



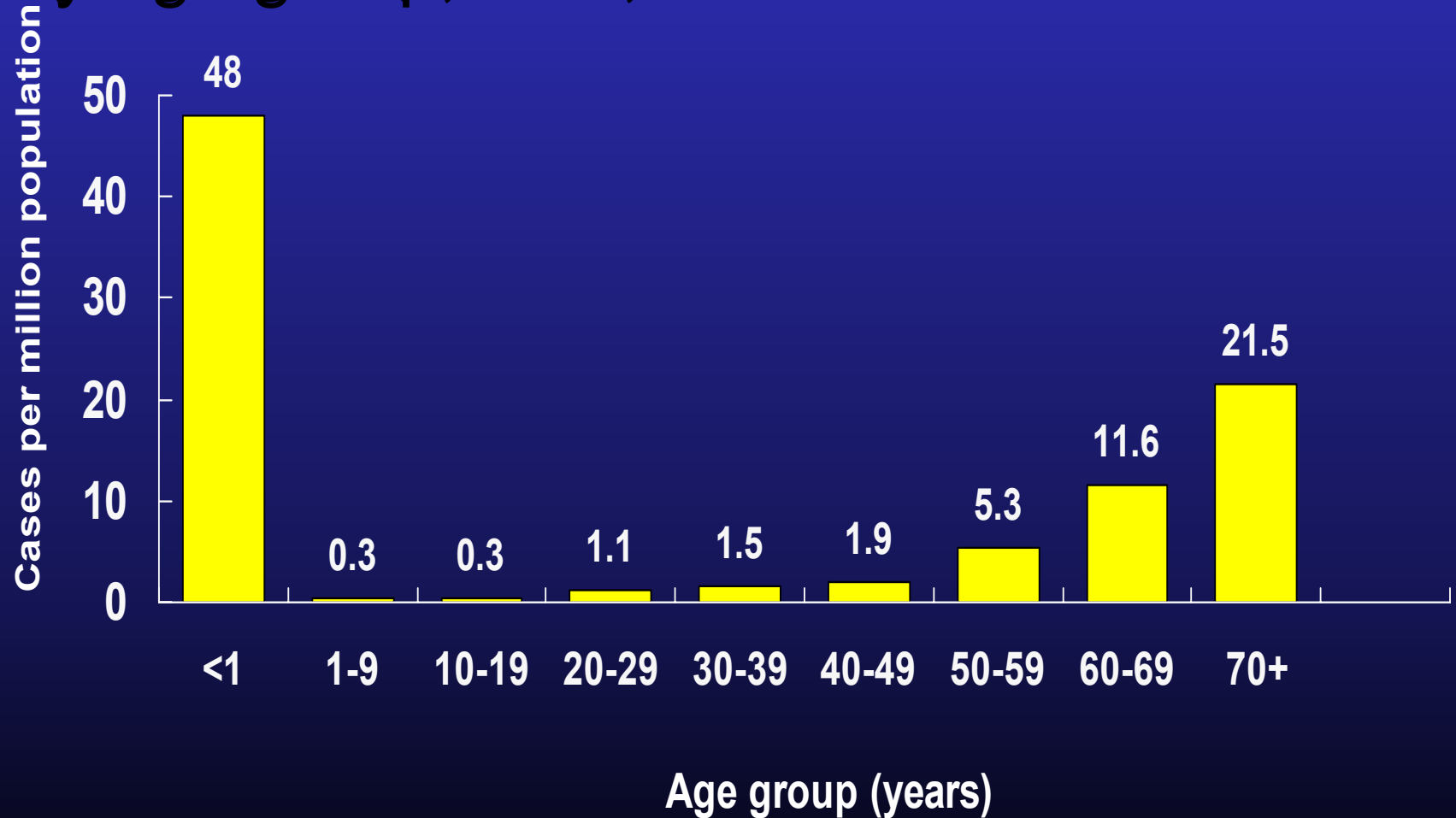
Listeria monocytogenes in
Ready to Eat Meat and Poultry
Plants: An Update

Randall Huffman
American Meat Institute
Foundation

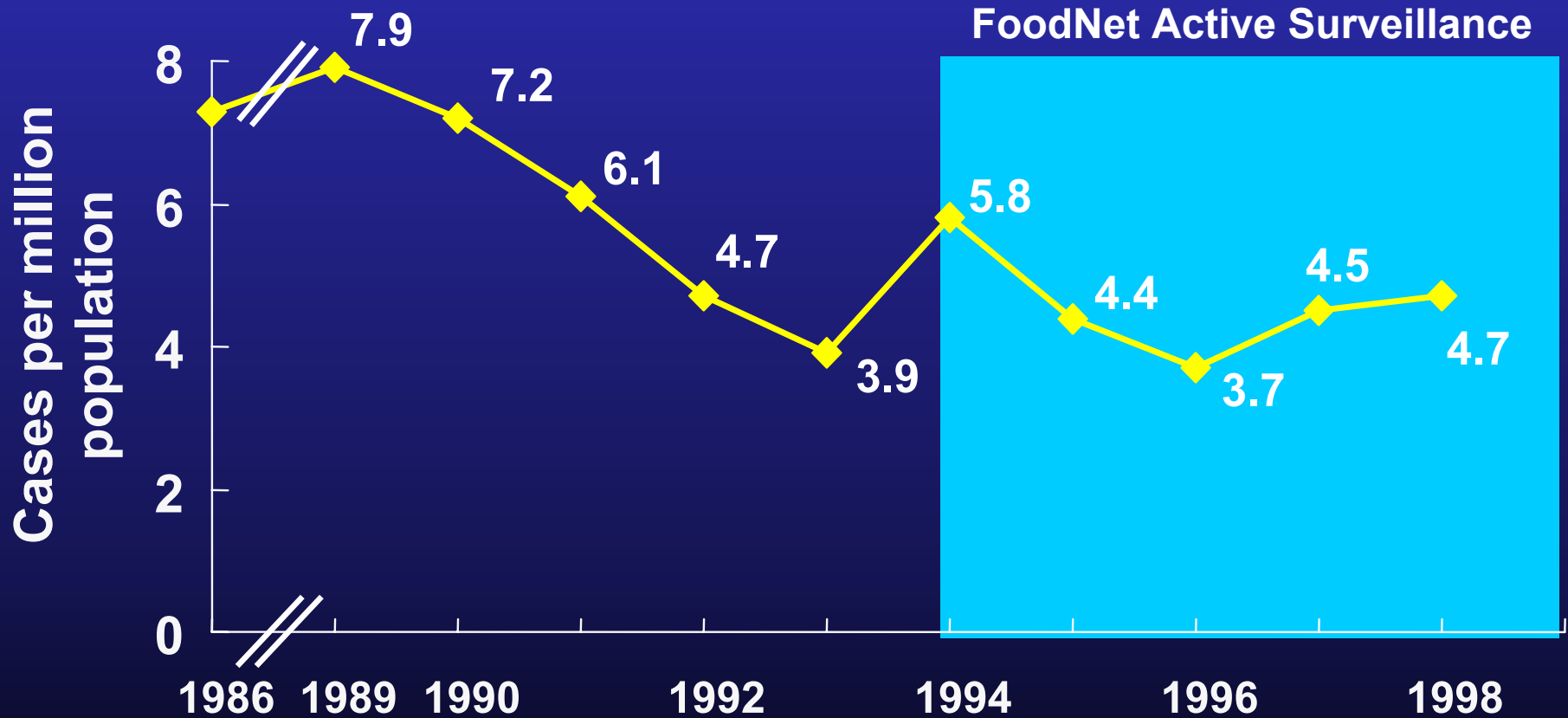
July 25, 2001



Incidence of listeriosis by age group, U.S., 1994-98

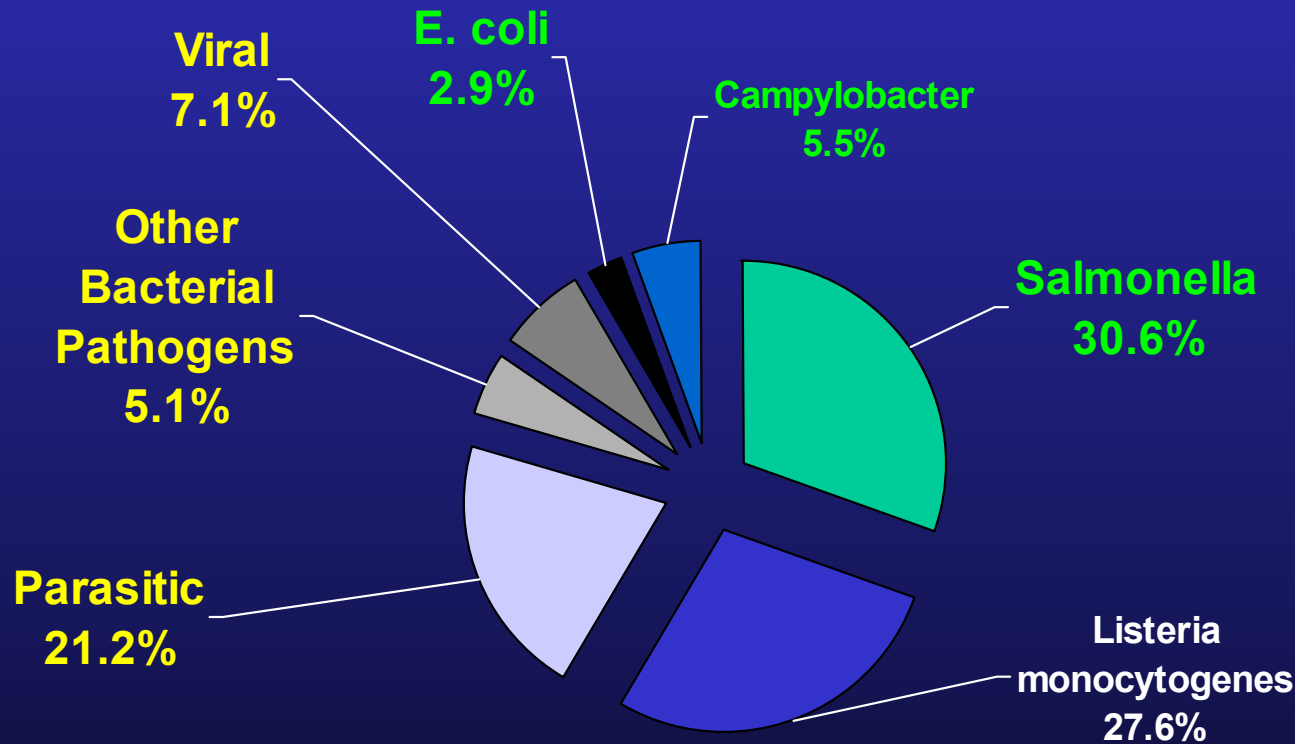


Incidence of listeriosis in the U.S., 1986-1998



Source: CDC

Deaths Caused By Known Foodborne Pathogens



Source CDC, 2000

**Listeriosis is a serious
disease primarily
transmitted through
foods.**

***Lm* can be isolated from a variety of animals:**

Sheep, cattle, goats, pigs, chickens, turkeys, pheasants, fish, crustaceans, mice, rats, rabbits, dogs, cats, deer, pigeons, parrots, frogs, insects, etc.

Wesley in Ryser & Marth, 1999

***Lm* has been isolated from a wide variety of foods:**

Dairy Products: cheeses, ice cream

Meats: sausages, ham, pâté

Poultry: chicken, turkey

**Vegetables: potatoes, radishes,
salad mixes**

Seafood: crab, shrimp, salmon, trout

**Farber & Peterkin, 1991; Ryser & Marth,
1999**

***Lm* has been isolated from food plant environments**

- Floors
- Drains
- HVAC
- Coolers
- Condensate
- Conveyors
- Peelers, etc.
- Mops, sponges

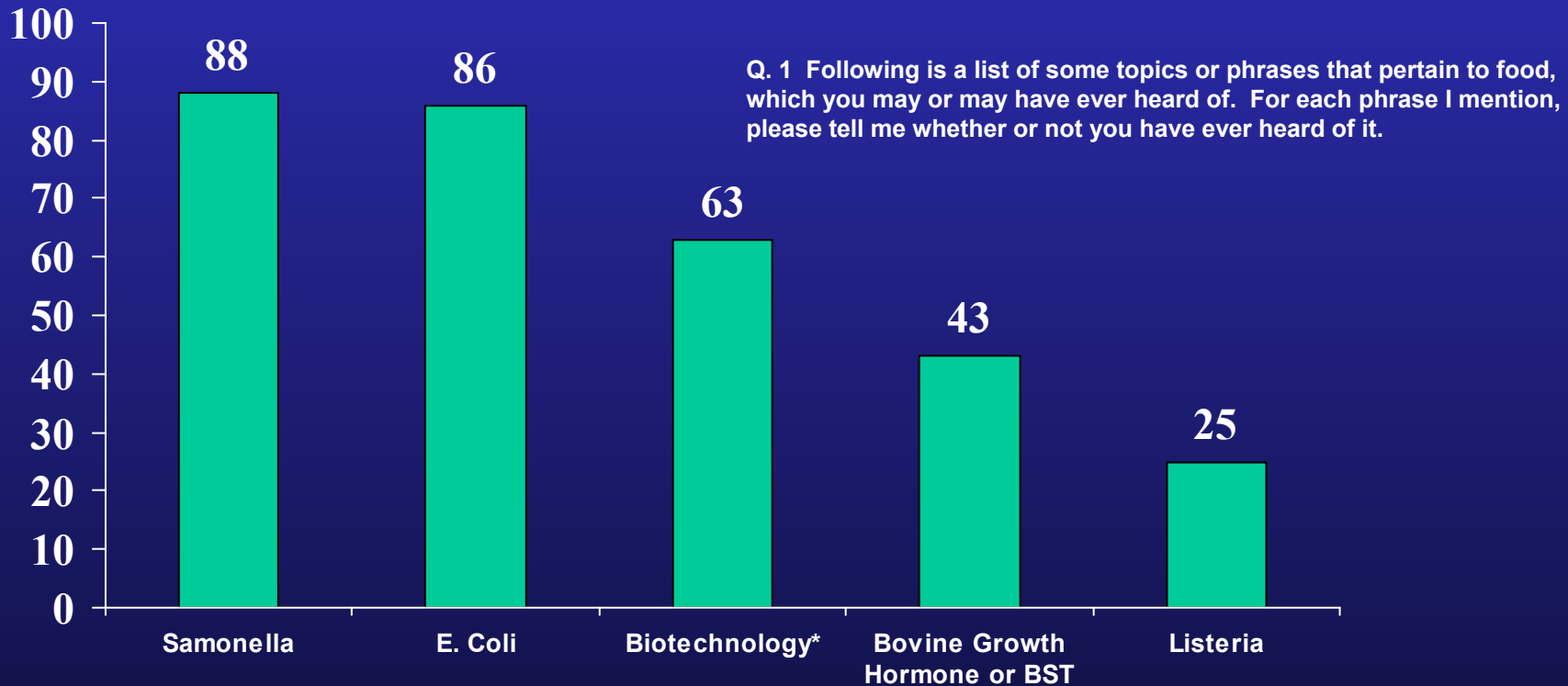
**Bernard & Sveum, 1994;
Gravani in Ryser & Marth, 1999**

***Lm* can be isolated from
the intestinal tract of
humans:**

**0.8-21% of normal,
healthy humans**

**Slutsker & Schuchat in
Ryser & Marth 1999**

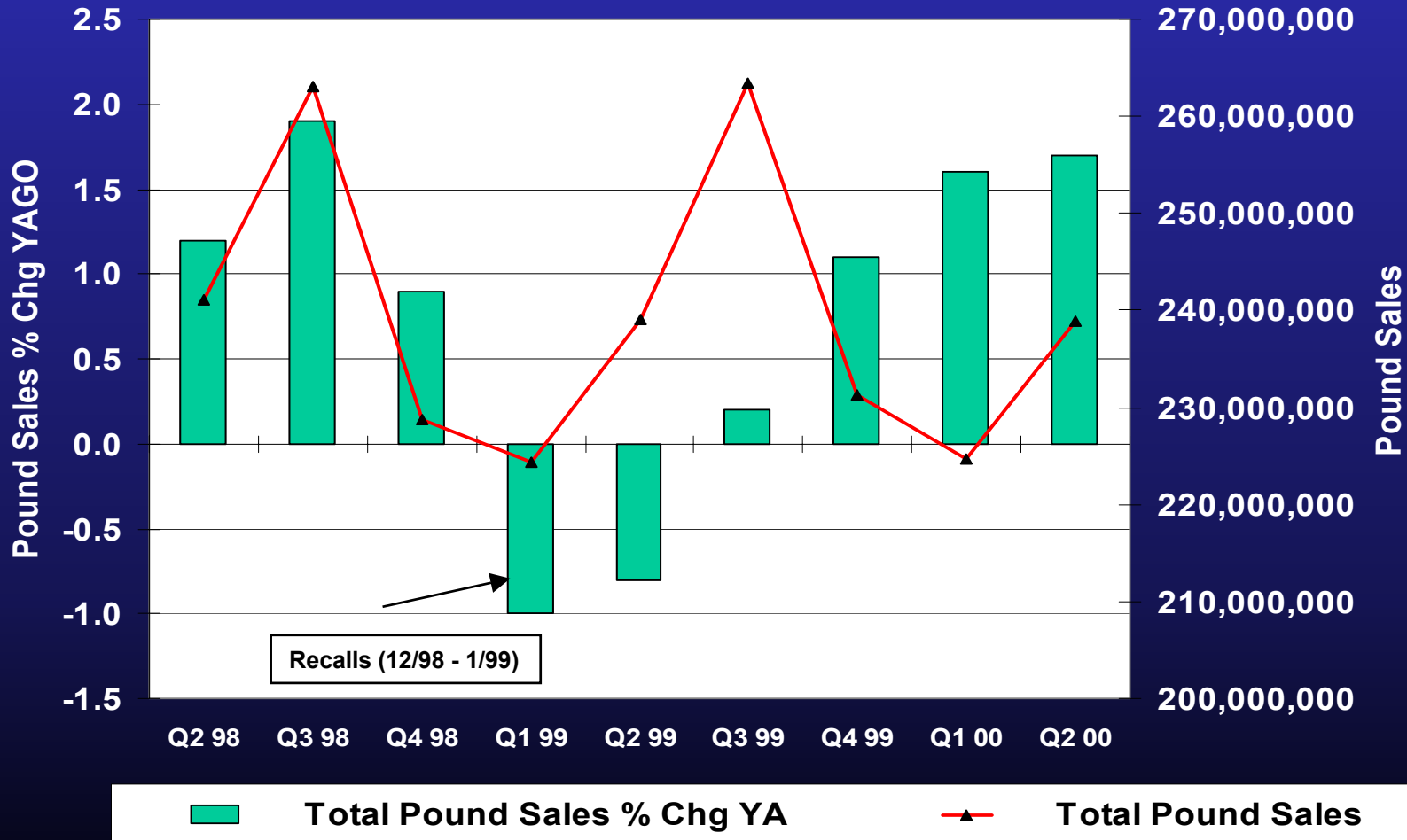
Awareness among consumers growing- but not top of mind, yet



*Biotechnology as it relates to food growing and manufacturing otherwise referred to as Genetically Modified Foods.

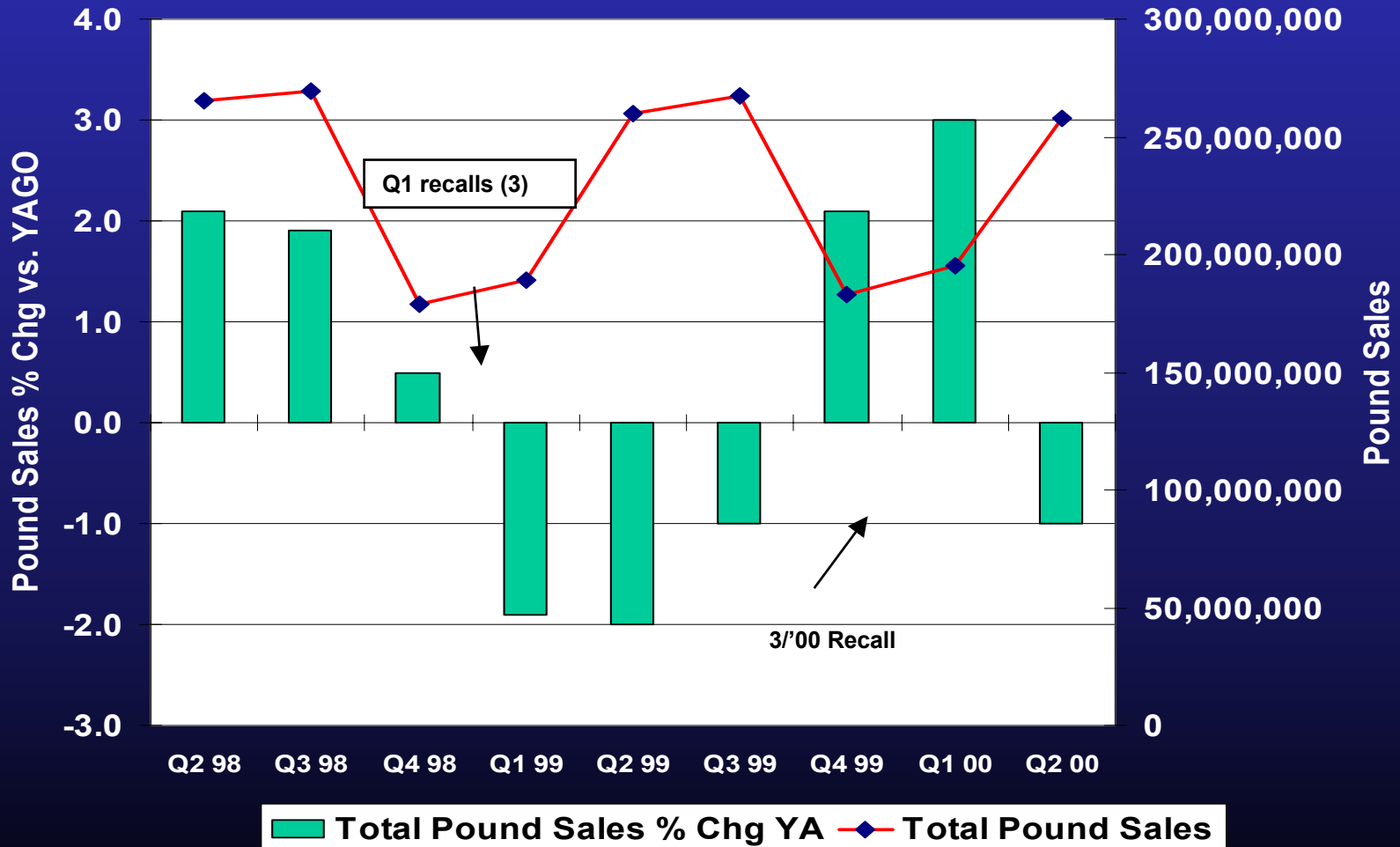
Cold Cut Category

Total Cold Cut Category



Hot Dog Category

Total Hot Dog Category



In the past:

- **CDC and others looked for unusual an number of cases of listeriosis (i.e., peaks).**

Today:

- **It is possible to detect an outbreak that involves widely scattered cases that would otherwise go unnoticed.**
- **These outbreaks may involve large numbers of people distributed over a long period of time.**

Three General Scenarios

1. Isolated case

2. Cases due to a single event or lot of food

3. Clusters and isolated cases scattered by time and location.

Scenario No. 1: The Isolated Case

- **An individual case of listeriosis with no apparent link to others.**
- **The conditions leading to isolated cases are varied and often uncertain or unknown.**
- **Some may be part of a cluster or outbreak that was not detected.**

Scenario No. 2: Cases Linked by a Single Lot of Food

- **One lot of contaminated food that leads to a cluster of cases.**
- **One or more food handling errors may be involved.**
- **The outbreak ceases when the lot of food is no longer available.**

Scenario 3:

Clusters or outbreaks involving multiple lots of food from a single source

- **The cases may be scattered by time and location.**
 - **An unusually virulent strain of *Lm* has become established in a food operation.**
 - **Multiple lots of food are contaminated over time.**
 - **The food supports the growth of *Lm*.**

Industry Priorities

- 1. Prevent conditions that lead to extended outbreaks (scenario 3).**
- 2. Control conditions to minimize the risk of isolated cases and clusters (scenarios 1 and 2).**
- 3. Control conditions to satisfy regulatory requirements.**



Appreciates the efforts of the following companies:



What Great Taste Is All About

Strategies for Control of *Lm* in the post-thermal environment

- 1. Prevent the establishment of *Lm* growth in a niche or other sites that can lead to contamination of RTE products.**
- 2. Implement a sampling program that can assess in a timely manner whether the RTE environment is under control.**

Strategies for Control of *Lm* in the post-thermal environment

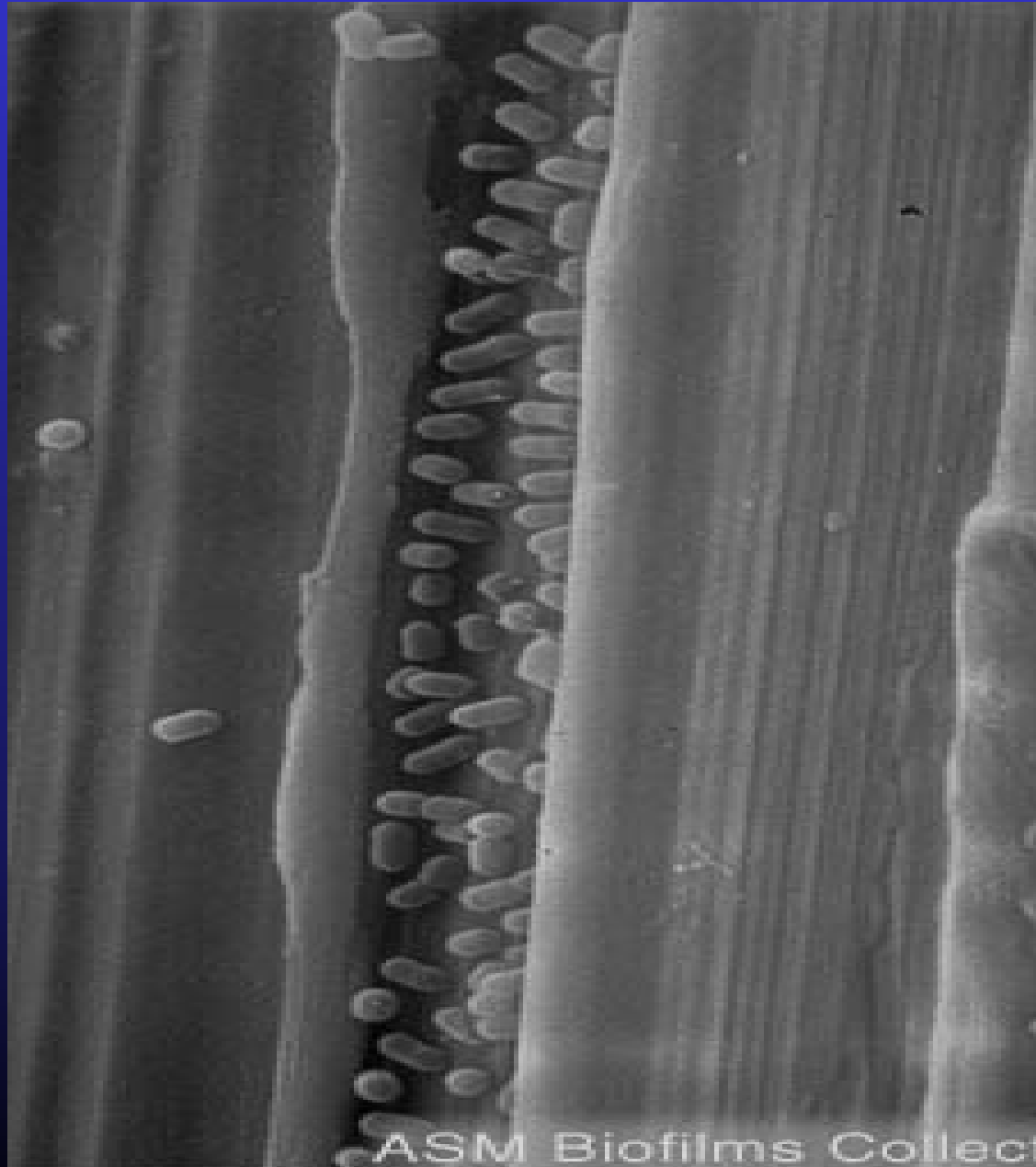
- 3. Respond to each positive product contact sample as rapidly and effectively as possible.**
- 4. Verify the problem has been corrected.**
- 5. Provide a short term assessment.**
- 6. Provide quarterly or annual summaries.**

Conditions that can lead to contamination of multiple lots of food

**Biofilms and
Harborage sites or Niches**

Biofilm

- **Bacteria that are attached to a surface and protected by a bacterial film.**
- **Biofilms provide increased resistance from disinfectants.**
- **Biofilms can occur on surfaces**
 - ▶ **such as metal, flooring materials, rubber, fabric, wood**
 - ▶ **that are infrequently or inadequately cleaned (eg, not scrubbed)**



ASM Biofilms Collect

Harborage Site or Niche

A site within the food processing environment wherein microorganisms become established and multiply.

- ▶ **The sites serve as a reservoir from which microorganisms are dispersed and contaminate equipment during operation.**
- ▶ **Niches may contain spoilage organisms and/or pathogens.**

Significance of a Niche

- **Niches are of greatest importance when located after a kill step in the process (eg, cooking) and can lead to contamination of ready-to-eat food.**
- **The processing environment typically appears visually clean and acceptable.**
- **Microbiological testing is necessary to detect the niche.**
- **Certain pathogens are more likely to be involved in a niche.**

Airborne versus Aerosol-borne Contamination

- Airborne contamination is dry in nature (e.g., dust particles). Mold spores are commonly transferred by air. This mechanism is not normally associated with transfer of Lm.
- Aerosols are fine, moisture droplets. Aerosols can be generated by high-pressure hoses, from moisture in compressed air lines, and from pumps. This type of contamination may be a potential source of *Listeria*.

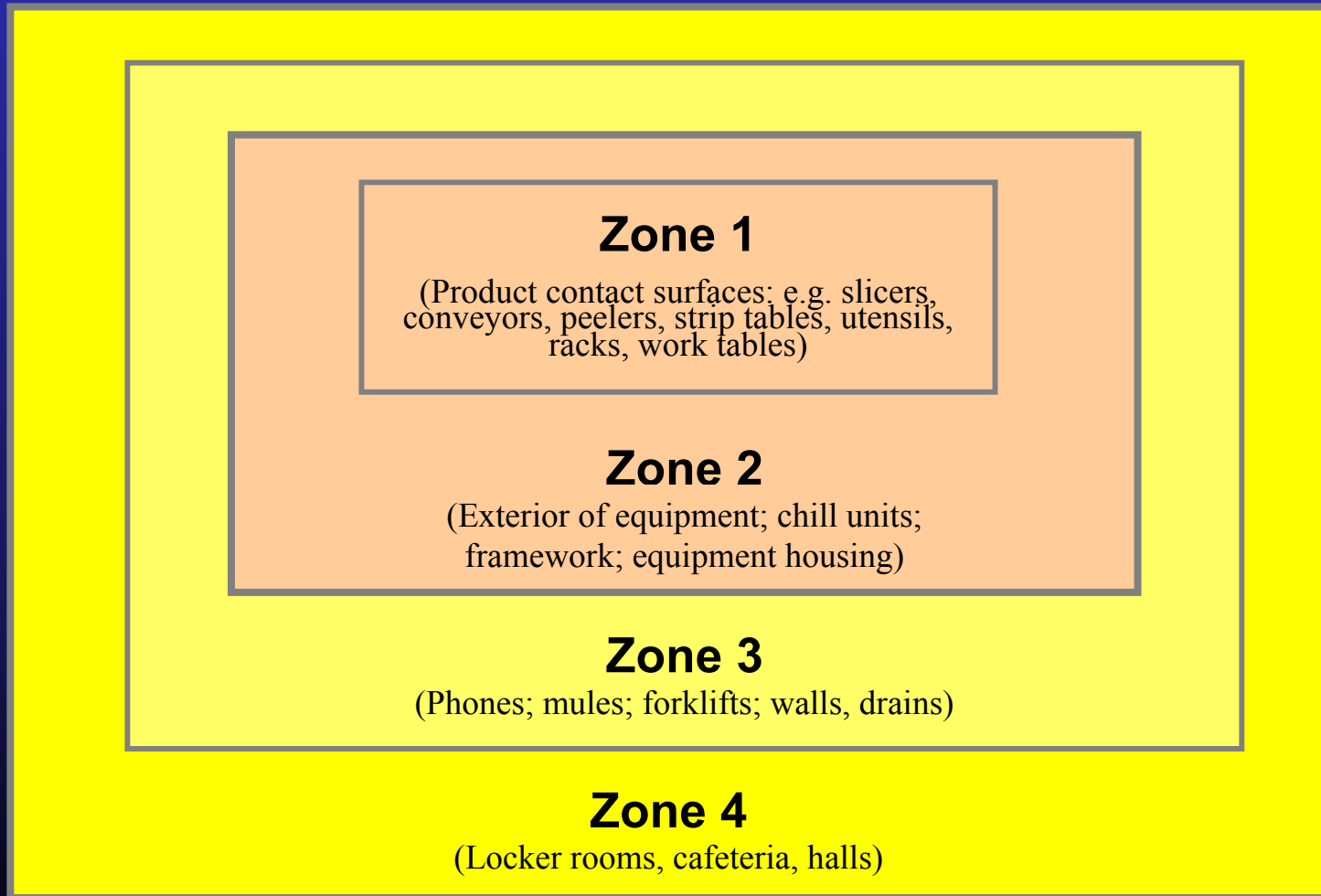
Listeria Equation

Controlled Traffic Patterns + GMP's + Clean, Dry Uncracked Floors + Sanitary Design Equip Building + Effective Sanitation Procedures Controls

=

**Listeria
Control**

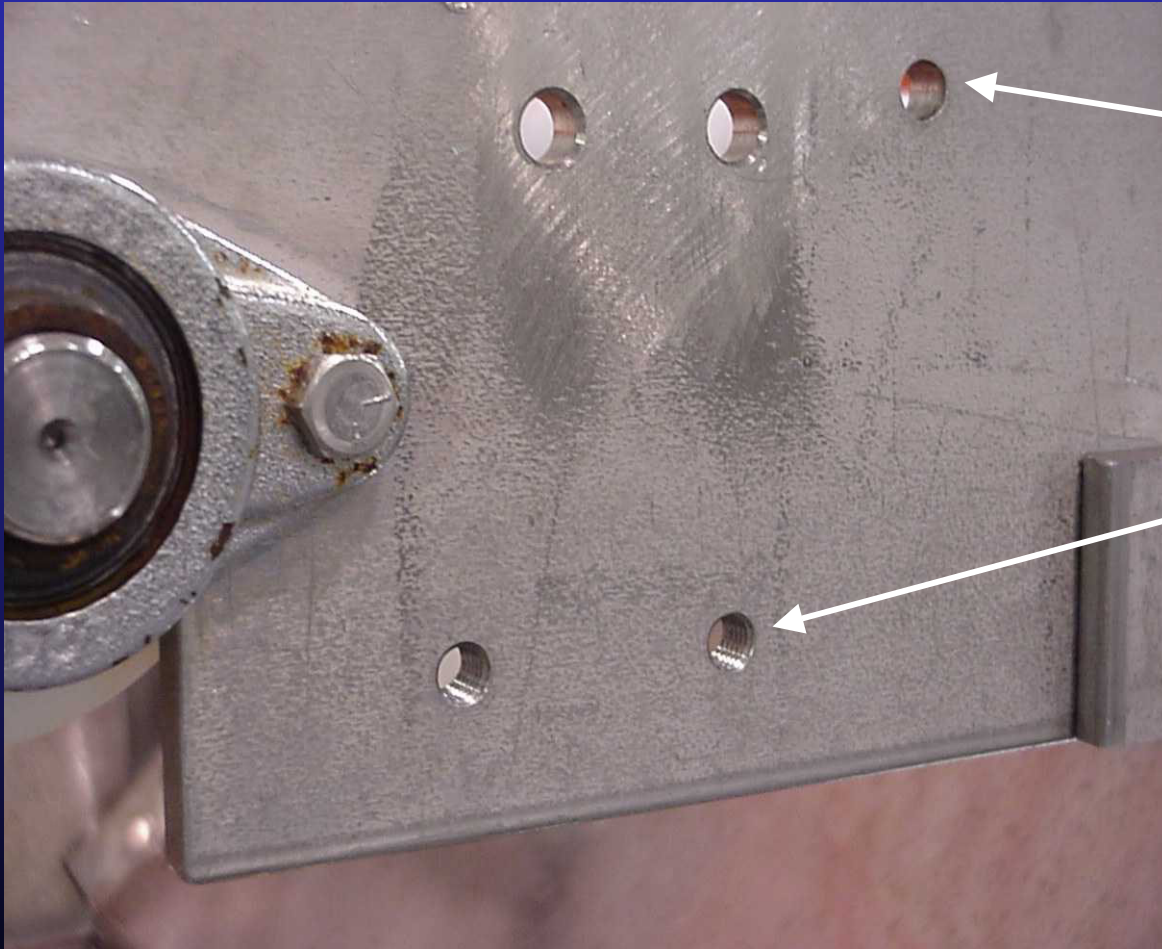
Sanitary Zones



Principles of Sanitary Design

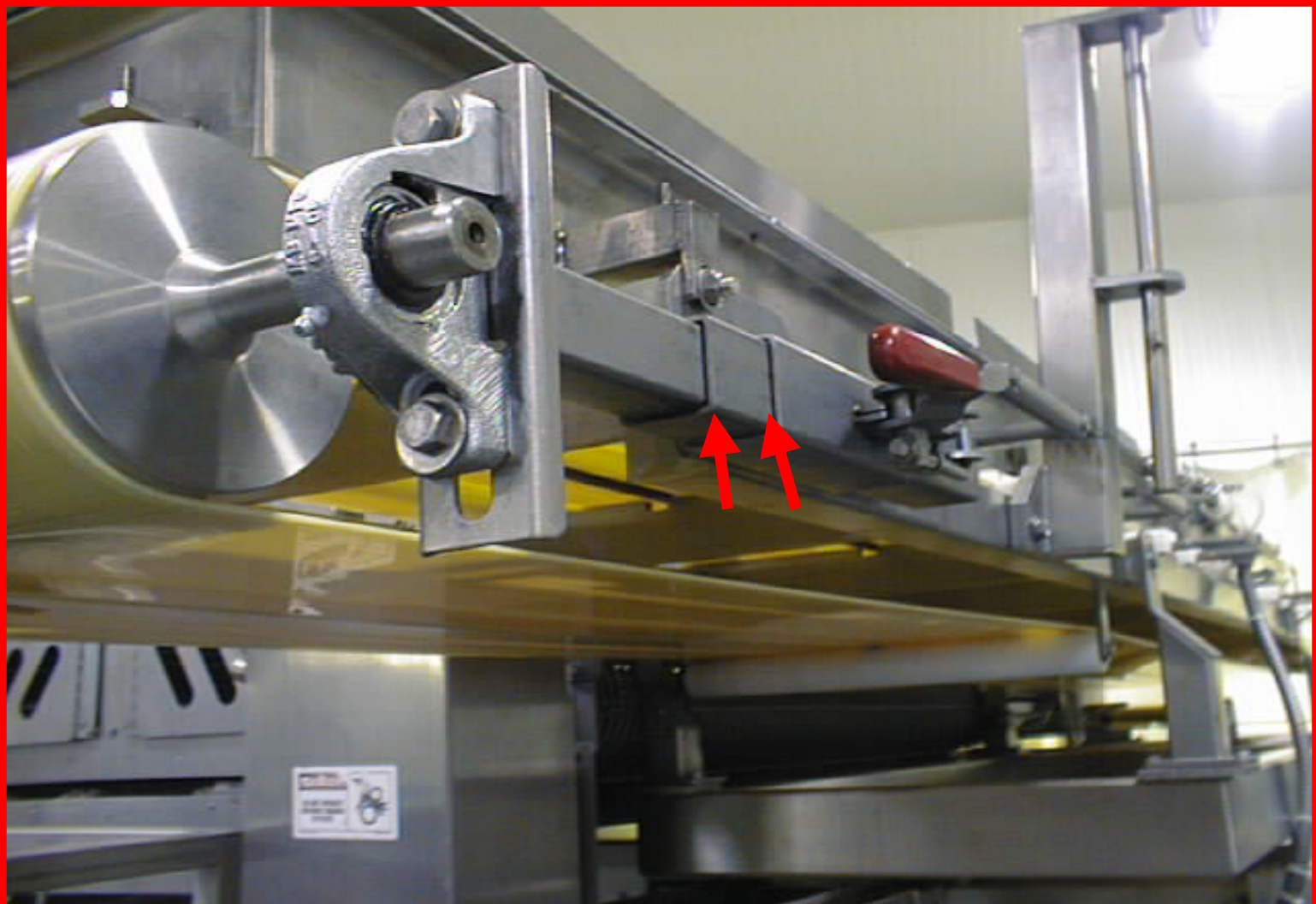
- Separate Raw from RTE
- Must be Cleanable
- Made of Compatible Materials
- Smooth Surfaces and Accessible
- Must be Self Draining
- Framework not penetrated
- Proper Ventilation

Must Be Cleanable



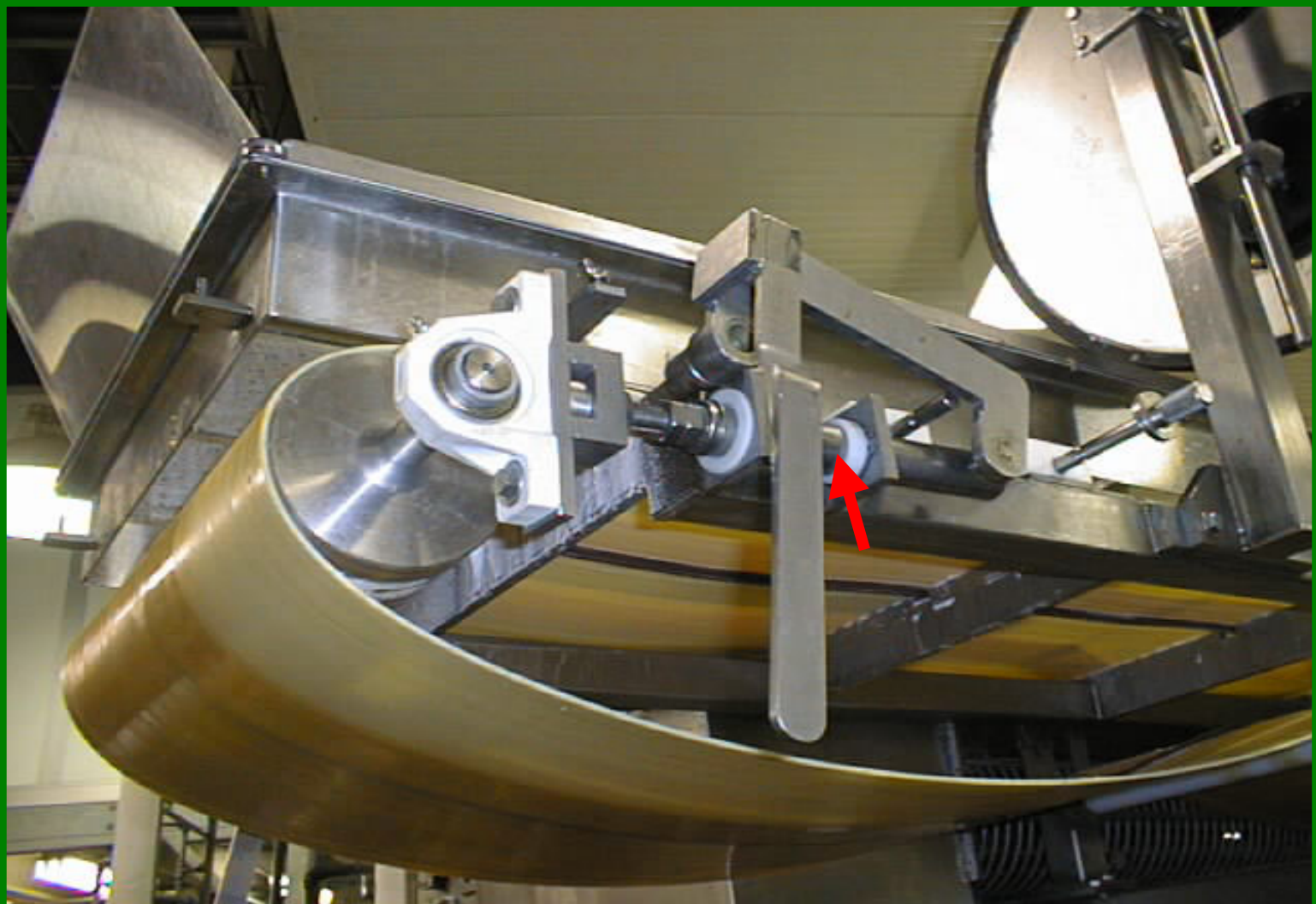
Any small opening is difficult to clean.

Threaded openings provide excellent harborage areas..



Overlapping surfaces of belt tensioner are not accessible

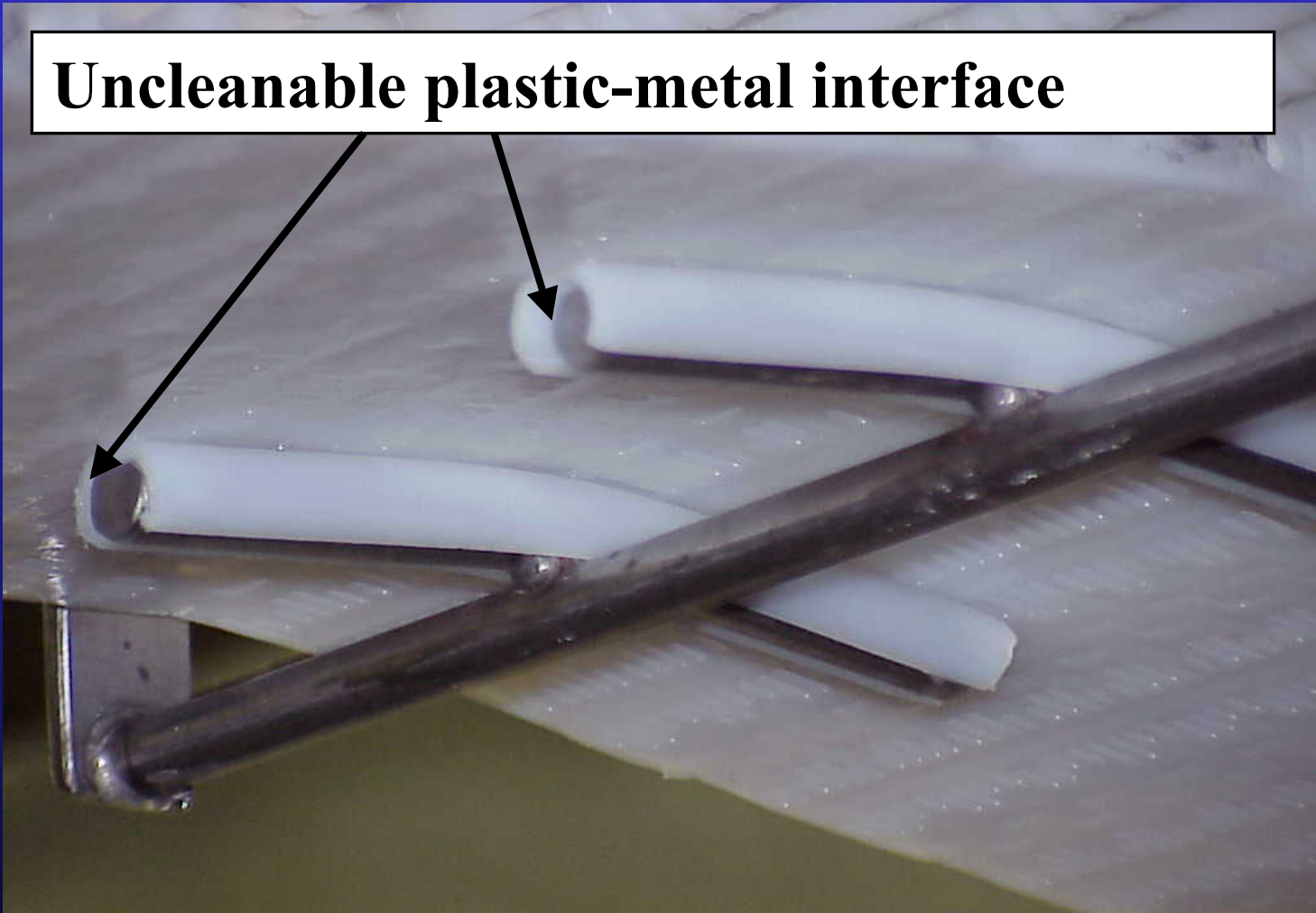




Improved belt tensioner design minimizes hidden surfaces



Uncleanable plastic-metal interface





Name plate riveted in place.



Name plate welded in place



Topics in RTE Sanitation

Back to Basics

- RTE Sanitation Procedures
- RTE Operative Sanitation - GMP
- RTE Employee Practices
- Environmental Monitoring.

Steam as a sanitizer

“Internal” Temperature of 160 F for ~30 min.



An Effective Sampling Program Will Yield Positive Samples

- **The ultimate goal is a *Listeria* negative environment, but this is difficult to maintain over the long term.**
- **The sampling plan should be designed to detect *Listeria*, if it is present.**
- **Positives must be treated as a “success” because they enable corrections that can protect consumers!**

Two factors determine the effectiveness of a *Listeria* control program:

- **Environmental testing**
- **Response to a positive finding**

A recent survey indicates that industry recognizes this basic need.

Extent of Industry Testing for “*Listeria*”

	<u>No.</u>	<u>% of Establishments</u>	
	<u>Est.</u>	<u>Product</u>	<u>Environment</u>
Large	74	88	100
Small	193	64	92
Very Small	22	27	41
Size Unknown	14	64	93
<hr/>			
Total	303	67	90

Source: NFPA, AMI, NTF, NCC, NMA, NAMP, SMA, AAMP (Reported May 15, 2000)

Sampling Program Benefits

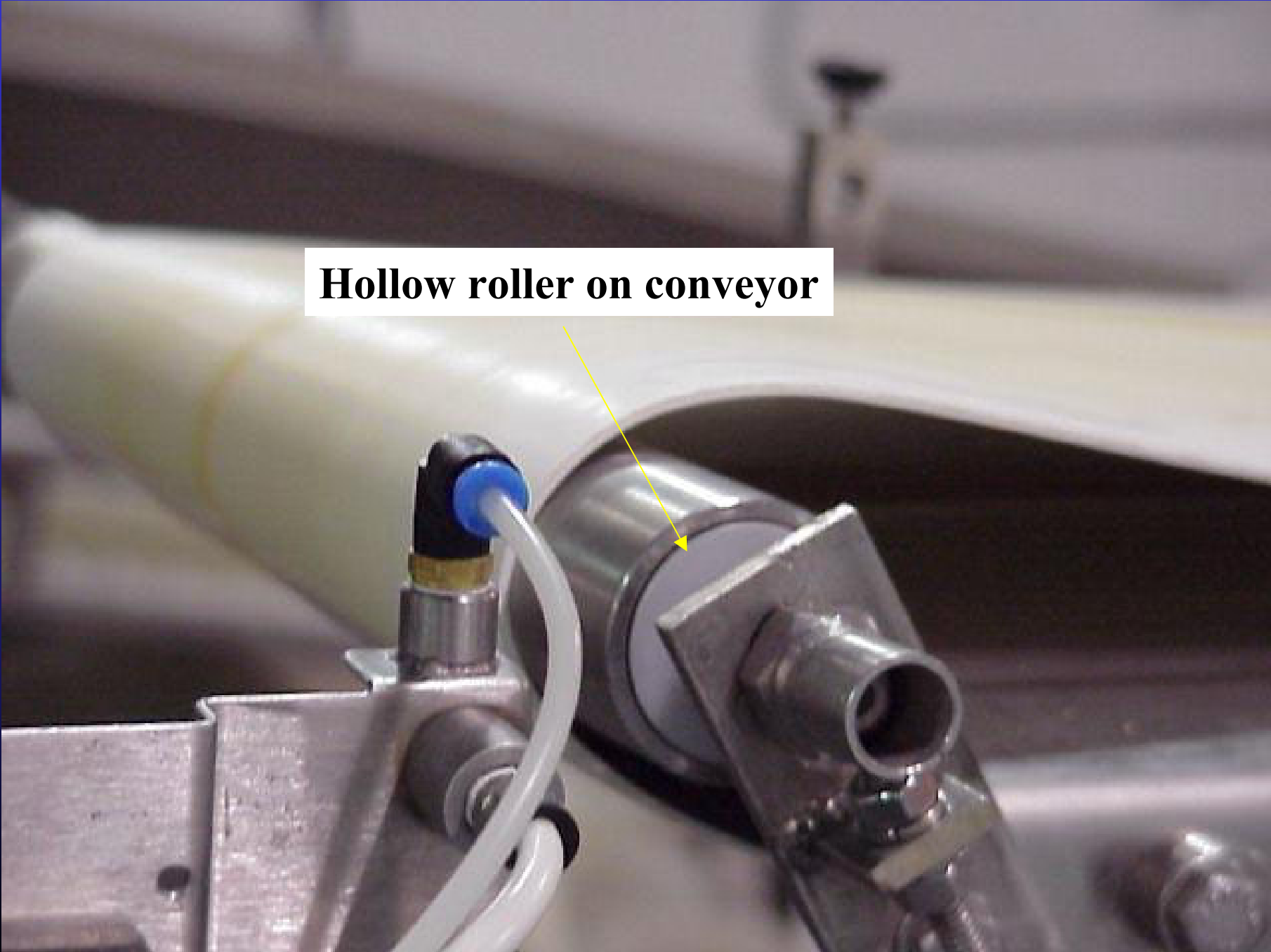
- **Provides a measure of process control**
- **Serves as an early warning system before multiple lots of product are involved**
- **Identifies the source of contamination**
- **Ability to focus resources**
- **Verifies sanitation procedures**

Sampling Plans

Biased - not random

- **Focused on finding the problem**
 - ▶ Do not care about the overall average percent positives on the floor
- **Use indicator sites that are more likely to be positive than an average site**
- **Sample High Risk areas at a higher rate than Low Risk areas**
- **Often include *non specific sites* which are open for the investigator to try to find problems (take 5 samples every other week of potential problem areas)**

Hollow roller on conveyor



Summary

- **An effective, routine sampling of the RTE environment is the key to verifying control of *Listeria*.**
- **The sampling plan must be designed to find *Listeria* when present, particularly on product contact surfaces.**
- **If present, subsequent investigational sampling is necessary to find the source and implement corrective action.**

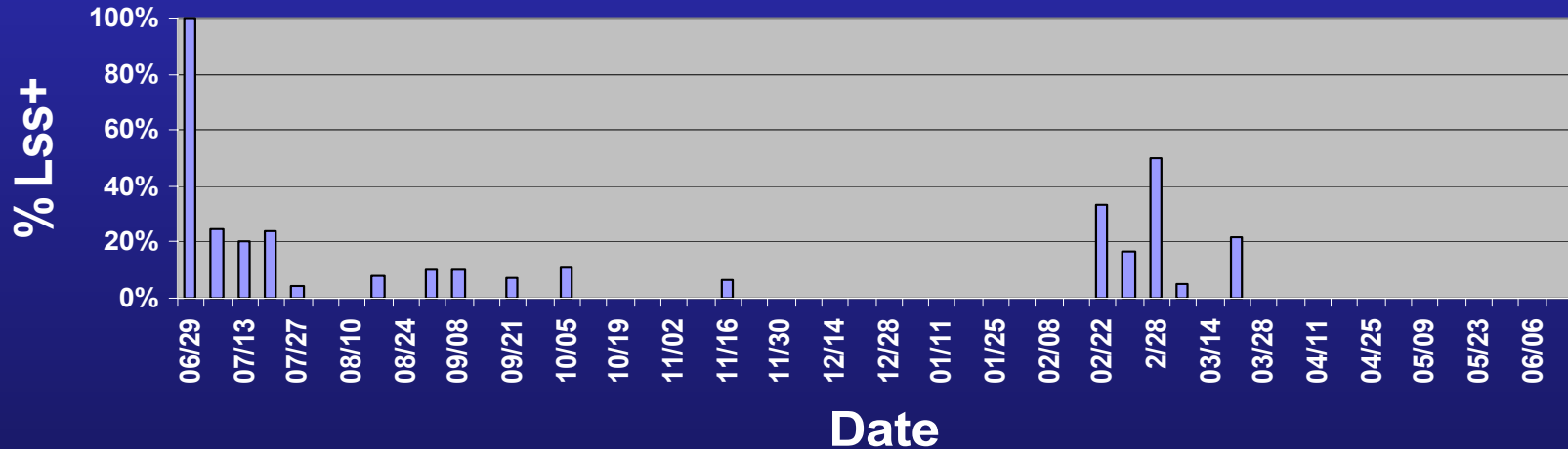
Data Analysis

- **Must recognize the biased, non-random, variable and dynamic nature of the sampling plan generating the data.**
- **Traditional statistical analysis tools (mean, standard deviation, correlation coefficient, etc.) can often mislead as opposed to direct the investigation team.**
- **The best statistical tool is often a Pareto analysis which ranks grouped data**

Sample locations for ongoing Environmental Monitoring of IQF area

725		8.6%		Date Composite monitoring, Indiv resample							Indiv monit								
Number	Location	n	%+	06/29	07/07	07/13	07/20	07/27	08/04	08/10	8/17	08/24	08/31	09/08	09/14	09/21	09/28	10/05	10/12
1	Location 1	2	0.0%																
2	Location 2	14	7.1%	1	0	0	0	0											
3	Location 3	14	7.1%	1	0	0	0	0								0			
4	Location 4	16	6.3%	1	0	0	0	0								0			
5	Location 5	12	8.3%	1	0	0	0	0								0			
6	Location 6	10	10.0%	1	0	0	0									0			
7	Location 7	9	11.1%	1	0	0	0												
8	Location 8	8	12.5%	1	0	0	0												
9	Location 9	3	0.0%																
10	Location 10	2	0.0%									0							
11	Location 11	2	0.0%									0							
12	Location 12	1	0.0%									0							
13	Location 13	9	0.0%		0				0				0				0		
14	Location 14	9	0.0%		0				0				0				0		
15	Location 15	9	0.0%		0				0				0				0		
16	Location 16	10	0.0%			0								0				0	
17	Location 17	13	0.0%			0				0				0				0	
18	Location 18	13	0.0%			0				0				0				0	
19	Location 19	17	11.8%				1	0	0		0				0				0
20	Location 20	19	15.8%				1	0	0		0				0				0
21	Location 21	19	21.1%				1	0	0		0				0				0
22	Location 22	19	10.5%				1	0	0		0				0				0
23	Location 23	17	17.6%				1	0	0		0				0				0
24	Location 24	17	11.8%				1	0	0		0				0				0
25	Location 25	16	6.3%			1	0	0		0	0			0				0	
26	Location 26	16	6.3%			1	0	0		0	0			0				0	
27	Location 27	21	14.3%			1	0	0		0	1	0	0	0				1	0
28	Location 28	14	7.1%			1	0	0		0	0			0				0	
29	Location 29	14	7.1%			1	0	0		0	0			0				0	
30	Location 30	17	11.8%			1	0	0		0	0			1	0	0	0	0	
31	Location 31	12	8.3%		1	0	0		0				0				0		
32	Location 32	11	9.1%		1	0	0		0				0				0		
33	Location 33	15	13.3%		1	0	0		0				1	0	0	0	0		
34	Location 34	9	11.1%		1	0	0		0				0				0		
35	Location 35	10	10.0%		1	0	0		0				0				0		
36	Location 36	9	11.1%		1	0	0		0				0				0		
37	Location 37	18	16.7%	1	0	0		0				0				0			
38	Location 38	20	20.0%	1	0	0		0				0				1	0		0
39	Location 39	18	16.7%	1	0	0		0				0				0			
40	Location 40	20	20.0%	1	0	0		0				0				0			
41	Location 41	16	12.5%	1	0	0		0				0				0			
42	Location 42	18	16.7%	1	0	0		1	0	0		0				0			
43	Location 43	17	11.8%	1	0	0		0				0				0			
44	Location 44	14	14.3%	1	0	0		0				0				0			
			56	15	6	6	6	1	0	0	1	0	1	1	0	1	0	1	0
			569	15	24	30	25	24	16	9	12	12	10	10	8	14	11	9	8
			9.8%	100%	25%	20%	24%	4%	0%	0%	8%	0%	10%	10%	0%	7%	0%	11%	0%

Area Environmentalals



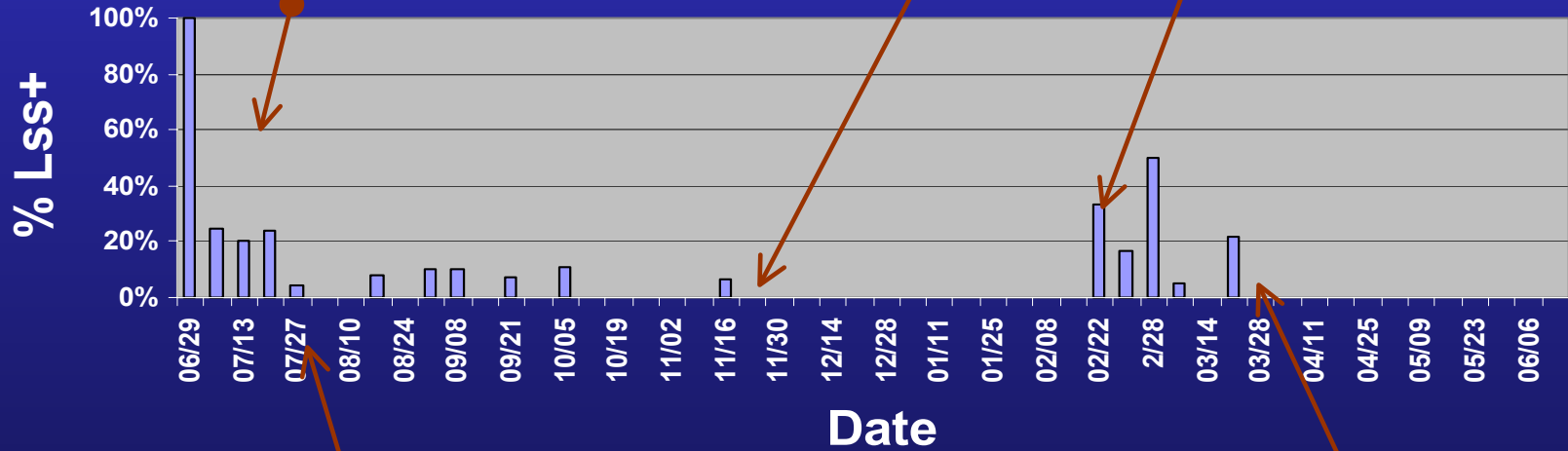
Identify trends in a given area or common location

Determine overall effectiveness (%*Listeria* species or *Listeria* like free)

**Composite sampling
Sanitizer coverage
inadequate
Improperly trained
workforce**

**Found and
eliminated
growth
niche**

**New
sanitation
supervisor**



**Applied flood sanitizer,
trained sanitation crew,
switched to individual
sampling**

**Audited sanitation
process updated
procedures**

Strategies for Control of *Lm*

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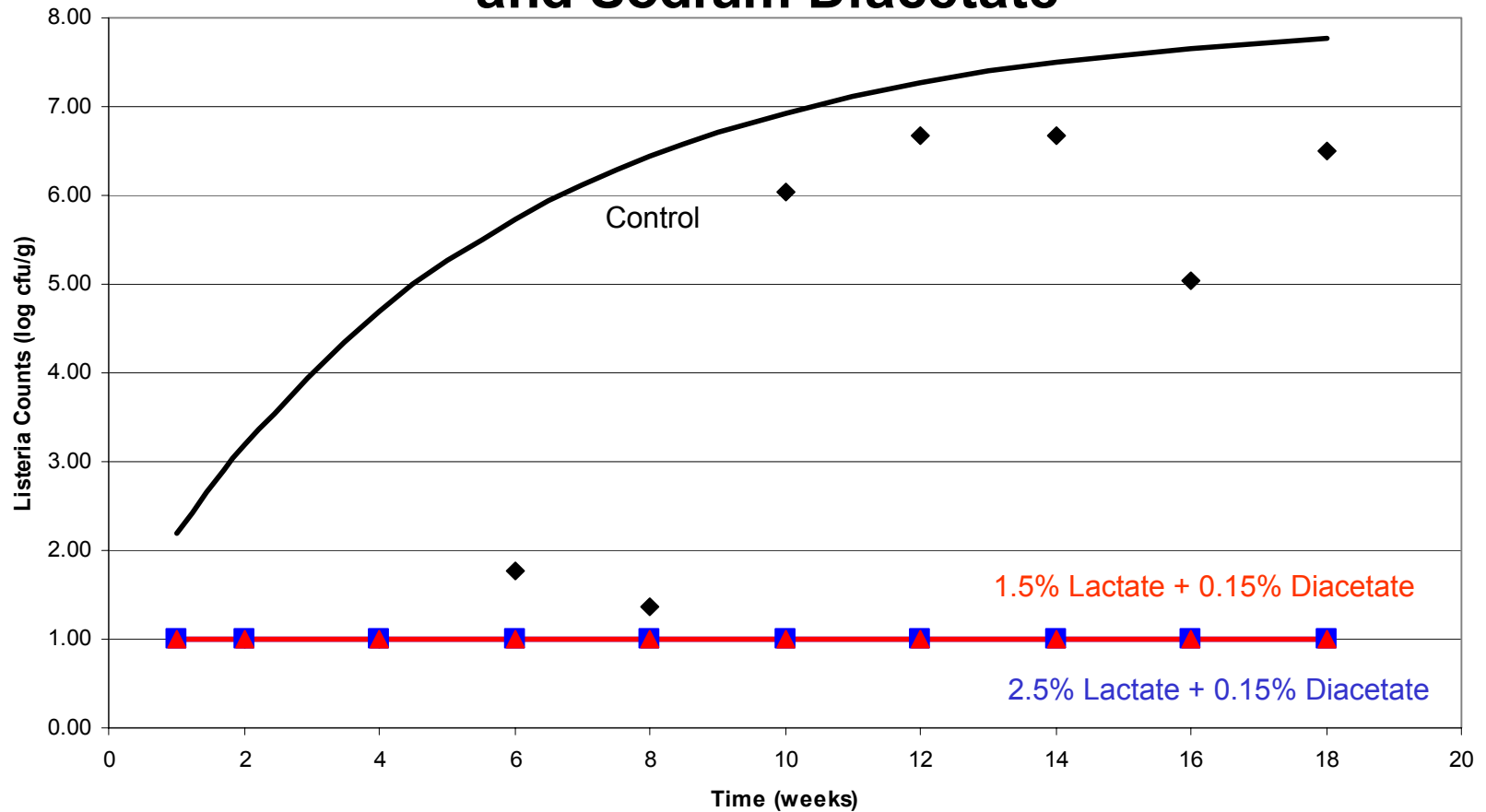
Strategies for Control of *Lm*

- 3. Respond to each positive product contact sample as rapidly and effectively as possible.**
- 4. Verify the problem has been corrected.**
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Product Formulation Changes and Secondary Pasteurization

- **Extending lag phase of growth, using antimicrobials, may prove useful.**
- **Addition of lactates and acetates commercially practiced.**
- **Post packaging heat pasteurization commercially practiced.**
- **Irradiation is not the simple answer, but has promise.**
- **Ultra high pressure will work for certain low throughput products.**
- **MAP is not effective. Many other unproven technologies are in development.**
- **For any of these technologies, an increase in product cost is inevitable; a change in product characteristics is likely.**

Inhibition of Listeria Growth on Inoculated Smoked Cooked Ham by Potassium Lactate and Sodium Diacetate



USDA Results for Franks and Lunchmeat

