



Pathogen Environmental Monitoring Tools for Produce Processors

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VISION:

To become a leading food safety research and outreach lab that fosters scientific curiosity and rigor in Nebraska and beyond.

MISSION:

To provide robust, credible science-based practical solutions to mitigate the risk of microbial foodborne illness and to deliver pertinent training and technical assistance to improve food safety and public health in a collaborative and professional way.

CORE VALUES:

Accountability, inclusive excellence, respect, teamwork, and tolerance.



CHAVES - FOOD SAFETY MICROBIOLOGY LAB



<https://chaveslab.unl.edu>

@that_bald_prof



1. Preventive Controls for Human Food
2. Preventive Controls for Food for Animals
3. Standards for Produce Safety
4. Mitigation Strategies to Protect Food Against Intentional Adulteration
5. Sanitary Transportation of Human and Animal Food
6. Foreign Supplier Verification Programs for Importers of Food for Humans and Animals
7. Accredited Third-Party Certification

- FSMA Preventive Controls for Human Food
- Facilities that **manufacture, process, pack, or hold foods** are required to establish and implement a food safety system.
- Food Safety Plan:
 - Hazard Analysis
 - Preventive Controls (PC)
 - Process PC
 - **Sanitation PC**
 - Food Allergen PC
 - Supply Chain Controls
 - Recall Plan





Part 117 – Current Good Manufacturing Practice, Hazard Analysis, and Risk-based Preventive Controls For Human Food

- Subpart B – cGMP
- Subpart C – Hazard analysis and risk-based preventive controls
- Subpart G – Supply chain program
- 21 CFR 117.135 (3) – Sanitation Controls:
 - Procedures, practices, and processes to ensure that the facility is maintained in a sanitary condition adequate to significantly minimize or prevent hazards such as environmental pathogens, biological hazards due to employee handling, and food allergen hazards.



- If during the course of a hazard analysis, a manufacturer determines that an environmental pathogen is reasonably foreseeable to occur, then a **sanitation preventive control** for that hazard must be implemented.
- The manufacturer is required to conduct **environmental monitoring** to verify that the preventive control is consistently implemented and effectively and significantly minimizing or preventing the hazard.
- Environmental pathogens:
 - *Listeria monocytogenes* (Lm)
 - *Salmonella*
- Zero Tolerance





- An environmental pathogen is reasonably foreseeable if:
 1. The product is RTE.
 2. The product is exposed to the environment prior to packaging.
 3. The product does not receive a lethal heat treatment or other control measure (such as a formulation lethal to the pathogen) that would significantly minimize the pathogen in the final product.



Contamination Routes

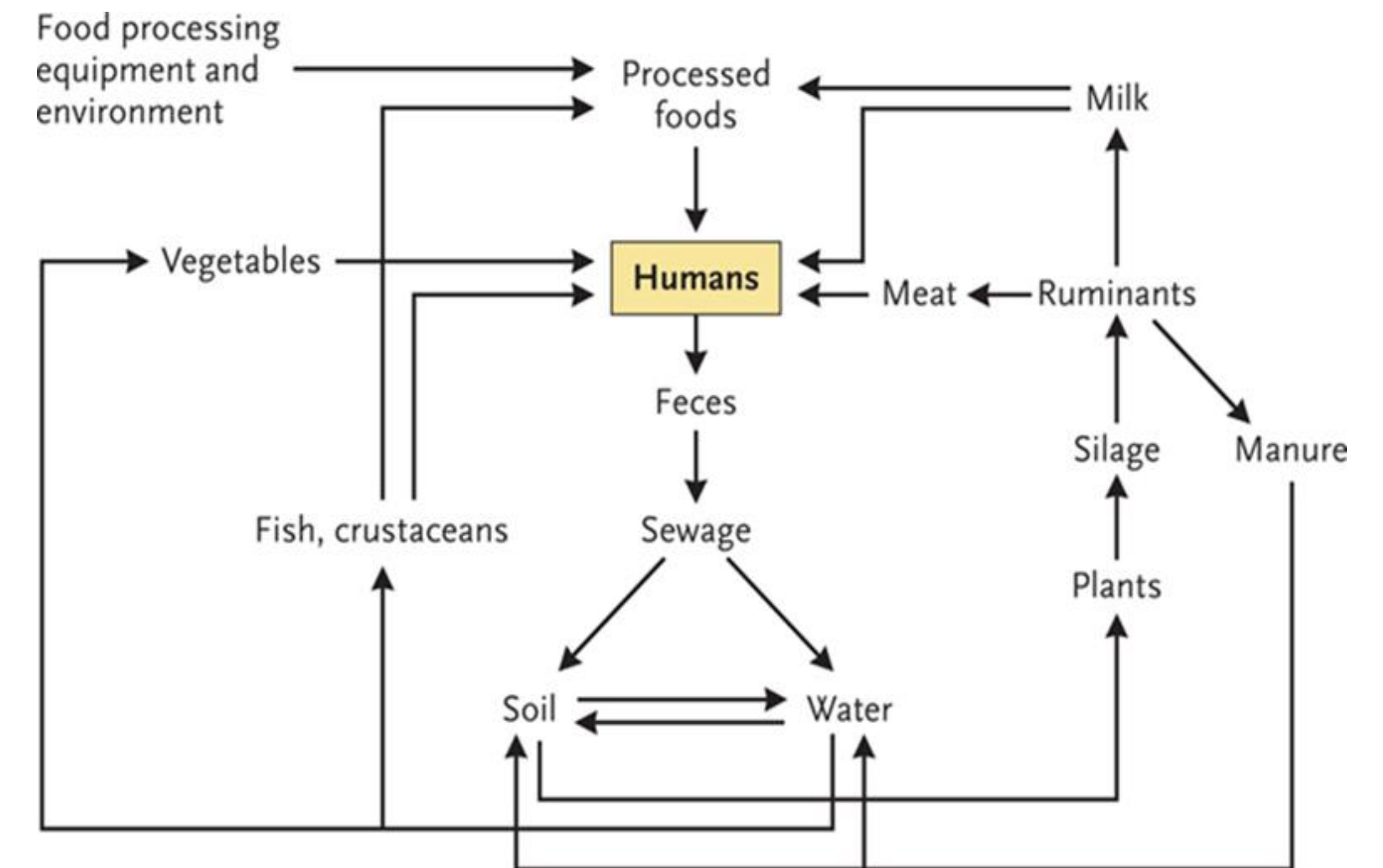
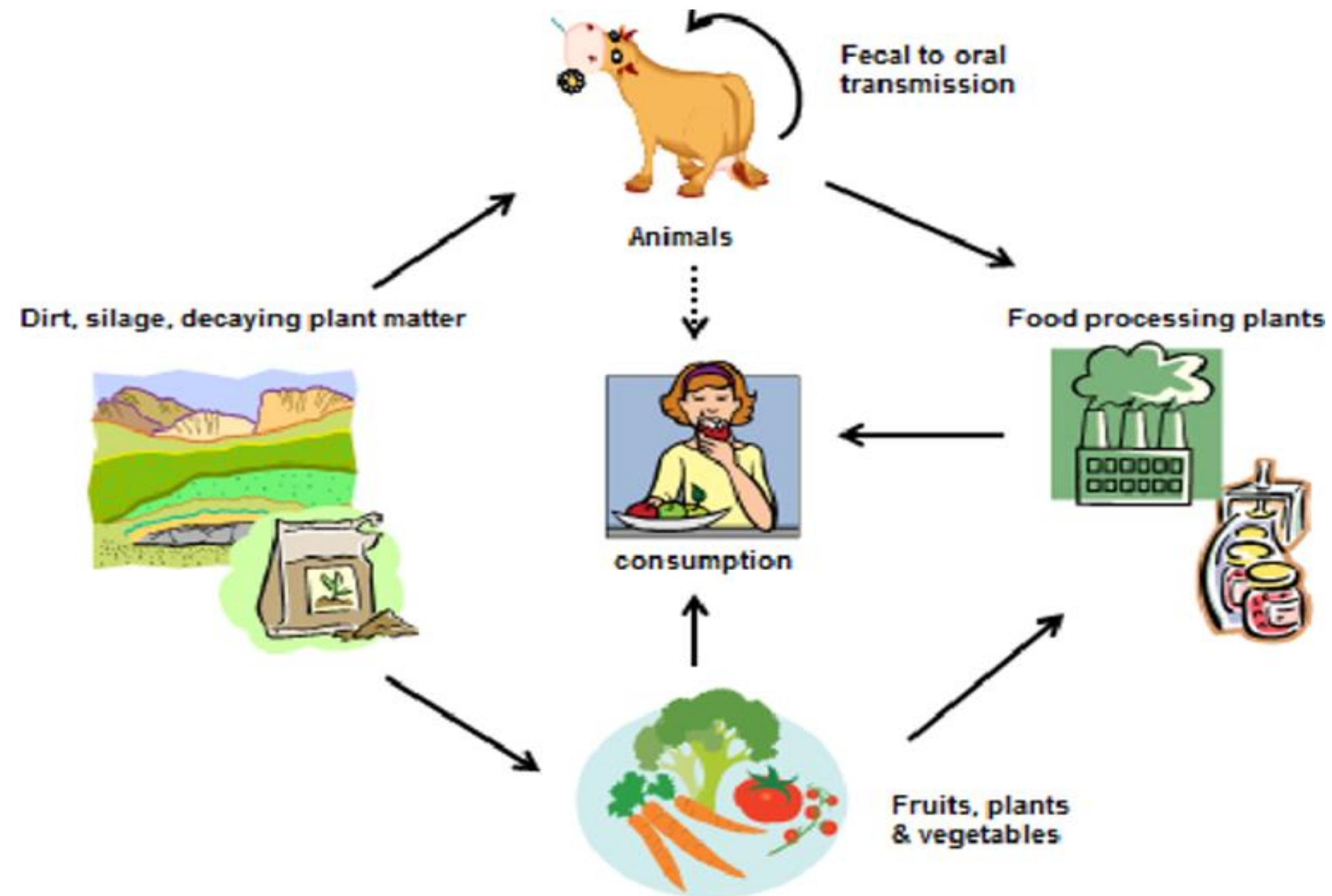


Figure Potential route of transmission of *L. monocytogenes* Food Microbiology: An Introduction, 5th Ed. 2017. ASM Press

- Deli meats, frankfurters and dairy (Mexican-style cheese) associated with earliest outbreaks
- Outbreaks have diversified to include other food matrices
- Outbreaks often traced back to environmental contamination



Mexican-style cheese outbreak, 1985. 142 cases, 48 fatalities.



Frankfurter outbreak, 1998. Multistate outbreak. 108 cases, 14 fatalities.



Deli meat outbreak, 2002. 54 cases, 8 fatalities.



Cantaloupe outbreak 2011: 28 states, 147 cases, 33 deaths.

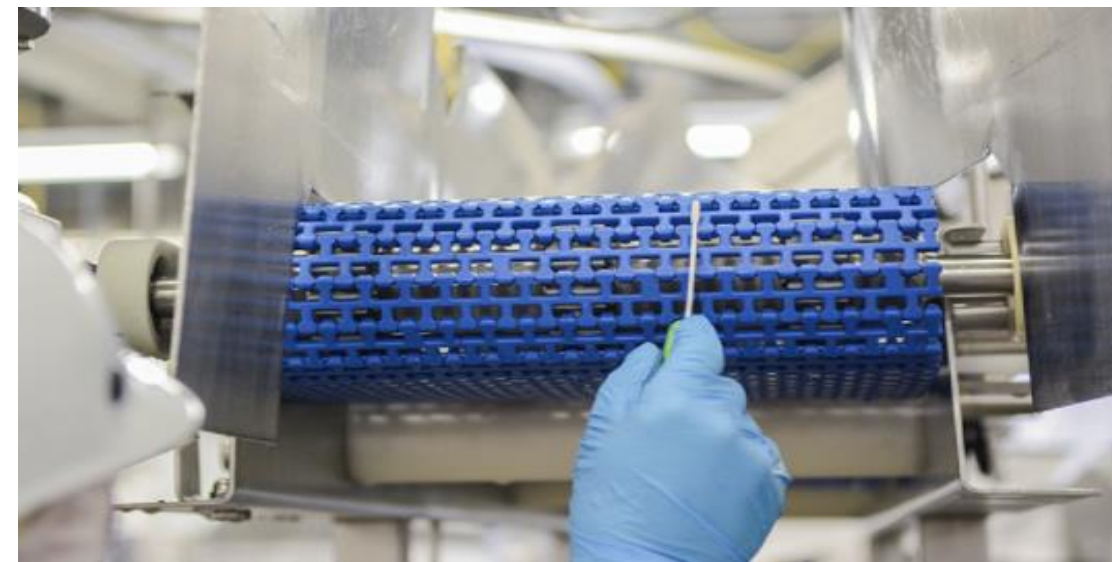


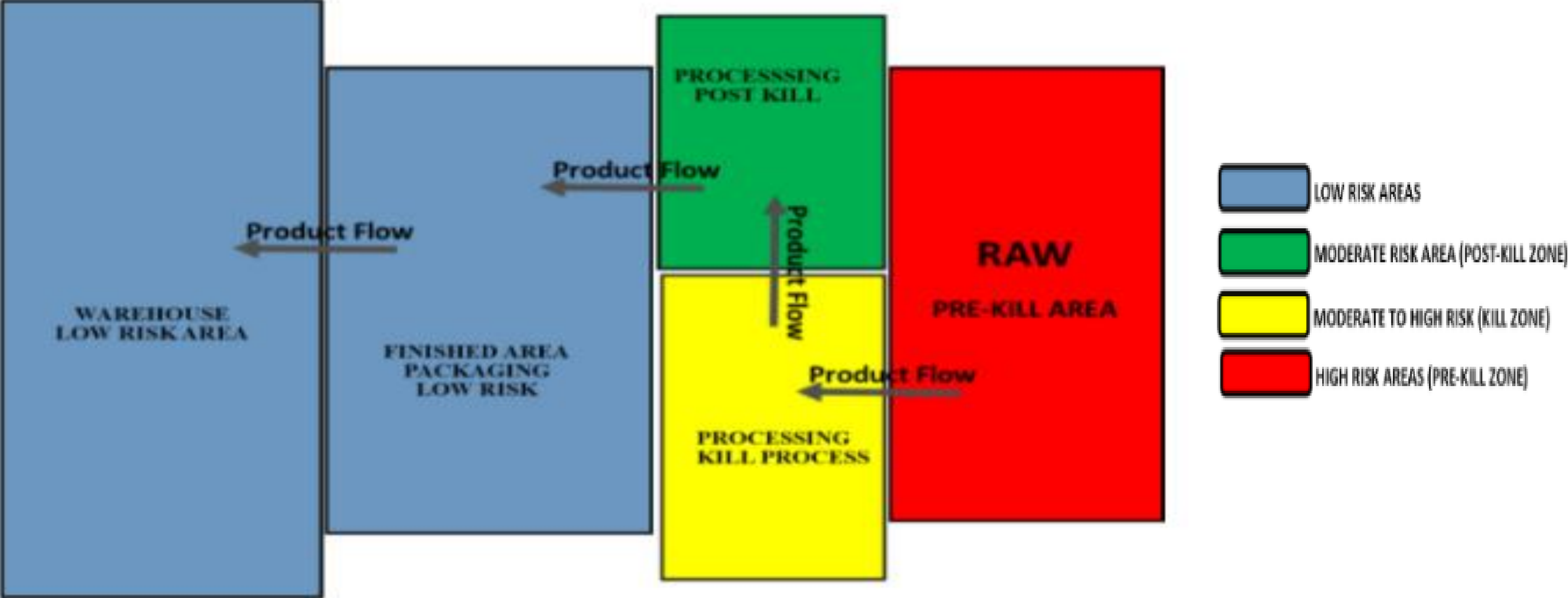
Sprout outbreak, 2014. 2 states, 5 cases, 2 fatalities.



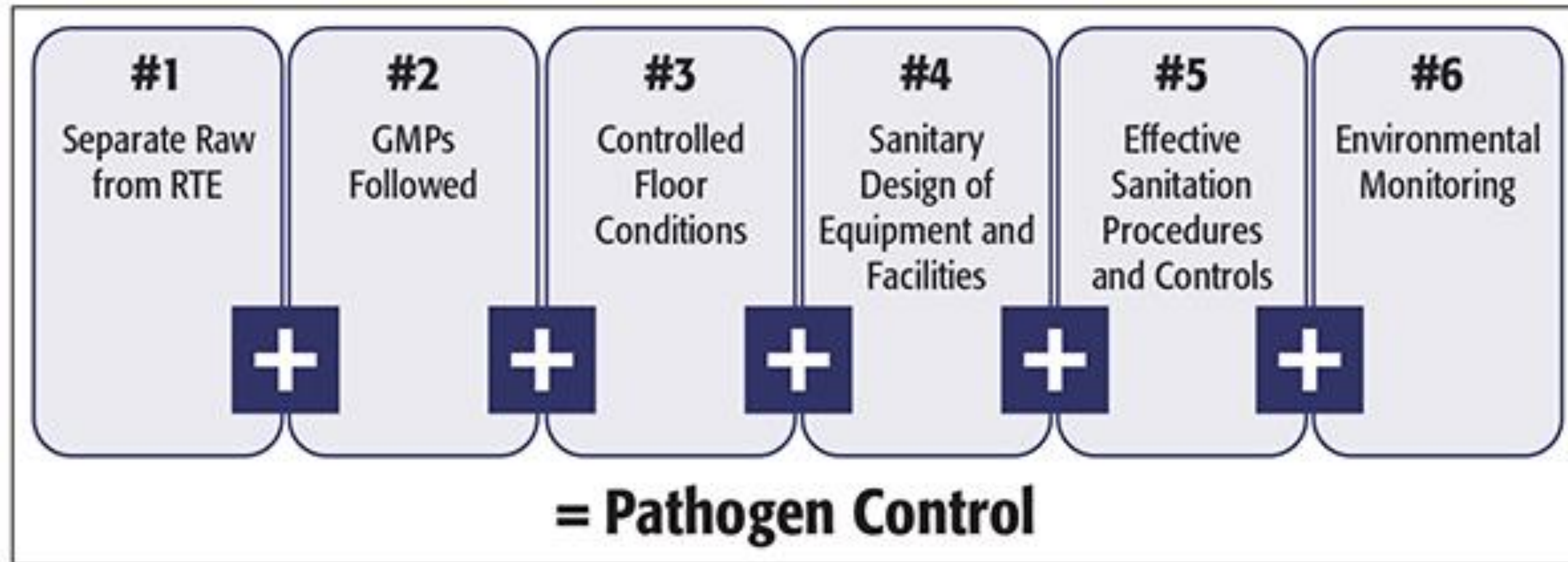
Enoki mushroom outbreak, 2020. 17 states, 36 cases, 4 fatalities.

EM Programs





The Pathogen Control Equation





- **Zone 1** – Product contact surfaces, the highest level of risk
- **Zone 2** – Non-product contact sites directly adjacent to product contact surfaces: Control buttons, equipment framework, mechanics' tools
- **Zone 3** – Within the post-processing areas - Floors, walls, drains, floor mats, forklifts, pallets and air handling units.
- **Zone 4** - Post-processing areas, but if unchecked, can lead to cross-contamination of Zones 1, 2 and 3: Hallways, loading docks, warehouses, coolers, bathrooms, locker rooms and break rooms



- Essential component of the QA/QC system
 - Control of microorganisms in air, compressed air, water, personnel, and surfaces.
- Verification tool, NOT a control measure
 - Minimize risk of cross contamination or reservoir for environmental pathogens.
- Must be written and be statistically sound
 - Experimental design and sampling
 - EXPERIENCE
- The results may be used to demonstrate that the environment is under control.
- Data must be analyzed at a pre-determined frequency to identify transmission routes and bacterial niches.



- *Listeria* spp. is an index organism for the presence of *Lm*.
- If *Listeria* is present, *Lm* may be present as well.
- *Lm* is one of 19-ish *Listeria* species.
 - Some share ecological niches.
- Usually present at very low quantitative levels.
 - Do you need to enumerate?
- Testing for *Listeria* spp. provides a higher probability of finding a positive sample.



- It is recommendable to test for *Listeria* spp.
 - If positive, then the environment is suitable for *Lm*.
 - Identification of sites that require additional control
- If testing for *Lm*, collect samples of surfaces in direct contact, segregate the product, and maintain it under control until a negative result is received.
- In general, you can only approximate the presence of *Lm* using *Listeria* spp. if you follow exceptional sanitation practices.



- Scenarios for *Listeria* transmission
 - *Listeria* – transient
 - *Listeria* – spread from a focal point
 - *Listeria* – plant resident in a niche (biofilm or other)
- How do you gain control back from each of those scenarios?



- Regulatory agencies expect occasional positive results.
- A positive result must be accompanied by a corrective action adequately implemented and by a root cause analysis that will help prevent reoccurrence of the default.
- Sporadic positive results demonstrate that the monitoring system works, assuming the design is sound.
 - Positive results may be the symptom for a serious disease!



Packingshouses vs. Fresh Cut

What's Riskier?



Off season vs. Peak Season

What's Riskier?



Risk Factors

Listeria contamination



Where to sample?

Listeria contamination



How often to sample?

Listeria contamination



THANK YOU!