \(FDA\)](#) to investigate an outbreak of *Listeria monocytogenes* infections (listeriosis) linked to commercially produced, prepackaged caramel apples. *Listeria* can cause a serious, life-threatening illness.
 - People at higher risk for listeriosis include adults 65 years or older, people with weakened immune systems, and pregnant women.
- On January 6, 2015, Bidart Bros. of Bakersfield, California [voluntarily recalled](#) Granny Smith and Gala apples because environmental testing revealed contamination with *Listeria monocytogenes* at the firm's apple-packing facility.
 - On January 8, 2015, FDA laboratory analyses showed that these *Listeria* isolates were indistinguishable from outbreak strains by [pulsed-field gel electrophoresis \(PFGE\)](#).
 - *Listeria* isolates from whole apples produced by Bidart Bros., collected along the distribution chain, were also indistinguishable from outbreak strains by PFGE.
- Consumers should not eat any recalled Granny Smith and Gala apples produced by Bidart Bros., and retailers should not sell or serve them.
 - Consumers who are buying or have recently bought Granny Smith or Gala apples can ask their retailers if the apples came from Bidart Bros.
- Consumers should not eat commercially produced, prepackaged caramel apples that were recalled or made with Bidart Bros. apples, and retailers should not sell or serve them.
 - [Happy Apples](#), [California Snack Foods](#), and [Merb's Candies](#) each announced a voluntary recall of commercially produced, prepackaged caramel apples after hearing

At a Glance:

- **Case Count:** 32
- **States:** 11
- **Deaths:** 7
- **Hospitalizations:** 31
- **Recall:** Yes

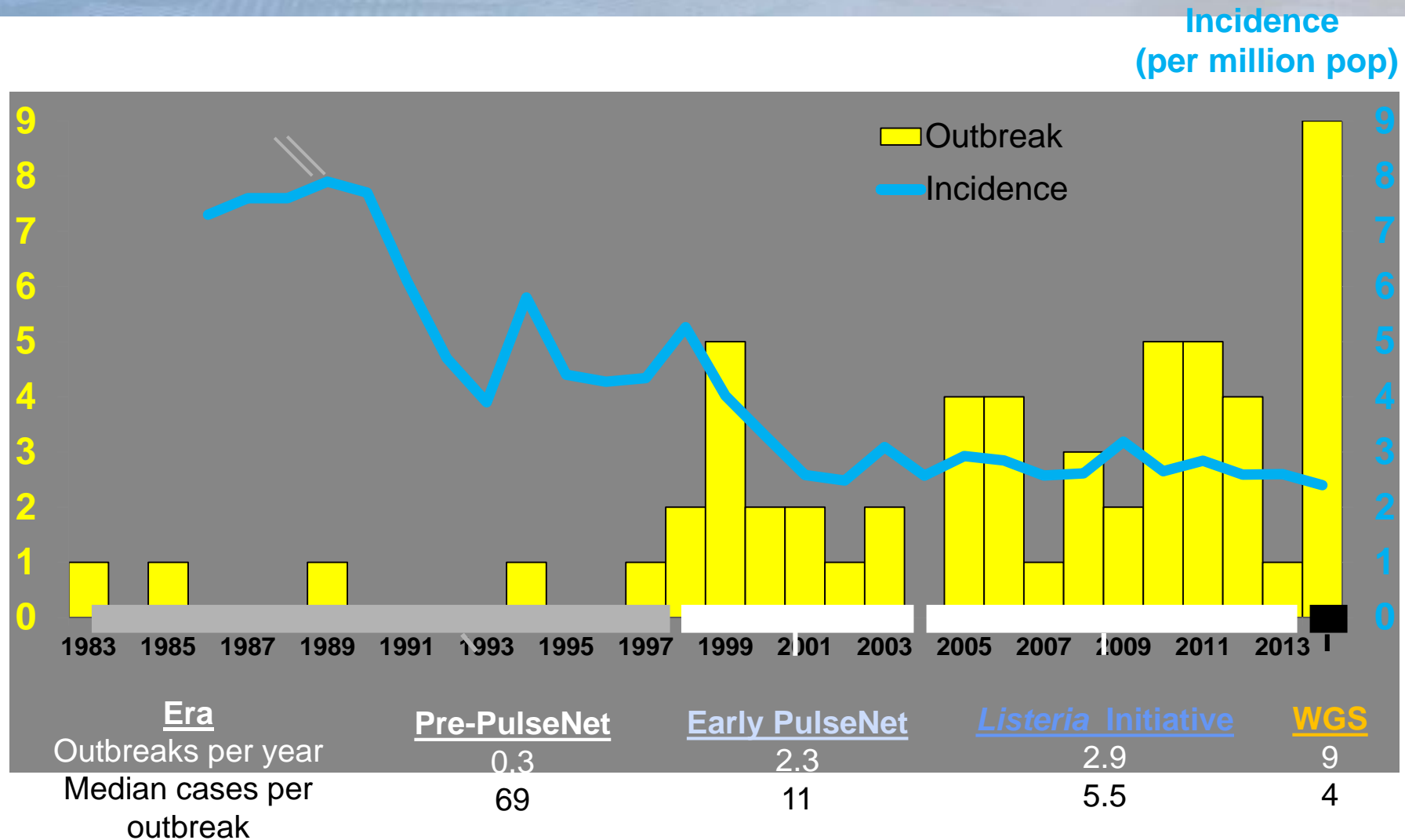
More Information:

- [Recall & Advice to Consumers](#)
- [Signs & Symptoms](#)
- [Key Resources](#)



[CLICK TO VIEW CASE COUNT MAP.](#)

Listeria outbreaks solved and incidence, 1983-2014



Slide: CDC via M. Wiedmann

A changing risk management paradigm?

Listeria (Listeriosis)

Listeria (Listeriosis)

Definition & Symptoms

Outbreaks

Listeriosis Linked to Frozen Vegetables

Recall & Advice to Consumers and Retailers

Information for Health Professionals

Case Count Maps

Epi Curves

Signs & Symptoms

Key Resources

[CDC](#) > [Listeria \(Listeriosis\)](#) > [Outbreaks](#)

Multistate Outbreak of Listeriosis Linked to Frozen Vegetables



Posted May 3, 2016 5:00 PM ET

Highlights

- [Read the Recall & Advice to Consumers, Restaurants, and Retailers>>](#)
- Since March 2016, CDC has been collaborating with public health officials in several states and the [U.S. Food and Drug Administration \(FDA\)](#) to investigate a multistate outbreak of *Listeria monocytogenes* infections (listeriosis).
- *Listeria* can cause a serious, life-threatening illness.
- Eight people infected with the outbreak strains of *Listeria* have been reported from three states since September 13, 2013.

At a Glance:

- **Case Count:** 8
- **States:** 3
- **Deaths:** 2
- **Hospitalizations:** 8
- **Recall:** [Yes](#)

A changing risk management paradigm?

Sunflower seeds recalled over possible Listeria contamination

USA TODAY NETWORK Mary Bowerman, USA TODAY Network 1:21 p.m. EDT May 5, 2016



(Photo: Kroger, FDA)

f 137 **t** **in 1**
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Massive voluntary recalls were issued this week for a slew of products that contain sunflower seed, which may have been contaminated with listeria. The bacteria can cause listeriosis, a life-threatening illness.

TreeHouse Foods Inc. and Kroger Co. announced recalls in separate statements earlier this week. On Tuesday, TreeHouse Foods recalled almost 100 products, including items like Meijer's-brand protein



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Australian wildlife: C
cuddle in 360

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A simple lab test helped save my life

Watch Tamika's story



RECALL ALERT

IMPORTANT NEWS ON CONSUMER PRODUCTS THAT CAN KEEP YOU SAFE

Walnuts Recalled for Possible Listeria Contamination

By Elizabeth Arakelian



Getty Images



A simple lab test helped save my life



Watch Tamika's story

TRENDING STORIES

1 Missing Columbia Student Found Safe: NYPD

Open questions for risk managers

- What is the risk of low, sporadic *Listeria* in no-growth foods?
 - How is a no-growth food defined?
- Does strain variability influence risk and effectiveness of control measures?
- How do risk factors in product and consumers impact the stringency of control measures that need to be applied?
- What interventions can effectively control *Listeria* in fresh produce?
- What are appropriate criteria for *Listeria monocytogenes*?



Appropriate criteria for *L. monocytogenes*?

- Codex Alimentarius Commission (2005)

Microbiological criterion for ready-to-eat foods in which growth of *L. monocytogenes* will not occur

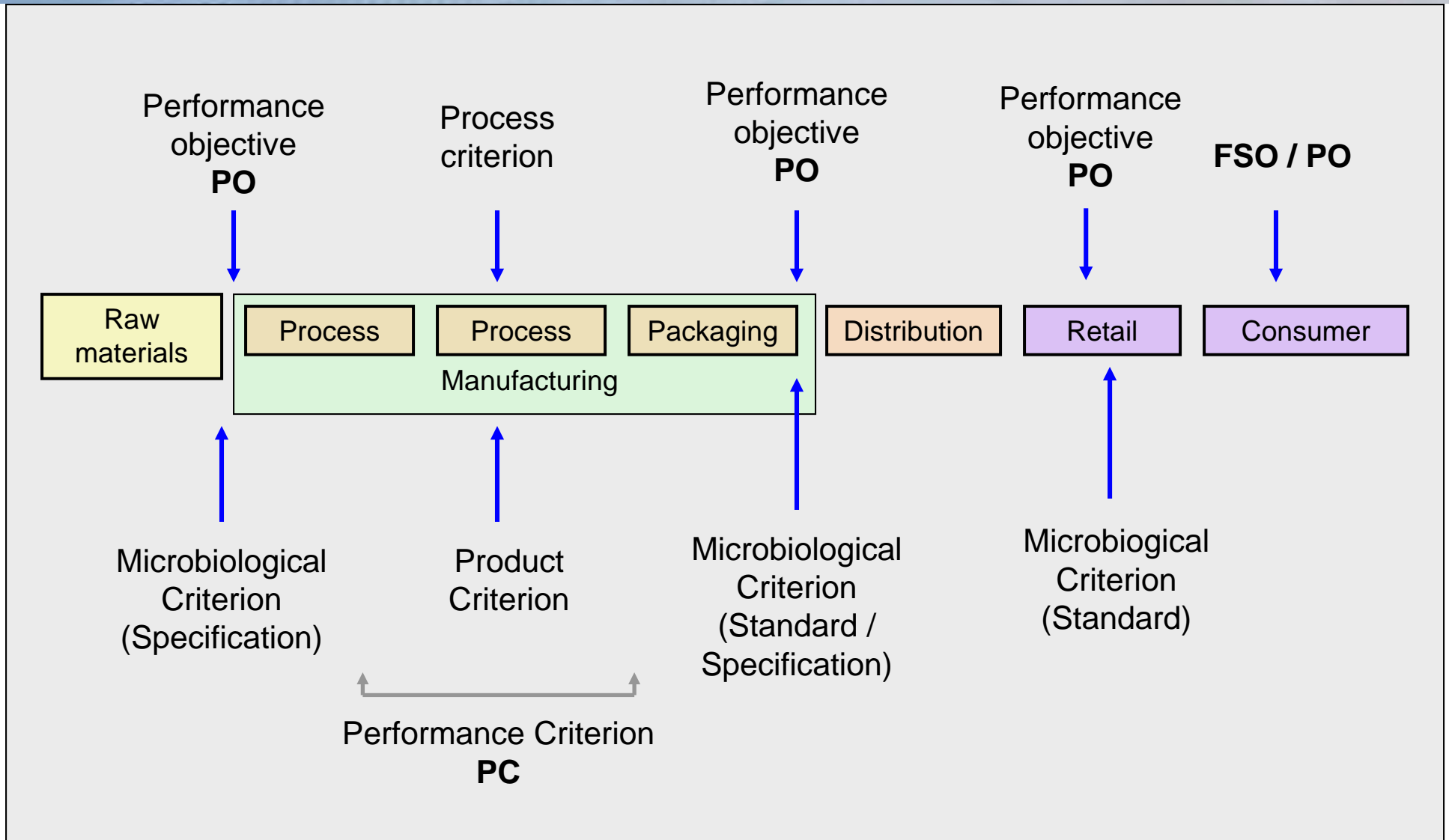
Point of application	Microorganism	n	c	m	Class Plan
Ready-to-eat foods from the end of manufacture or port of entry (for imported products), to the point of sale	<i>Listeria monocytogenes</i>	5 ^a	0	100 cfu/g ^b	2 ^c

Microbiological criteria for ready-to-eat foods in which growth of *L. monocytogenes* can occur

Point of application	Microorganism	n	c	m	Class Plan
Ready-to-eat foods from the end of manufacture or port of entry (for imported products), to the point of sale	<i>Listeria monocytogenes</i>	5 ^a	0	Absence in 25 g (< 0.04 cfu/g) ^b	2 ^c

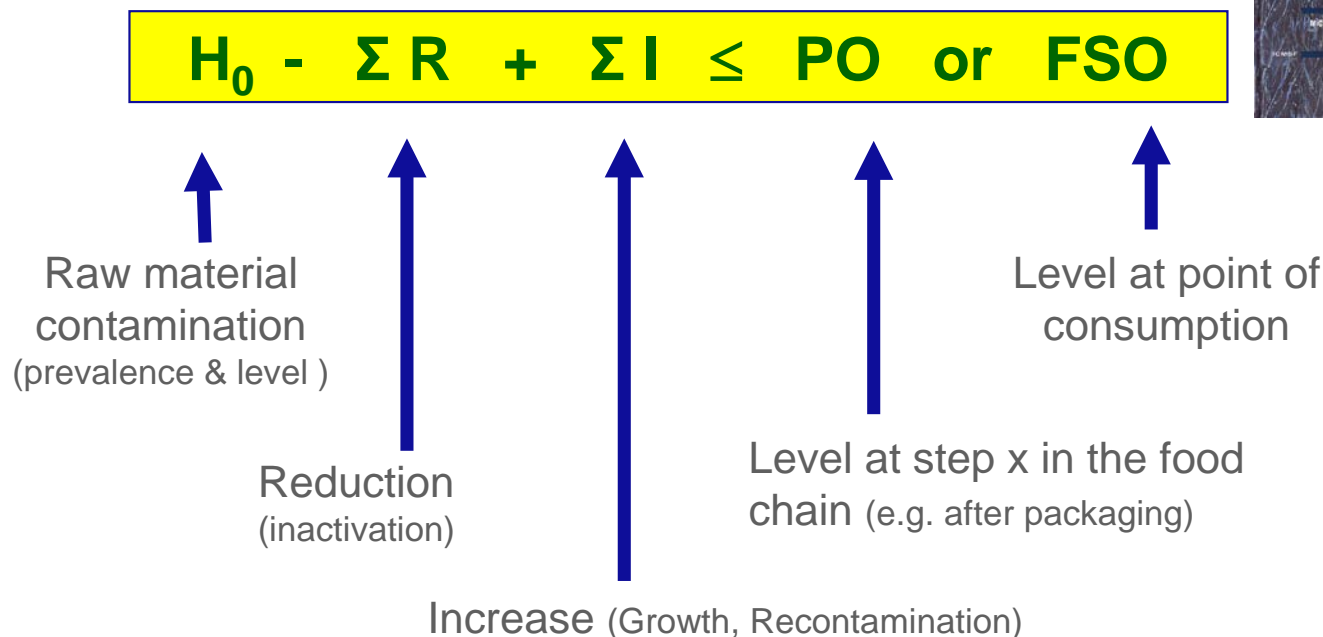
- Also other authorities: eg, Canada, EU, Australia, New Zealand

Risk based metrics



Full chain approach

ICMSF's conceptual equation¹



Σ = sum of events

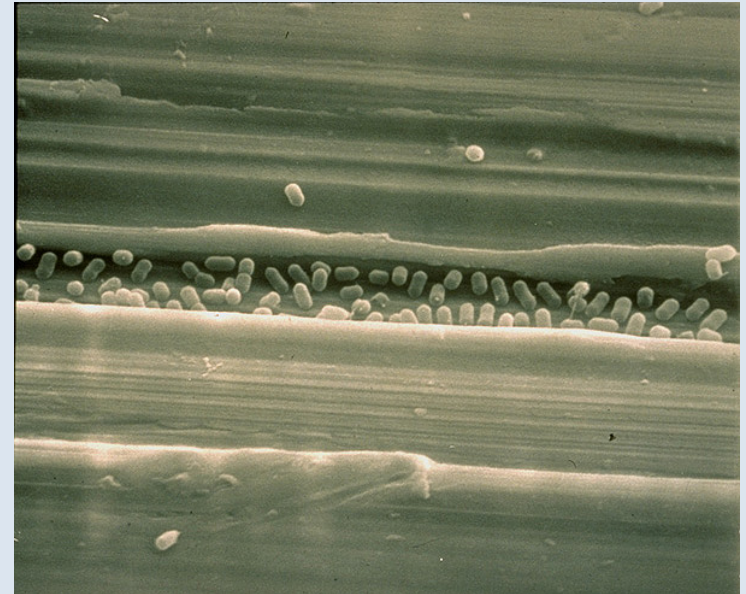
PO: Performance Objective

FSO: Food Safety Objective

¹Microbiological testing in Food Safety Management, ICMSF (2002); Book 7

Listeria monocytogenes

- *Listeria* genus.
 - *Currently eight species identified*
 - *L. monocytogenes* pathogenic
- Sources
 - Carried by animals and humans
 - Widespread in the environment
 - Raw materials
 - Post-processing contamination
- *Listeria* can attach to surfaces and form biofilms
 - Surface attached communities of cells embedded in an extra-cellular polysaccharide matrix.
 - More resistant to physical and chemical agents



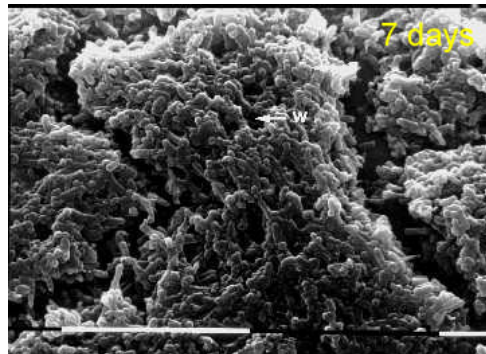
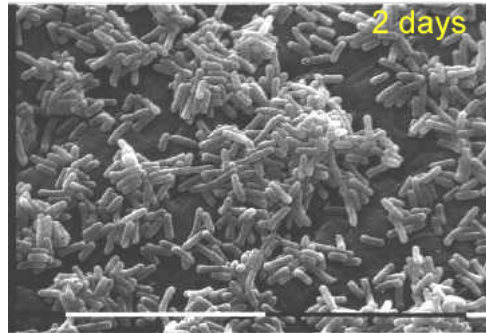
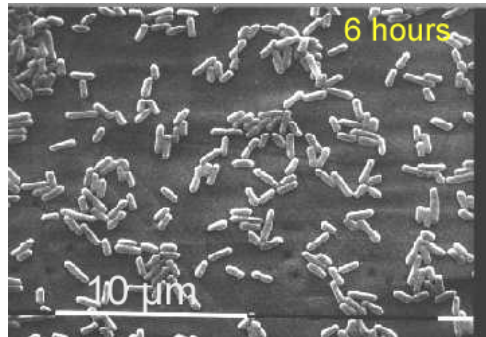
A. Wong UW Madison

Listeria monocytogenes control

- Non-sporeforming
 - Relatively heat sensitive in high moisture products
 - Inactivated by pasteurization
- Psychrotrophic
 - Able to grow under refrigeration

Growth and survival limits for <i>Listeria monocytogenes</i>				
Parameter	Minimum	Maximum	Optimal	Can survive (but no growth)
Temperature (°C)	-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 (a_w)	0.90 to 0.93	> 0.99	0.97	< 0.90
Salt (%)	< 0.5	12 to 16	N/A	≥ 20

Factors leading to persistence



SEM micrographs: P. Chavant, M. Hébraud, B. Martinie (INRA, Theix)

- Reports of strains surviving for years or decades in food plants (Ferreira et al, 2014)
- Formation of biofilms
- Existence of persister cells
 - Cells enter a persister stage after stationary phase marked by changes in cell morphology and increased resistance to heat, high pressure, sanitizer etc
- Resistance to sanitizers
 - Repeated sub-lethal exposure
- Survival in niches
- Re-introduction into the environment

Issues that may lead to contamination

Category	Issue or problem
Facility design and structure	Construction work
Facility services	Rubbish bins not being routinely emptied, maintained or cleaned / sanitized
Employees	Employees unfamiliar with business / processing procedures Employees moving between hygiene zones Cleaning of equipment parts on the processing floor Poor personal hygiene practices Inadequate training
Sanitation	Sanitation procedures during production Poor sanitation
Maintenance	Repair of equipment, floors, drain blockage, etc. Installation of new equipment

Issues that may lead to contamination

Category	Issue or problem
Equipment	Equipment failure and breakdowns Alteration of production lines Product or product debris left on equipment
	Frequent changes of packaging material and production line speeds Commissioning of new equipment or equipment from another facility or storage Raw product in cooked area / cooked product in raw area
Production	Difficulty in meeting sanitation schedules due to production schedules Movement or modification of a production line Heavy production schedules Using out of date stock (eg poor stock rotation) Frequent product changeovers Stagnation of product flow through processing

Listeria control strategy

- Validated lethal processing steps
- Product formulation
- Identify sources of contamination

Direct	Indirect
Conveyors	Drains
Containers	Floors / Gangways
Hand tools	Walls
Protection clothing eg white coats	Ceilings
Racks used in transporting finished products	Maintenance equipment
Filling and packaging equipment	Cleaning equipment
Dicing, slicing, blending equipment	Transportation equipment (e.g. forklift)
Brines	Insulation in walls or around pipes
Packaging	Air, steam, condensation

Listeria control strategy

- Written sanitation program
 - Effective cleaning before sanitizing critical
 - Infrequent defrosting cleaning and maintenance of spiral freezers can lead to contamination
- Sanitizers:
 - Hot water ($> 82^{\circ}\text{C}$) in conjunction with a sanitizer can be effective in the removal of biofilms
 - Chlorine: Levels of 0.2 to 0.5 ppm
 - Efficacy influenced by temperature, contact time, pH, organic material, etc.
 - Iodophors: 200 ppm, 10 to 20 minutes
 - Have a reduced efficacy against *L. monocytogenes* at temps $< 4^{\circ}\text{C}$
 - Quaternary ammonium compounds
 - Very effective against *L. monocytogenes*
 - Peracetic acid and peroctanoic acid

Listeria control strategy

- Maintenance activities
- Personal hygiene of food workers
 - Staff working in high risk areas should receive additional training in how to avoid cross-contamination
 - Staff working with sanitation procedures
 - Managers and supervisors lead by example
- Packaging
 - Packaging kept clean and dry
 - Packaging storage at a high level of hygiene
- Storage and distribution
 - Separation into raw and ready-to-eat
 - Pallets made of plastic, kept clean and dry

Listeria control strategy

- Recognize operational issues that could increase risk of cross-contamination
- Control humidity and moisture
 - Wet processing areas isolated from other areas
 - Eliminate or quickly remove areas of standing water
 - Remove water hoses from production areas before production
 - Avoid practices producing aerosols (high pressure hoses)
 - Cooling units have dehumidifying capabilities
- Control air quality and ventilation
 - Positive air pressure between raw and cooked
 - Minimize use of compressed air; filter at point of use
 - Control of air quality and ventilation should minimize condensation

Pathogen control strategy

- Eliminate niche environments

Area	Example
Ancillary items	Rubbish Bins, skips
Ancillary services	Compressed air lines, hollow bump guards on bottoms of doors, plexiglass shields
Personnel hygiene	Wash basins, aprons, gloves
Plant hygiene	Cleaning equipment
Premises	Cracked walls, floors, ceilings, wet insulation, standing water, switches
Equipment	Hollow rollers on conveyors, conveyor belts, slicers, dicers, mincers, weighing scales, switches, rubber seals, open bearings, equipment motor housings, hollow frames, ice makers, damaged pipe / hoses, hollow box cutters, brine, packaging equipment, hand tools, hoppers, valves

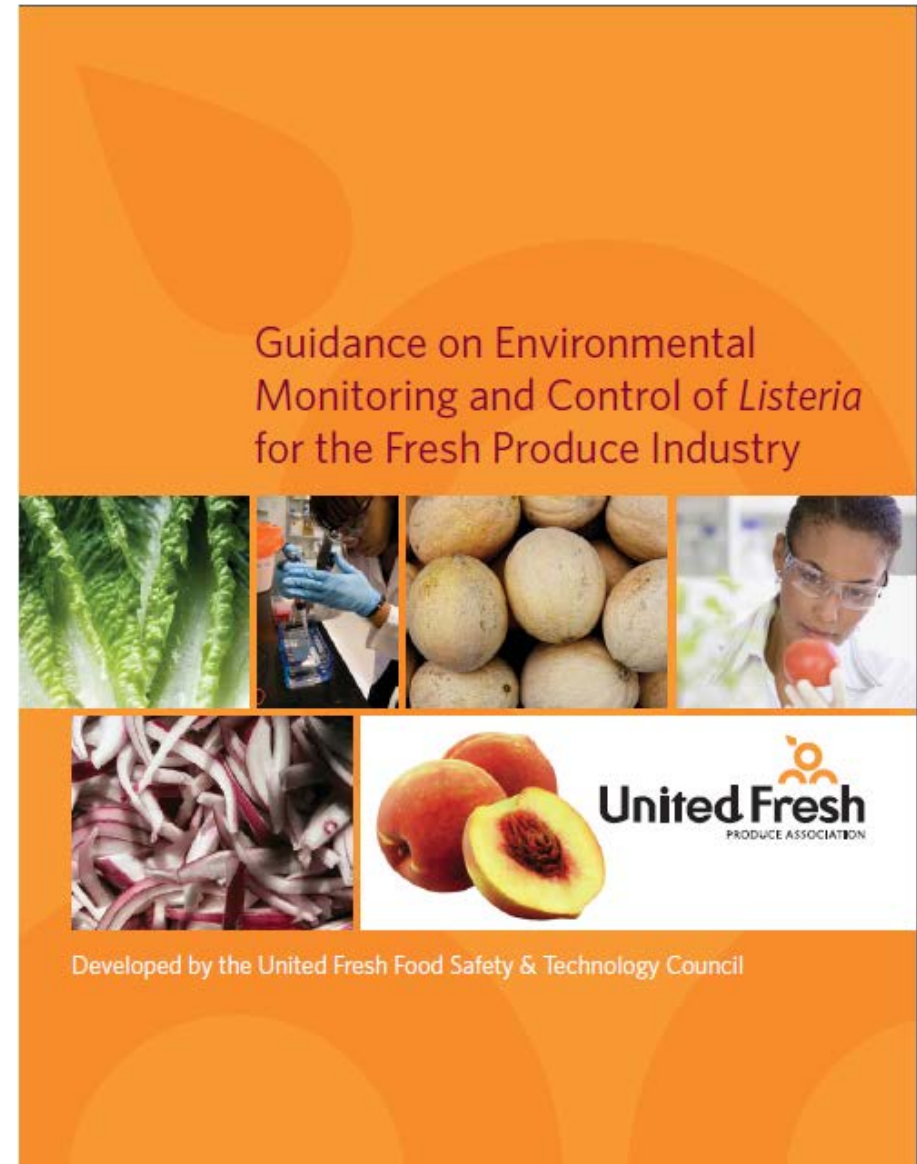
Pathogen control strategy

- Include safe processing of rework in HACCP plan
- Inedible and condemned material
 - Segregated and clearly identified
 - Waste containers located as far as possible and physically separated from production areas
 - Appropriate insect and rodent proof containers
- Monitor effectiveness of controls through pathogen and hygiene monitoring program



Listeria control in fresh produce

- Some control measures can inactivate *Listeria*:
 - Heat
 - Irradiation
 - HPP
 - Ohmic heating
- Control is usually a combination of control measures:
 - Minimizing *Listeria* in the field
 - Hygienic design of equipment
 - Surface sanitation (1-2 log reduction)
 - Cleaning and sanitation
 - Zoning
 - Personnel practices





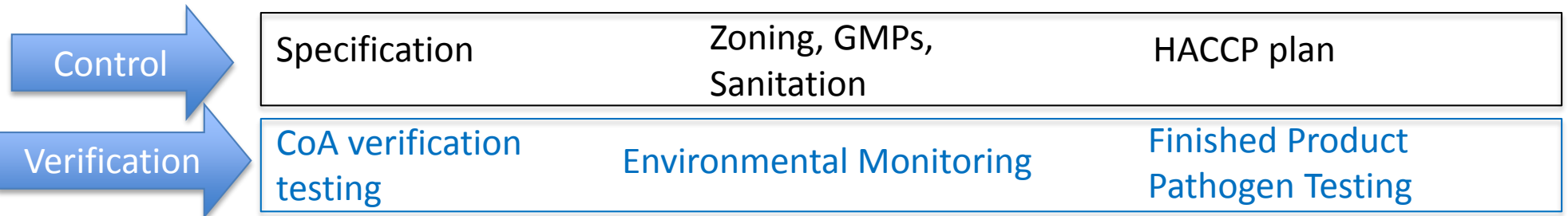
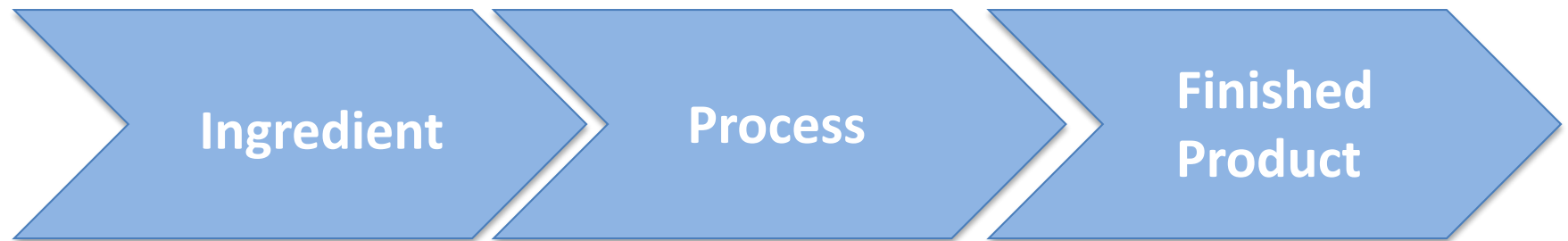
THE KRAFT HEINZ COMPANY

Managing *Listeria* During Cheese Production

Reid Ivy, Ph.D.
Senior Manager Food Safety
Kraft Heinz Company

Overview

Environmental monitoring and product testing are verifications that food safety controls are effective at preventing introduction of pathogens into the finished product



Risk-based Programs

- Process – What is the risk of environmental cross contamination?
 - Product exposure
 - ▢ Make – milk into cheese
 - ▢ Conversion – size reduction (e.g. slice/shred)
- Product
 - Hot fill or cold fill?
 - Does the product support the growth of *Listeria*?
 - Outbreak and recall history

Program Requirements Vary by Hygienic Zone

- High level of control
 - Highly sensitive product, exposed, post-pasteurization
- Normal level of control
 - Low to medium-sensitivity product, exposed
- Raw/Limited process
 - Ingredients for further process exposed; raw ingredients
- Non-manufacturing
 - Areas in plant where manufacturing is not taking place

Hygienic Zone dictates swabbing frequency, action limits, and corrective actions

Example – Environmental Monitoring for *Listeria*

- Swab Zone 1
 - Direct product contact surfaces
 - Indicators at start-up and in-process; *Listeria* spp. (high risk cheeses)
- Swab Zone 2
 - Immediately adjacent to product contact surfaces
 - *Listeria* spp. weekly
- Swab Zone 3
 - Non-product contact surfaces; remote from exposed product
 - *Listeria* spp. weekly
- Swab Zone 4
 - Outside of processing area but could impact processing areas
 - *Listeria* spp. weekly/monthly

Zone 1 Swabbing

- For high risk cheeses that support the growth of *Listeria monocytogenes*
- Refrigeration is not a control for *Lm*
- Product contact surfaces must be monitored to ensure no cross contamination of *Lm*

Effective Environmental Monitoring Programs

- 'Seek and Destroy' mentality
- Effective root cause analysis
 - Cleaning and vector swabbing are not root cause analysis
- Living program
 - Periodic reanalysis
 - Site rotation
 - Investigative swabbing

Testing

■ Ingredients

- In some cases (e.g. cheese conversion), Certificate of Analysis is the only preventive control for biological pathogens (supplier controlled hazard)
- History has shown us that CoA alone is not an effective verification of supplier controls
- In these cases, verification activities may include testing by receiving facility

■ Finished product

- Verifies preventive controls are working
- Under FSMA guidelines, FPT is required where deemed appropriate



Managing *Listeria* spp. in Frozen Products

Deann Akins-Lewenthal, Ph.D.



Managing *Listeria* spp.

- Supplier program
- Cleaning and sanitation
- Product and process criteria
- Hygienic Zoning

Hygienic Zoning

- Why do we need hygienic zoning?
 - Prevent microbial cross contamination of RTE products
 - Assure food safety of finished product
- What is Hygienic Zoning?
 - Identify and differentiate areas within the manufacturing facility based on microbiological risk
 - Scope: receipt, storage, processing and packaging of products
 - Consider personnel and materials traffic, air handling, equipment, effluent, drains, waste systems, locker rooms, or other situations that could result in transfer of microorganisms

Hygienic Zoning

- Program will vary based on
 - Product type
 - Design of manufacturing processes
 - Process flow

Hygienic Zoning Assessment vs Hygienic Zoning Controls

H
Z
A

- Is the product susceptible or not? (supports the survival or growth of pathogens)

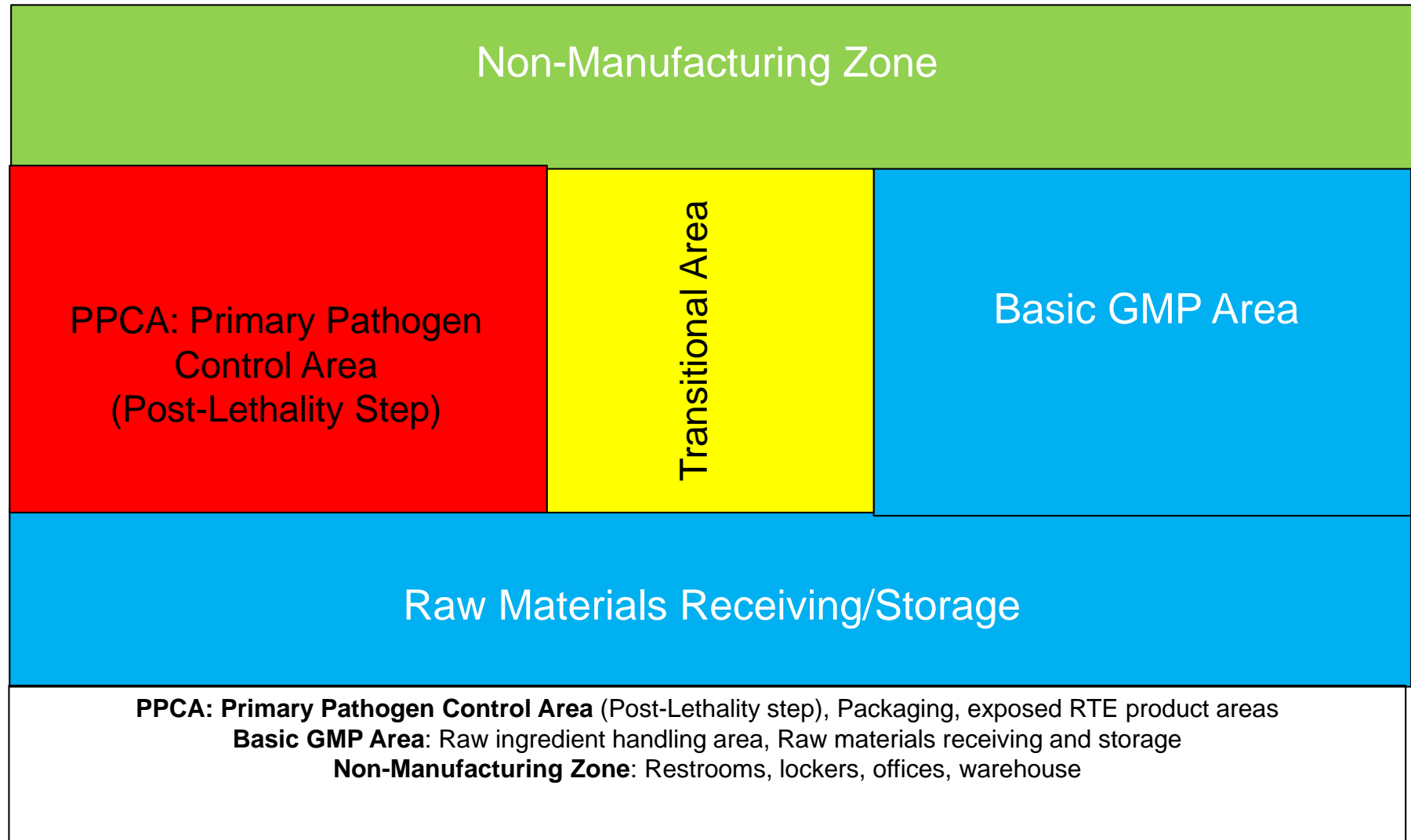
- Identification of target pathogens of concern

- Categorization of hygienic zones at the plant, Add traffic patterns to the map
 - Complete the Hygienic Zoning checklist

H
Z
C

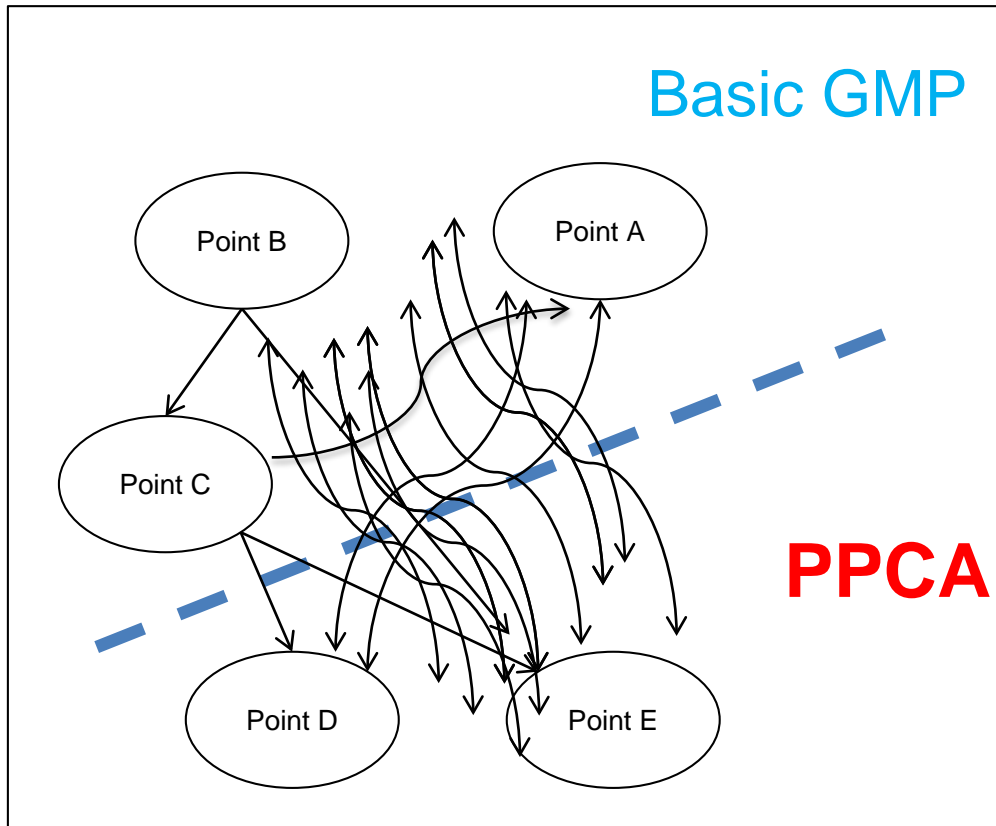
- The following control mechanisms shall be taken into consideration:
 - Usage of closed systems
 - Structural separation of the respective area by design
 - Control of traffic patterns of people, materials/supplies flow and equipment movements, internal transports
 - Use of a vestibule as entrance and exit with personnel hygiene and changing measures
 - Personnel hygiene practices of employees
 - Use of designated and/or coded tools and equipment
 - Filtration of the room air to protect the food against pathogens and/or spoilage organisms
 - Separation of effluent and water waste drains coming from zones with potentially higher contamination risk

Levels of Hygienic Zoning

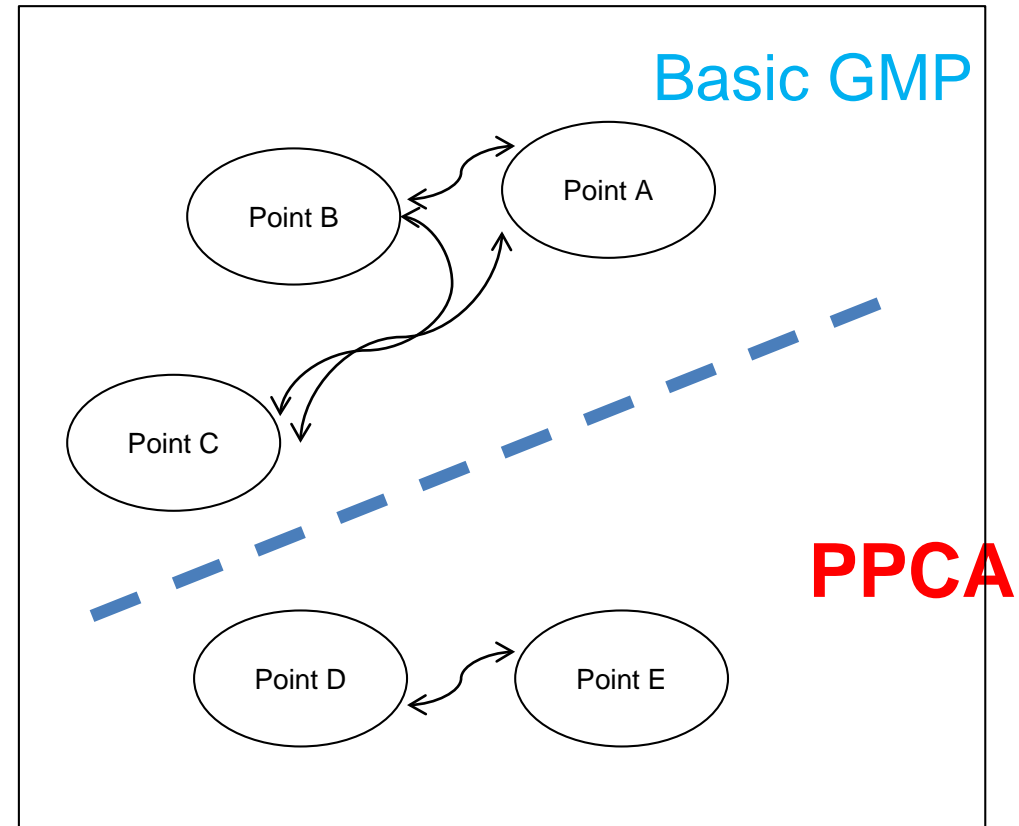


Consider Employee/Equipment Traffic Patterns

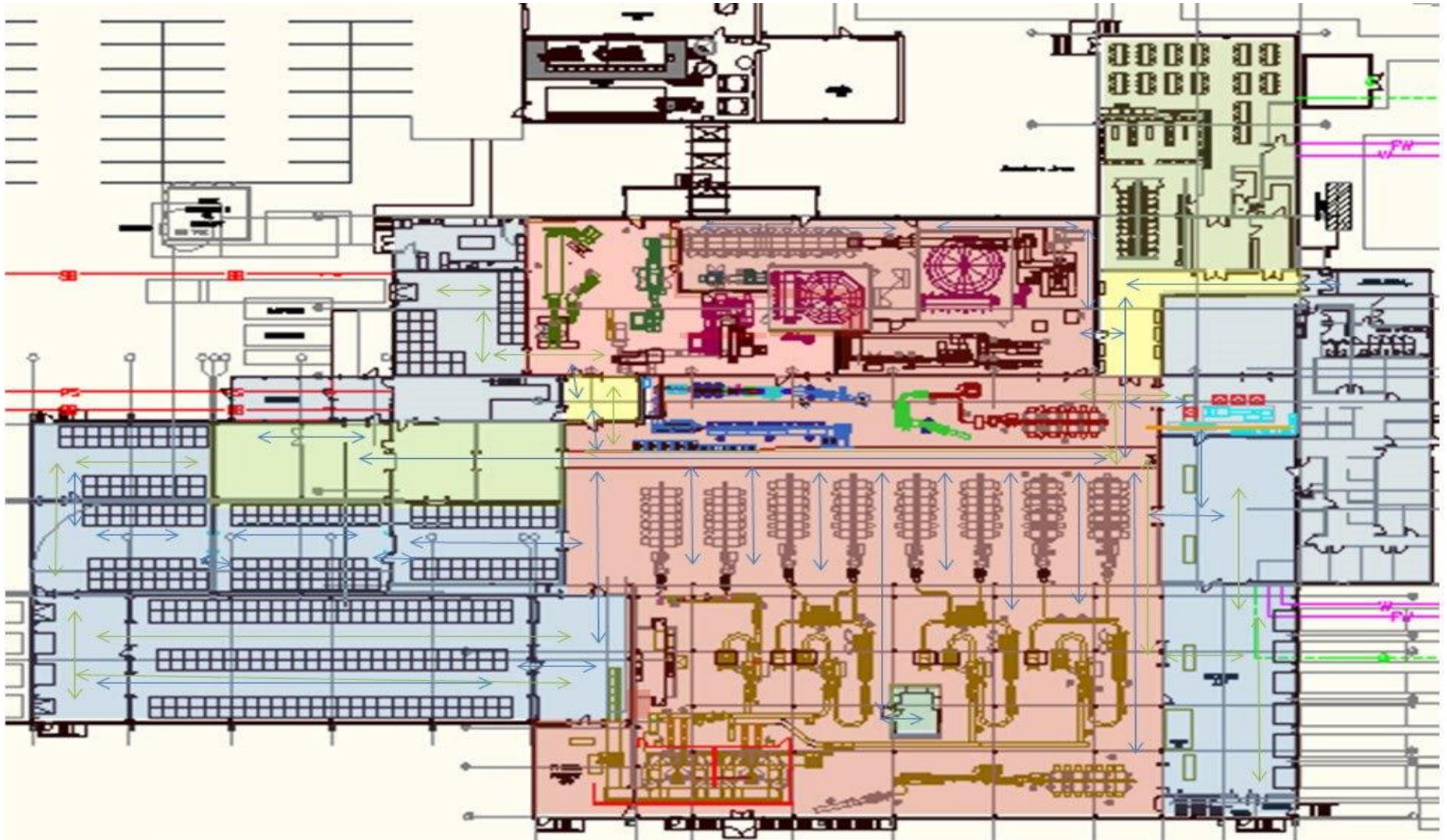
Path A



Path B



Hygienic Zoning Map



Verification

The following tools can be used:

- Routine pre-operational and operational inspections
- GMP audits
- Assurance of Sanitation Effectiveness Program
- Environmental Monitoring for Pathogen Control Program
- Environmental Air Monitoring Program



Managing Listeria for Dry Products

Dry products can have wet environments



Scott Hood

WHY

Presence = Recall

PRODUCT RECALLS

Bagged popcorn recalled over possible listeria contamination

Published October 01, 2012 · FoxNews.com

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Food Safety News

Breaking news for everyone's consumption

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Snacks, nuts, protein bars recalled for Listeria concerns

BY CORAL BEACH | MAY 3, 2016

Better to know and act than to have someone else
find the issue

Find It, Fix It

Seek and Destroy



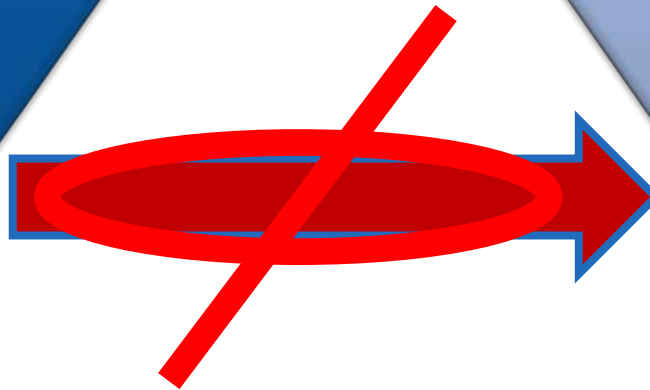
Microorganisms in the Environment

Transient
Findings

Established
Populations

Low Risk

Increased
Risk



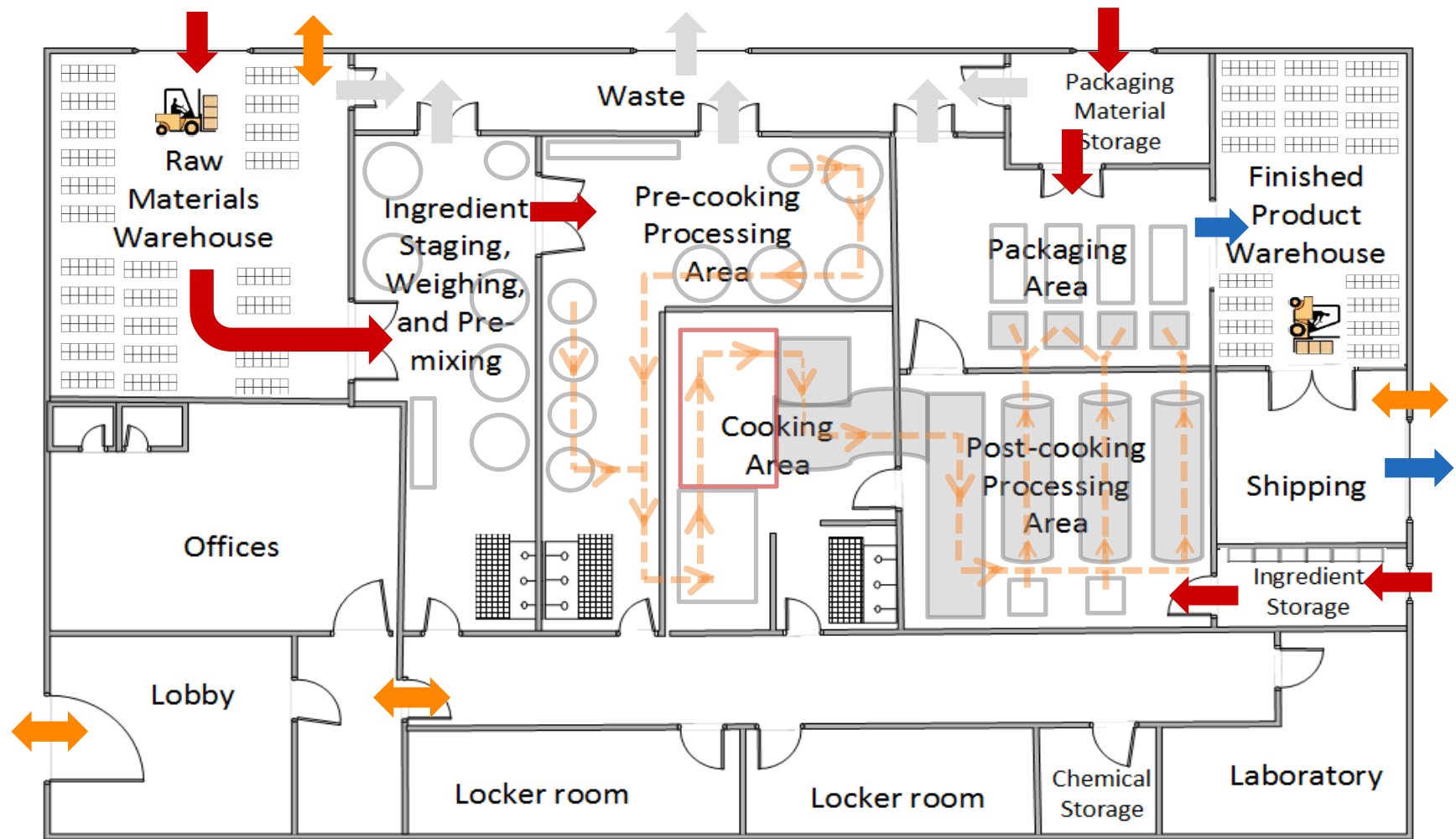
Practical Approach

➤ Policy Requirement

- In mostly dry areas, *Salmonella* should be emphasized. If there are specific locations that get wet, then also sample for *Listeria* species.



Plant Scenario



➡ Raw materials

➡ Waste

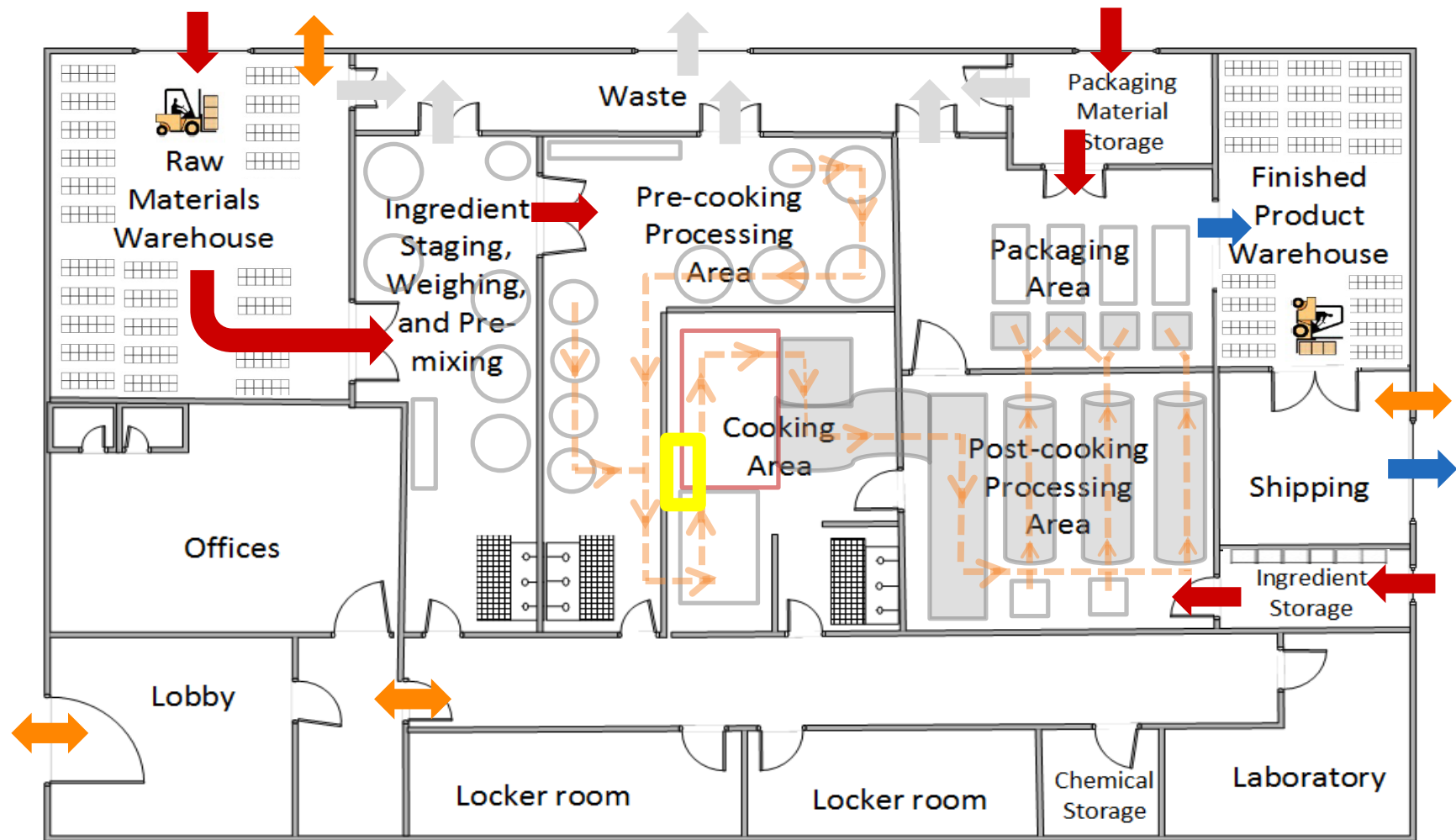
➡ Finished product

➡ Main personnel entrances/exits

---➡ Process flow



Plant Scenario



➡ Raw materials

➡ Waste

➡ Finished product

➡ Main personnel entrances/exits

---➡ Process flow



Escalation

Is *L. monocytogenes* present?

Is there an established population *L. monocytogenes*

What will be needed to eliminate *L. monocytogenes*



Resources

- U.S. Food and Drug Administration (1998). Guide to Minimize Microbial Food Safety Hazards for Fresh Fruits and Vegetables
www.fda.gov/downloads/Food/GuidanceComplianceRegulatoryInformation/GuidanceDocuments/ProductionandPlanProducts/UCM169112.pdf
- Codex Alimentarius Commission (2007). Guidelines on the application of general principles of food hygiene to the control of *Listeria monocytogenes* in ready-to-eat foods – CAC/GL 61-2007
http://www.codexalimentarius.net/download/standards/10740/CXG_061e.pdf (2007)
- Food Safety Authority of Ireland (2005). The Control and Management of *Listeria monocytogenes* contamination of Food.
- *Listeria*, Listeriosis and Food Safety (2007). 3rd Edition. Ryser and Marth (eds) CRC Press
- U.S. Food and Drug Administration (2008). Draft Guidance for Industry: Control of *Listeria monocytogenes* in Refrigerated or Frozen Ready-To-Eat Foods.
www.fda.gov/Food/GuidanceRegulation/GuidanceDocumentsRegulatoryInformation/FoodProcessingHACCP/ucm073110.htm
- Health Canada (2011). Policy on *Listeria monocytogenes* in ready-to-eat foods
- U.S. Department of Agriculture (2012). FSIS Compliance Guideline: Controlling *Listeria monocytogenes* in Post-lethality Exposed Ready-to-Eat Meat and Poultry Products.
http://www.fsis.usda.gov/shared/PDF/Controlling_LM_RTE_guideline_0912.pdf
- United Fresh Produce Association (2013). Guidance on environmental monitoring and control of *Listeria* for the fresh produce industry.

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Conclusions

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GMA SEF/ JIFSAN meeting research needs

- Growth / no-growth
 - Highest growth and dose, strain persistence, micro ecology/ niches
- Virulence
 - animal models, co-infection, multiple exposures
- Risk assessments
 - Dose response, subpopulations, getting right info to the right people
- Other
 - Cross training between industries, broadening the participants in the conversation

Next Steps

- Anxiously awaiting FDA guidance

ALP Alliance for
Listeriosis Prevention



In the meantime, industry must take prudent steps to evaluate the risk of *L. monocytogenes* and control for this pathogen

Thank you!

Questions???

(Please identify if you would like the question addressed by a specific presenter)

For questions after the webinar contact
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