



Draft - Interagency *Listeria monocytogenes* in Retail Delicatessens Risk Assessment

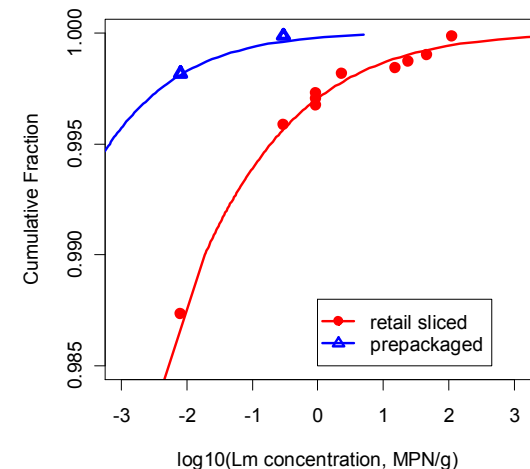
Dan Gallagher, Regis Pouillot, Sherri Dennis, Janell Kause

FMI Food Protection Committee

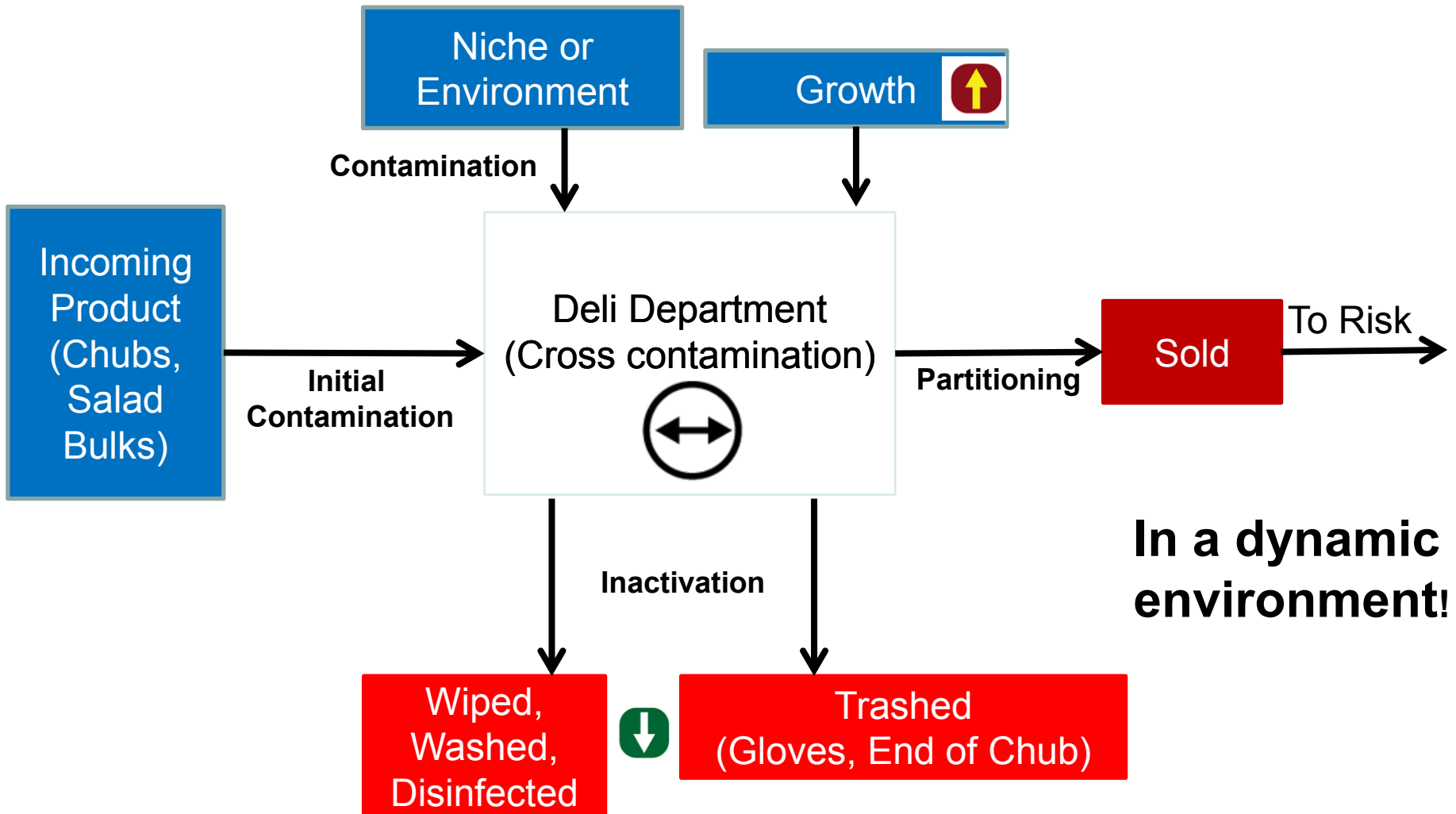
July 3, 2013

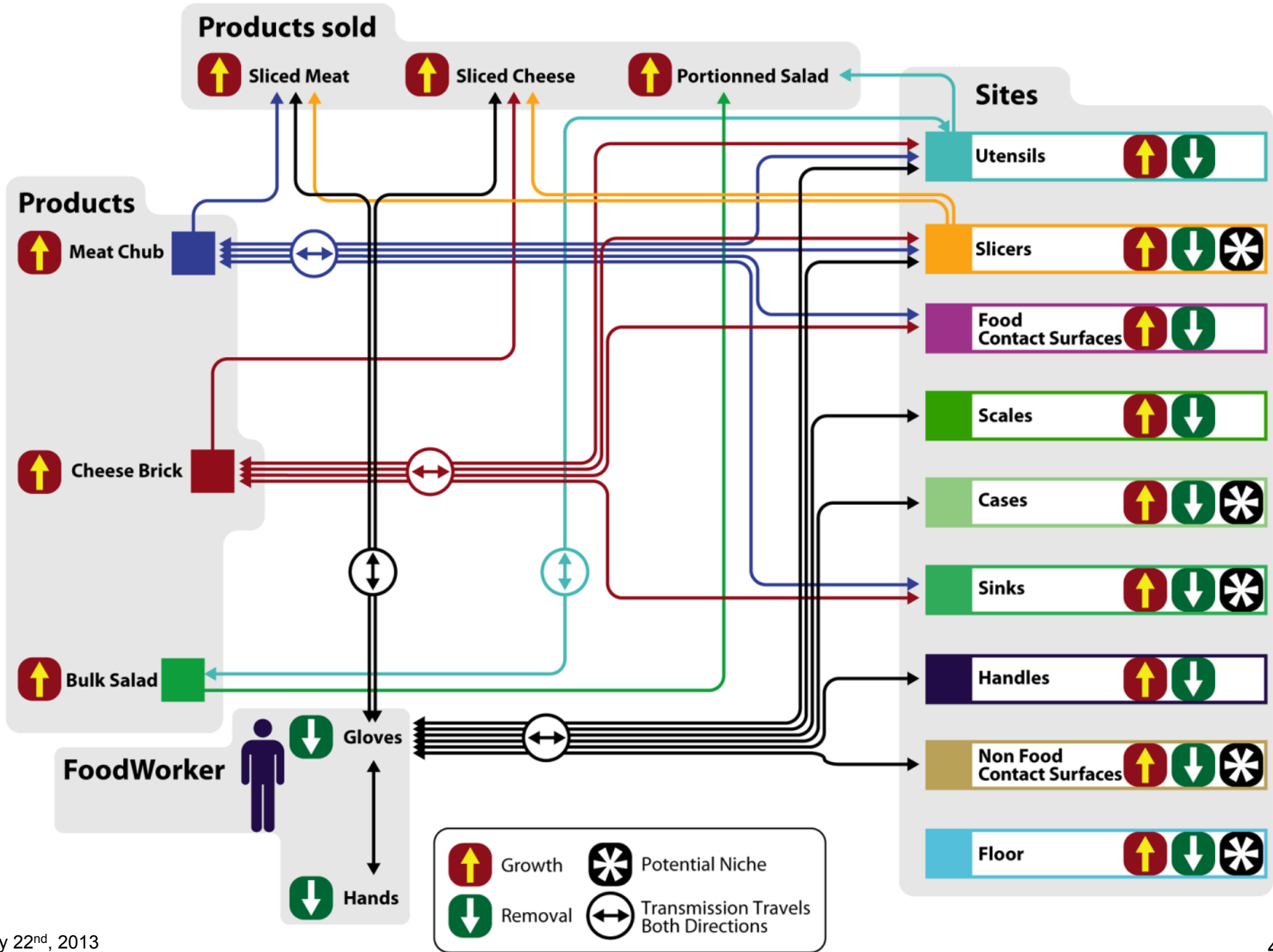
Need for Virtual Deli Model of *L. monocytogenes* (Lm)

- Lm: a major cause of foodborne related death in the US
 - 255 deaths per year (Scallan et al. 2011)
- Deli meat: highest risk of ready-to-eat (RTE) food categories
 - FDA/FSIS, 2003
- Lm prevalence and Lm levels are higher for in-store packaged than for manufacturer-packaged RTE food
 - Gombas et al., 2003 , NAFSS, 2008
- ~80% of all listeriosis cases attributed to deli meat are from deli meat sliced and packaged at retail
 - Endrikat et al., 2010, Pradhan et al. 2010
- **Hypothesis:** at retail
 - Additional cross-contamination?
 - Temperature abuse?



Basic Processes to be Considered Use Mass Balance Approach





Definition of Baseline Conditions

#1: “**Multiple Niche 100W**” baseline condition

- Stores with regular *L. monocytogenes* transfer from the environment and/or niches
- Incoming *L. monocytogenes* : from incoming products and from the environment/niche

#2: “**No Niche**” baseline condition

- Stores without transfer from the environment and/or niche
- Incoming *L. monocytogenes* : from incoming products

#3: “**Incoming Growth Chub**” baseline condition

- Stores with highly contaminated incoming product type that supports growth

#4: “**Incoming Non-Growth Chub**” baseline condition

- Stores with highly contaminated incoming product type that does not support growth

#5: “**Temperature Control**” baseline condition

- Stores without transfer from the environment and/or niche and with compliant temperature control ($\leq 41^{\circ}\text{F}$)

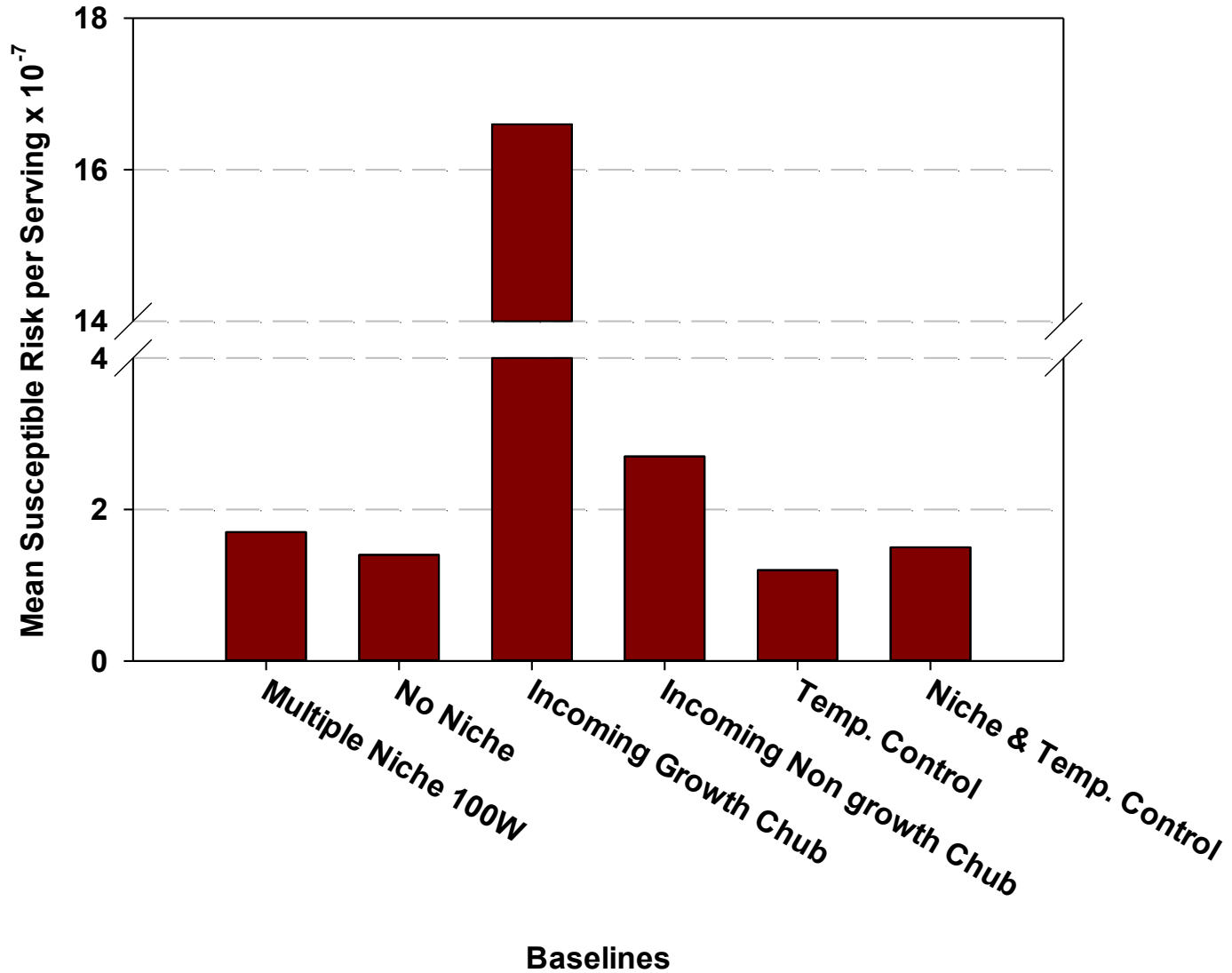
#6: “**Niche & Temperature Control**” baseline condition

- Stores with regular *L. monocytogenes* transfer from the environment and/or niches and with compliant temperature control ($\leq 41^{\circ}\text{F}$)

Source of Lm Entering the Deli

- Baselines #2 and #4 (“no niche” and “temperature control”)
 - Product entering the store based on observed FSIS in plant monitoring
- Baselines #1 and #6 (“multiple niche” and “niche and temperature control”)
 - Product entering the store based on observed FSIS in plant monitoring
 - Additional environmental / niche contamination
- Baselines #3 and #4 (“incoming growth chub” and “incoming non-growth chub”)
 - Product entering the store based on observed FSIS in plant monitoring
 - One additional product (growth or non growth) contaminated at higher concentrations than FSIS observed (hypothetical)

Baseline Risks

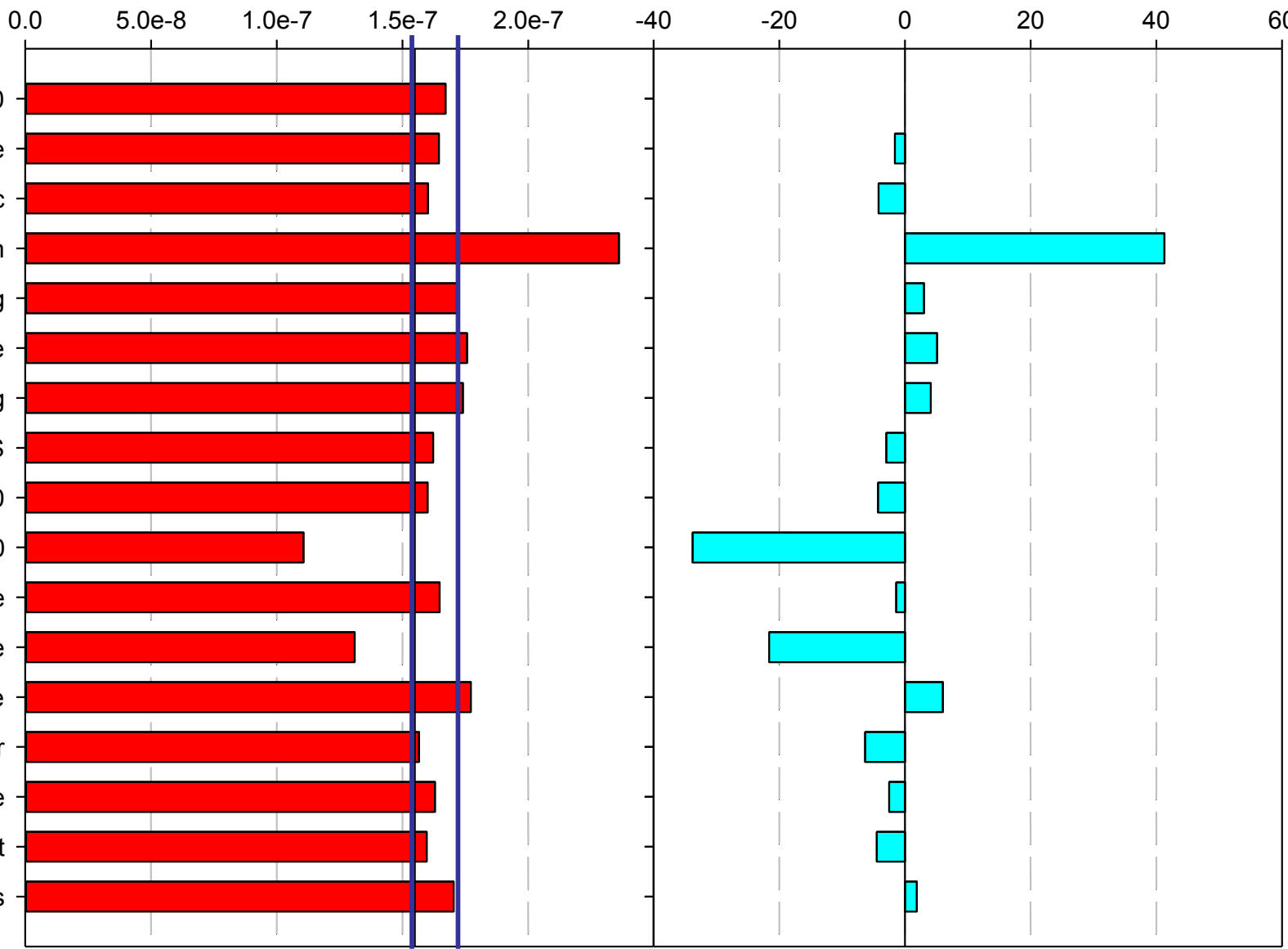


“What-If” Scenarios

- **Sanitation Related Scenarios**
 - Some NFCS cleaned FCS, Increase the effectiveness of cleaning, No sanitation, ...
- **Worker Behavior Related Scenarios**
 - No glove, No contact glove-case, Preslice products in the morning, Do not slice product on gloves
- **Growth Inhibitor Related Scenarios**
 - All products with GI, No product with GI
- **Cross contamination Related Scenarios**
 - Separate slicers, No cross contamination
- **Storage Temperature and Duration Related Scenarios**
 - Temperature in compliance with FDA food code, Temperature set so that no growth can occur

Multiple Niche Baseline : Risk per serving

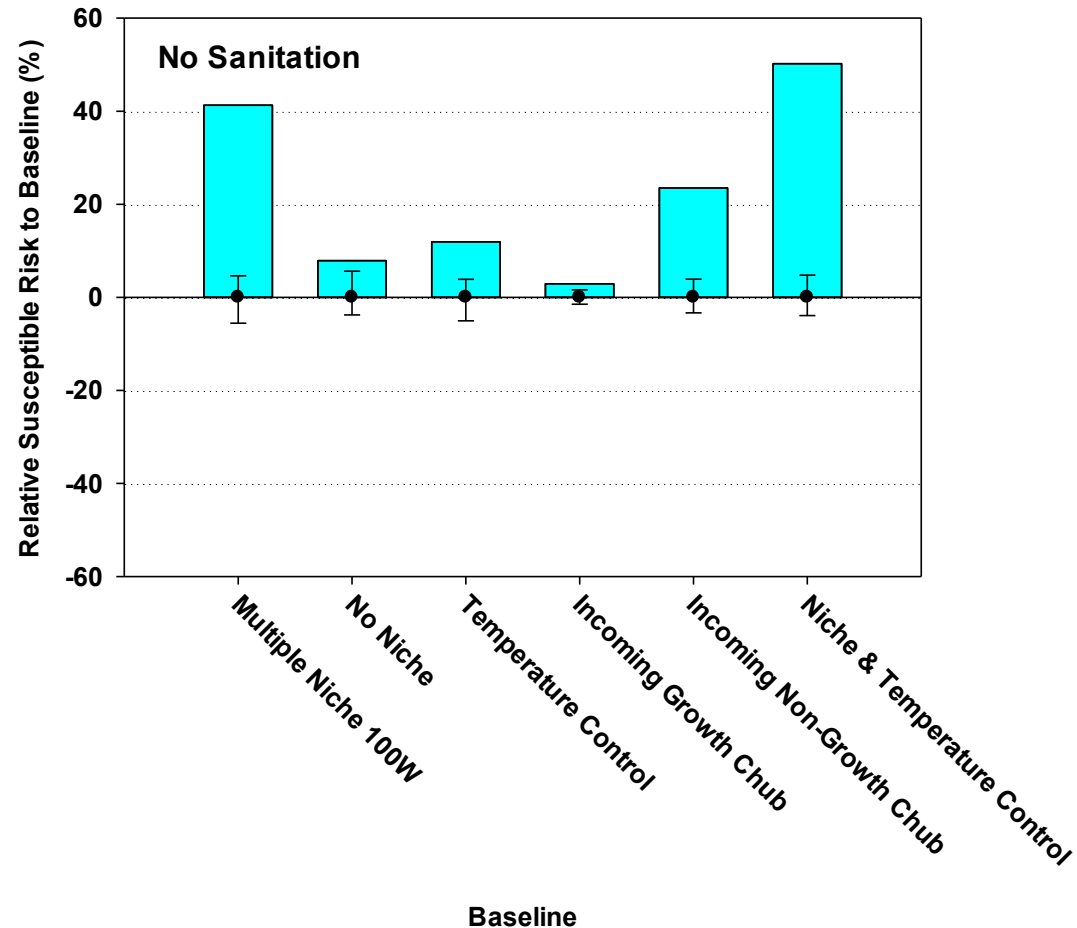
Mean Risk per Serving, Susceptible Population Relative Susceptible Risk to Baseline (%)



	Multiple Niche 100W	No Niche	Incoming Growth Chub	Incoming Non-growth Chub	Temp. Control	Niche & Temp. Control
Predicted risk per serving, susceptible population ²	1.7×10 ⁻⁷	1.4×10 ⁻⁷	16.6×10 ⁻⁷	2.8×10 ⁻⁷	1.2×10 ⁻⁷	1.5×10 ⁻⁷
Sanitation Related Scenarios:	Percent Change Relative to Baseline					
Wash & Sanitize: Increase the effectiveness of cleaning from simply washing to washing and sanitizing	-1.6	1.7	-0.6	2.0	-1.3	-7.6*
Clean 8 Sporadic: Double the number of sites cleaned from 4 to 8	-4.2	-4.1*	-0.7	-1.9	-0.5	1.3
No Sanitation: No wiping, washing, or sanitizing	41.3*	7.9*	2.9*	23.5*	11.9*	50.2*
No Sporadic Cleaning: Clean as required by the 2009 FDA Food Code, but no additional sporadic cleanings	3.0	-3.0	-0.4	1.7	1.7	3.5
NFCS As FCS: Workers clean deli NFCSs at same rate as FCSs	-3.0	0.7	-0.6	0.3	-5.4*	0.9
Worker Behavior Related Scenarios:						
No Glove: Workers do not use gloves when serving customers	5.1*	2.5	1.2	8.5*	6.0*	7.0*
Gloves Every Serving: Workers change gloves before every sale	4.1	0.7	0.7	0.6	-0.2	0.6
No Contact Glove Case: Workers do not use their hands to open the deli case (e.g. if a floor switch is used)	-1.4	-3.4	-1.3	1.3	1.3	-0.3
Pre-slice: Workers pre-slice RTE products in the morning, after cleaning	6.0*	24.9*	49.5*	-34.4*	19.2*	1.0
Separate Slicer: Workers use a separate slicer for RTE products that support growth of L. monocytogenes	-6.3*	-0.6	-1.7*	22.7*	-0.8	4.6
Do Not Slice On Gloves: Workers collect the slices of RTE products on tissue paper rather than on his/her gloved hand	1.9	1.0	0.2	3.8	-1.9	8.0*
Growth Inhibitor Related Scenarios:						
All GI: Reformulate all RTE products sold at the retail deli that would otherwise support L. monocytogenes growth to include growth inhibitors	-96.0*	-95.2*	-97.5*	-94.5*	-94.4*	-94.8*
No GI: Reformulate all RTE products that support L. monocytogenes growth that are sold at the retail deli to not include GI to restrict L. monocytogenes growth	184.1*	191.5*	35.1*	190.5*	187.7*	188.9*
Cross Contamination Related Scenarios:						
Transfers to 0: Cross contamination would only result from the deli slicer	-4.3	2.5	1.0	3.7	0.2	-0.3
Transfers and Slicer to 0: No cross contamination in the retail deli	-33.8*	-18.6*	-9.5*	-60.8*	-19.2*	-30.4*
Reduce Level: Mean incoming L. monocytogenes concentration in all RTE products lowered from -9.2 to -9.5 log ₁₀ cfu/g	-21.6*	-24.2*	-1.1	-9.8*	-22.5*	-15.6*
Separate Slicer Case: Workers use a separate slicer and a separate deli case for RTE products that support the growth of L. monocytogenes.	-2.5	-1.6	-1.2	21.0*	-0.9	7.5*
Lower Env Cont: Reduce transfer of L. monocytogenes among RTE products, FCSs, and NFCs (i.e., reduce transfer coefficients by 50%)	-4.5	-4.4*	-1.4	0.4	1.6	0.9
Storage Temperature and Duration Control Related Scenarios:						
Temp = 5°C: Set the retail deli case temperature to 5°C (41°F) (i.e., in compliance with the 2009 FDA Food Code) for all delis, instead of using the deli case temperatures reported by Ecosure	-4.8	-14.3*	-8.1*	-2.8	NA	NA
No Growth (T=-5°C): At this temperature, no L. monocytogenes growth will occur	-16.5*	-21.3*	-18.2*	-5.7*	NA	NA
Temp ≤ 5°C: Use only the retail deli case temperatures observed in the Ecosure dataset at or below 5°C (41°F).	-9.0*	-16.3*	-12.3*	-8.2*	NA	NA
Shorten Time in Retail Delis: Reduce the length of time RTE products are held before they are sold or disposed from 7 to 4 days	-2.5	3.3	-1.2	2.0	-0.2	1.7

Risk Management Question: Sanitation

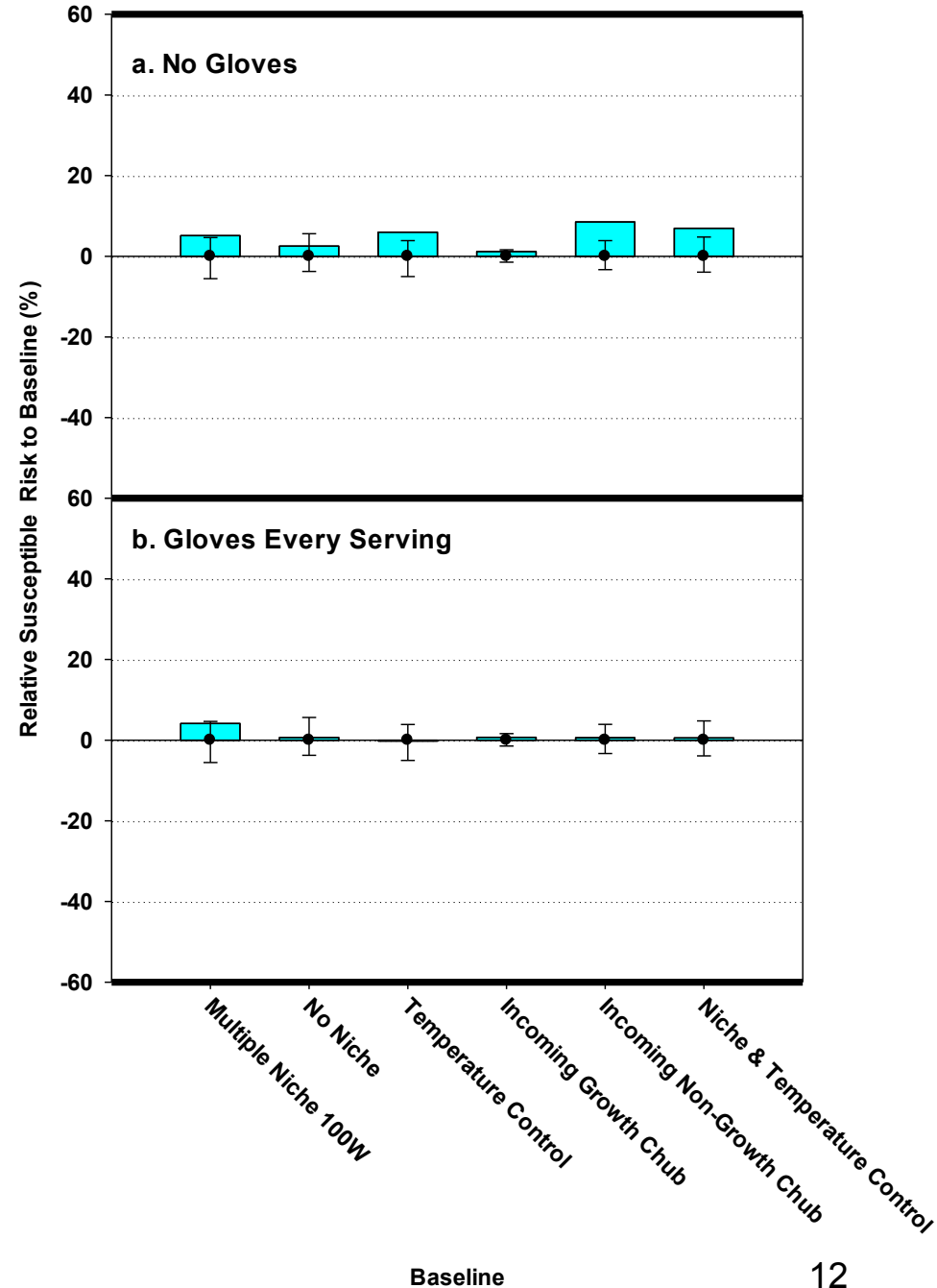
- Observed sanitation practices critical in reducing risk.
 - Stopping sanitation increased risk across all baselines.
- Additional sanitation (more effective cleaning, more frequent cleaning, ...) generally not significant.



Risk Management

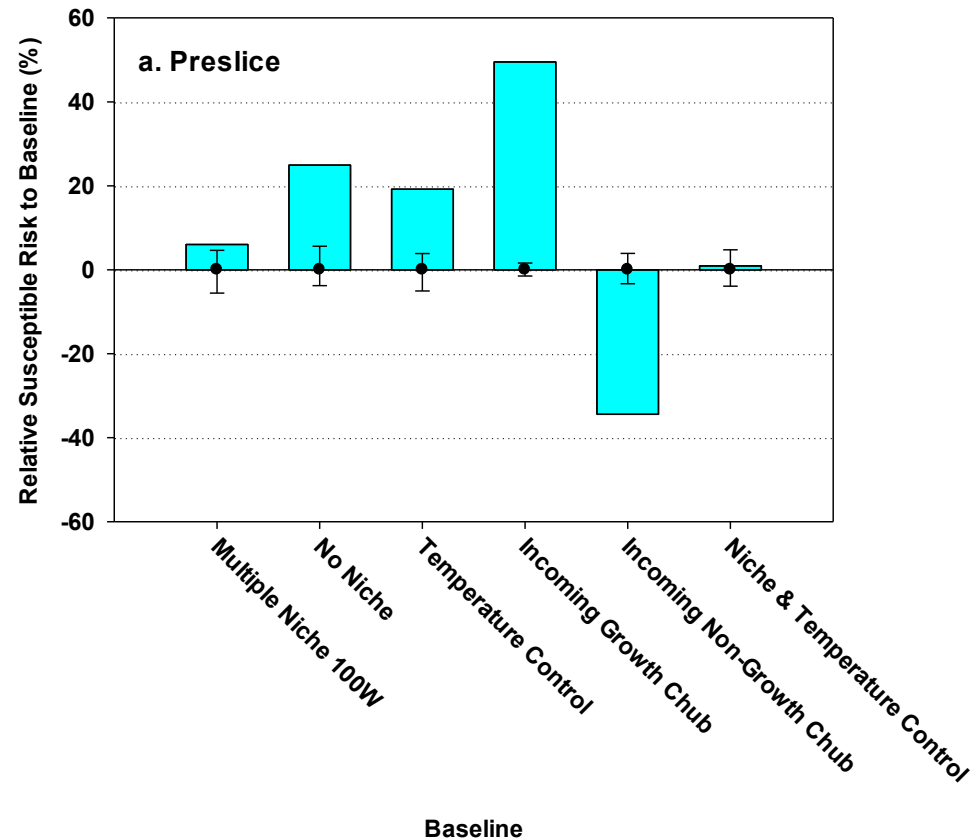
Question: Worker behavior, glove use

- Glove changes observed ~65% of customers.
- Never using gloves increased risk in 4 of 6 baselines.
- Changing gloves for every customer led to no significant risk reduction.



Risk Management Question: Worker behavior

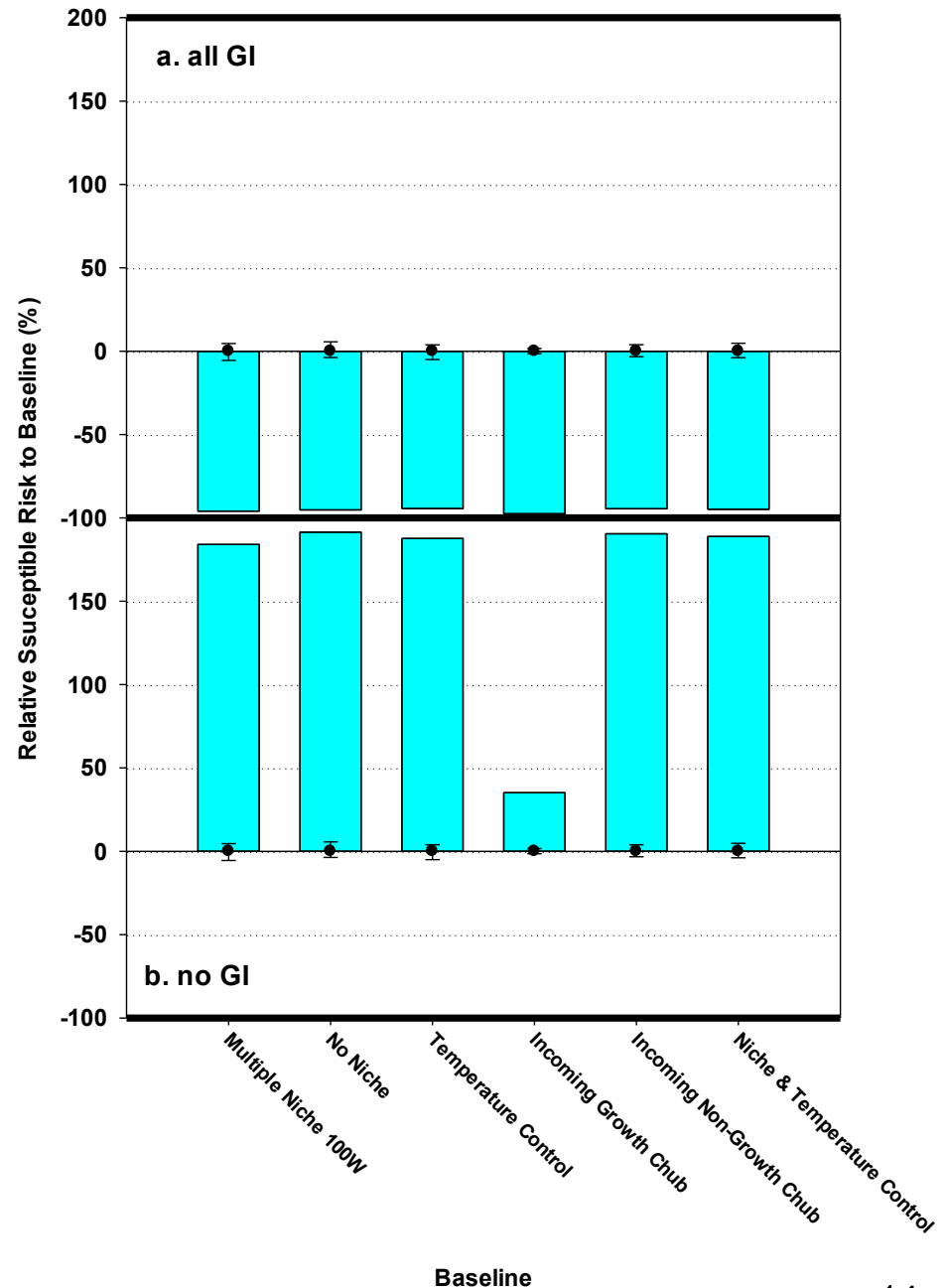
- Changes to worker behavior sometimes depended on the type of baseline store.



Risk Management

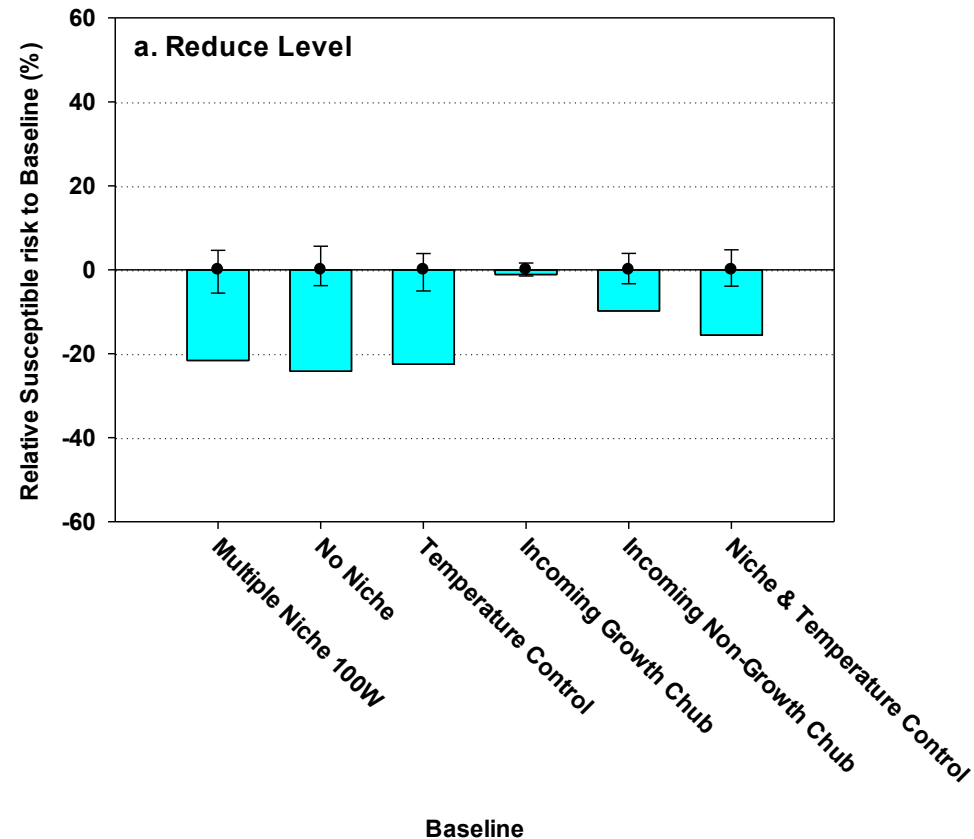
Question: Growth Inhibitors

- Growth inhibitors prevented growth both at retail and at home.
- Broad growth inhibitor use led to dramatic reduction in risk.



Risk Management Question: Cross contamination, incoming levels

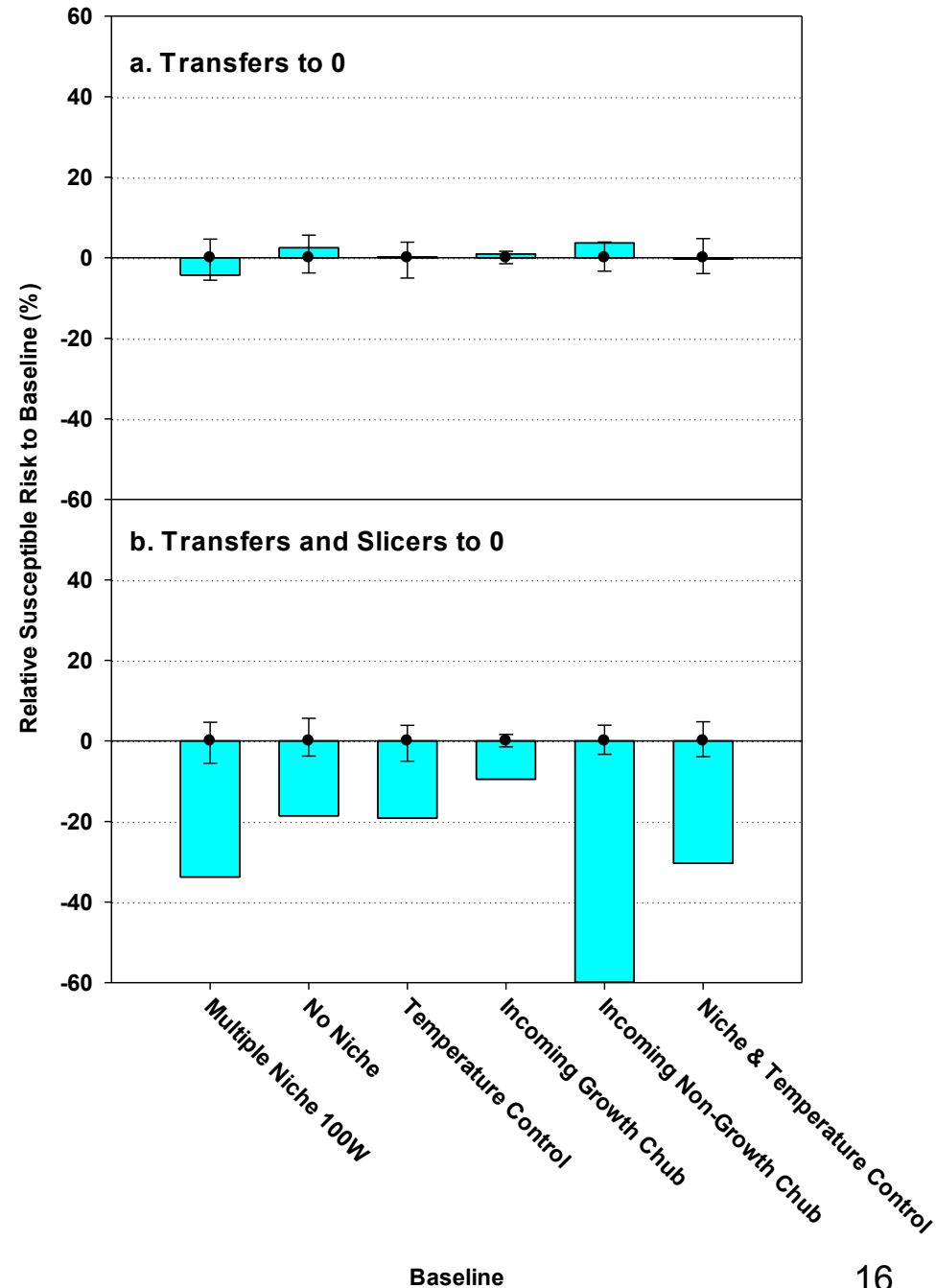
- Reducing incoming mean concentrations by factor of 2 reduced risk across all baselines except incoming growth chub.



Risk Management

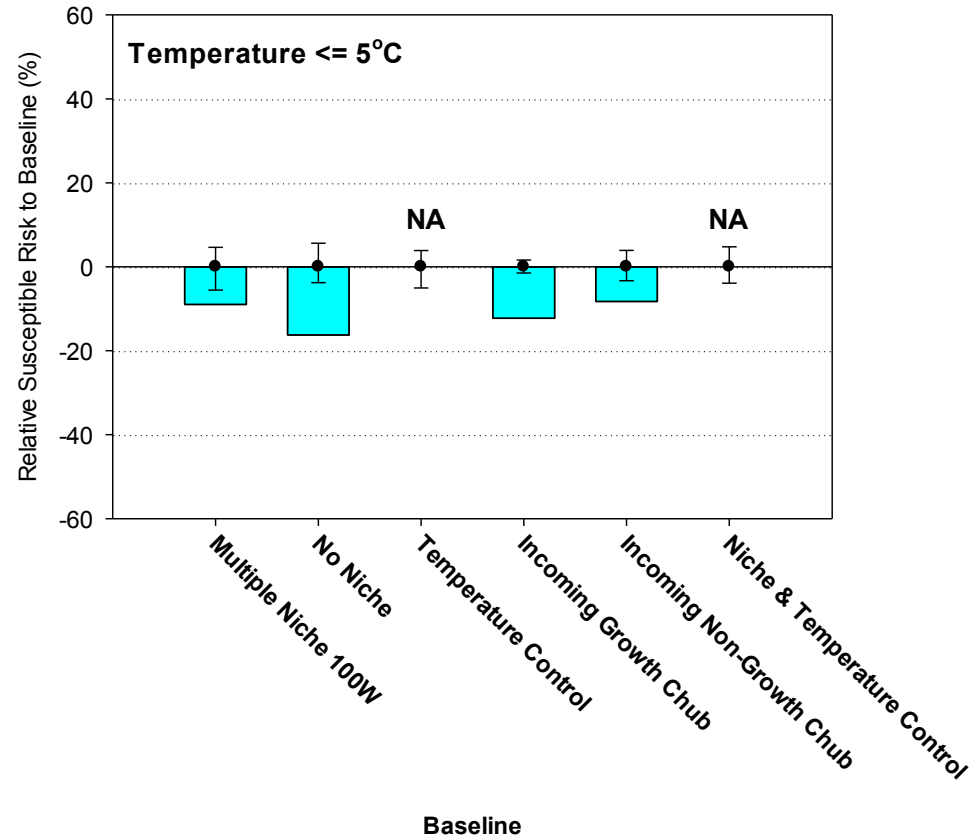
Question: Cross contamination

- Eliminating cross contamination reduced risk across all baselines, especially incoming non growth chub
- Slicer is primary nexus for cross contamination.



Risk Management Question: Temperature

- If retail delis simply followed the FDA recommended temperature versus current observed practice, an 8-16% reduction could be achieved.
- Reduces in-store growth



Key Findings

- To reduce predicted risks of listeriosis to consumers
 - Prevent Lm entering deli department
 - from incoming growth supporting product
 - from incoming non growth supporting product
 - from environment / niches
 - Increase growth inhibitor use (growth at retail and at home)
 - Improve temperature control (growth at retail)
 - Maintain adequate sanitation & glove use

No single intervention will eliminate listeriosis risk from food sold at retail delis. Instead, there are a host of steps that deli operators and suppliers can take to reduce the risk.

Discussion

- Pre-slicing
- Holding of product after slicing
- Separate slicer
- Sanitation
- Dose-response