



# **Epidemiologic Approaches for Food Safety**

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# Epidemiology..

- **“the study of the distribution and determinants of health-related conditions or events in defined populations, and the application of this study to control of health problems”**
  - **J. Last**



# Epidemiology

- **Scientific approach for public health**
- **Provides the scientific method to identify and evaluate risk factors**
- **Provides a way to measure the impact of interventions/prevention and control strategies**
- **Design and analysis of surveillance databases**

# Epidemiology

- **Determine and evaluate sampling strategies**
- **Determine sensitivity/specificity of new diagnostics**
- **Provide population data for risk assessments**



# 32.1 Epidemiologic Approaches to Food Safety

- **Established in 1999 to provide funding for epidemiologic research**
- **Over \$33 million awarded**
- **Only existing research program to fund large epidemiologic studies in food safety**



# Epidemiologic Approaches for Food Safety

- **Goals-** Enhance epidemiologic methods; improve the understanding of epidemiology, ecology and risk factors of foodborne disease; provide specific intervention/control strategies; to develop outcome measurements; address emerging issues in food safety and public health
- **Objectives-**
  - Identification or evaluation of risk factors
  - Quantifying effect on foodborne disease from interventions, management strategies, prevention or control programs
  - Development of quantitative outcome measures



# Risk Factors

- **Organic vs conventional dairy farms in 4 state region (matched on herd size)**
- **Environmental, farming, and processing effect on microbial contamination of produce**
- **Role of lairage and transportation on *Salmonella* in swine**

# Human/Animal Studies

- Genotypic and phenotypic diversity of *Salmonella typhimurium* in 2 county area, CA
- Cohort study of humans and differences in their exposure to antimicrobials, cattle, and beef products
- Pediatric diarrheal diseases and link to foodhandling and food sources
- Oysters and *Salmonella*





West Coast bay (state)	% Oysters positive		East Coast bay (state)	% Oysters positive		Gulf Coast bay (state)	% Oysters positive	
	<i>Sal.</i> <sup>a</sup>	<i>Coli.</i> <sup>b</sup>		<i>Sal.</i> <sup>a</sup>	<i>Coli.</i> <sup>b</sup>		<i>Sal.</i> <sup>a</sup>	<i>Coli.</i> <sup>b</sup>
1W (OR)	19.4	20	1E (ME)	27.8	45	1G (FL)	0	100
2W (OR)	2.8	21	2E (ME)	0	72	2G (FL)	5.5	85
3W (WA)	11.1	0	3E (VA)	0	42	3G (FL)	16.7	0
4W (WA)	0	22	4E (NY)	0	38	4G (FL)	77.8	6
5W (WA)	16.7	0	5E (NY)	0	19	5G (LA)	0	97.5
6W (WA)	36.1	5	6E (ME)	41.7	12.8	6G (LA)	0	100
7W (CA)	0	5	7E (DE)	0	23	7G (LA)	0	100
8W (AK)	0	39	8E (DE)	0	93	8G (FL)	5.5	78
9W (AK)	0	39	9E (NY)	0	0	9G (FL)	0	0
10W (OR)	0	15	10E (SC)	0	95	10G (MS)	0	100
11W (AK)	0	19	11E (NY)	0	24.6	11G (LA)	0	75
12W (AK)	0	8	12E (NJ)	2.8	63	12G (LA)	0	100

<sup>a</sup>Sal., *Salmonella* is expressed as the percentage of oysters positive in the bay.

<sup>b</sup>Coli., fecal coliforms. Fecal coliforms are expressed as the percentage of oysters above the MPN.

## •Conclusions:

- *Salmonella* was isolated from oysters obtained from all three coastal areas with a prevalence high of 78% and an overall prevalence of 7.3%
- The majority of the *Salmonella* isolates were of the Newport serotype
- Multiple antibiotic resistance was noted in *Salmonella* isolates especially to tetracycline and ampicillin
- Restriction patterns of *Salmonella* DNA were very similar within and between bays
- RT-PCR values ranged between  $10^4$  to  $10^6$  *Salmonella* per gram of oyster meat



# Objective I: Selected Results from Farm Surveys

## ■ Field Source

- 50% report animals near or in crop fields
- 6% have barriers to keep animals out of fields
- 6% test produce items for fecal indicators

## ■ Human Source

- 56% report that ill workers are sent home
- 22% report that workers are required to wash hands before work
- 11% of farmers/laborers were familiar with the terms “GMP”, “GAP”, or “HACCP”



# Objective II: Produce Quality Data

## ■ General Microbiological Quality

- Microbial quality of produce in the field varies between and among produce types
- Low level of *E. coli* contamination in leafy greens; higher level in cantaloupe
- Relatively high prevalence of *E. faecium* and *E. faecalis* in fresh produce with varying degrees of antibiotic resistance but virtually none of human clinical relevance

## ■ Pathogens

- *Salmonella* detected only in cantaloupe (3.3%)
- *Listeria monocytogenes* and *E. coli* O157:H7 were not detected in any produce items

Table 4. *Enterococcus* isolates by commodity type

Commodity (N=141)	# of Domestic	# of Imported	# of <i>Enterococcus</i> Isolates (% total isolates)	Number of Isolates (%)		
				<i>E. faecium</i>	<i>E. faecalis</i>	Other <i>Enterococcus</i> spp.
Broccoli	0	15	7 (5)	6 (4)	0 (0)	1 (1)
Cabbage	0	45	35 (25)	27 (19)	3 (2)	5 (4)
Cilantro	42	30	77 (55)	29 (21) <sup>a</sup>	38 (27) <sup>b</sup>	10 (7)
Parsley	9	0	9 (6)	3 (2)	6 (4)	0 (0)
Total	51	90	128	65	47	16

<sup>a</sup> 17 isolates were of imported origin, and 12 isolates were of domestic origin

<sup>b</sup> 3 isolates were of imported origin, and 35 were of domestic origin



# Prevention/Control

- **Effect of chlorine concentration on prevalence and transmission of *E. coli* and *Campylobacter* and water consumption in feedlot cattle**
- **Novel approach for testing and monitoring feedlot cattle**
- **Effect of management practices on food safety, feed efficiency and weight gain in feedlots**

# Antimicrobial Resistance

- **Role of clonal dissemination in antimicrobial resistance**
- **Role of poultry litter in dissemination of genes**
- **Sources and determinants of *Campylobacter* infection (fluoroquinolone-resistant) in broilers**



# Sampling issues

- **Sensitivity/specificity of different sampling schemes for detection**
- **Prevalence estimates for pooled sampling**
- **Mathematical modeling**

# Focus from 2006

- Innovative methods or studies to quantify the *effect of existing interventions or management strategies* on foodborne pathogens or disease;
- Development of new *quantitative outcome measures* for the impact of intervention or management strategies
- Identification of new risk factors or quantitative evaluation of existing risk factors that may affect prevalence, transmission, or persistence of foodborne organisms or the prevalence of disease.



# **FY 2007**

- **Must have an epidemiologist as an active participant in the study**
- **Limit \$1.0 million**
- **Funds around 15-20%**
- **Total budget around \$4 million**
- **Deadline December 14, 2007**
- **Contact: Dr. Mary Torrence, (202) 401-6357, [mtorrence@csrees.usda.gov](mailto:mtorrence@csrees.usda.gov)**



# Life Lessons...

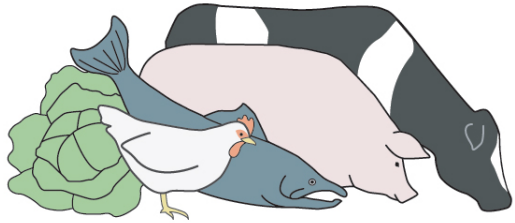
- **Epidemiology and microbiology provide a perfect complement of expertise and synergy in the study of food safety**
- **Epidemiology provides the necessary scientific approach for food safety**

# A Multi-disciplinary Team

## Food Safety Research and Response Network

- USDA CSREES Cooperative State Research Education and Extension Service (CSREES)
- National Research Initiative
- Food Safety- CAP
- \$ 5 million for 4 years
- Lead institution: NC State University





# **FSRRN**

Food Safety Research & Response Network

17 Universities  
50+ Food Safety Researchers  
and Support Specialists

**Cornell Univ.**

**Iowa State Univ.**

**McMasters Univ.**

**Mississippi State Univ.**

**N. Dakota State Univ.**

**The Ohio State Univ.**

**Tuskegee Univ.**

**Univ. of Arizona**

**Univ. of Calif. Davis**

**Univ. of Calif. Berkley**

**Univ. of Florida**

**Univ. of Illinois**

**Univ. of Kentucky**

**Univ. of Minnesota**

**Univ. of Montreal**

**Washington State Univ.**

**West Texas A&M Univ.**

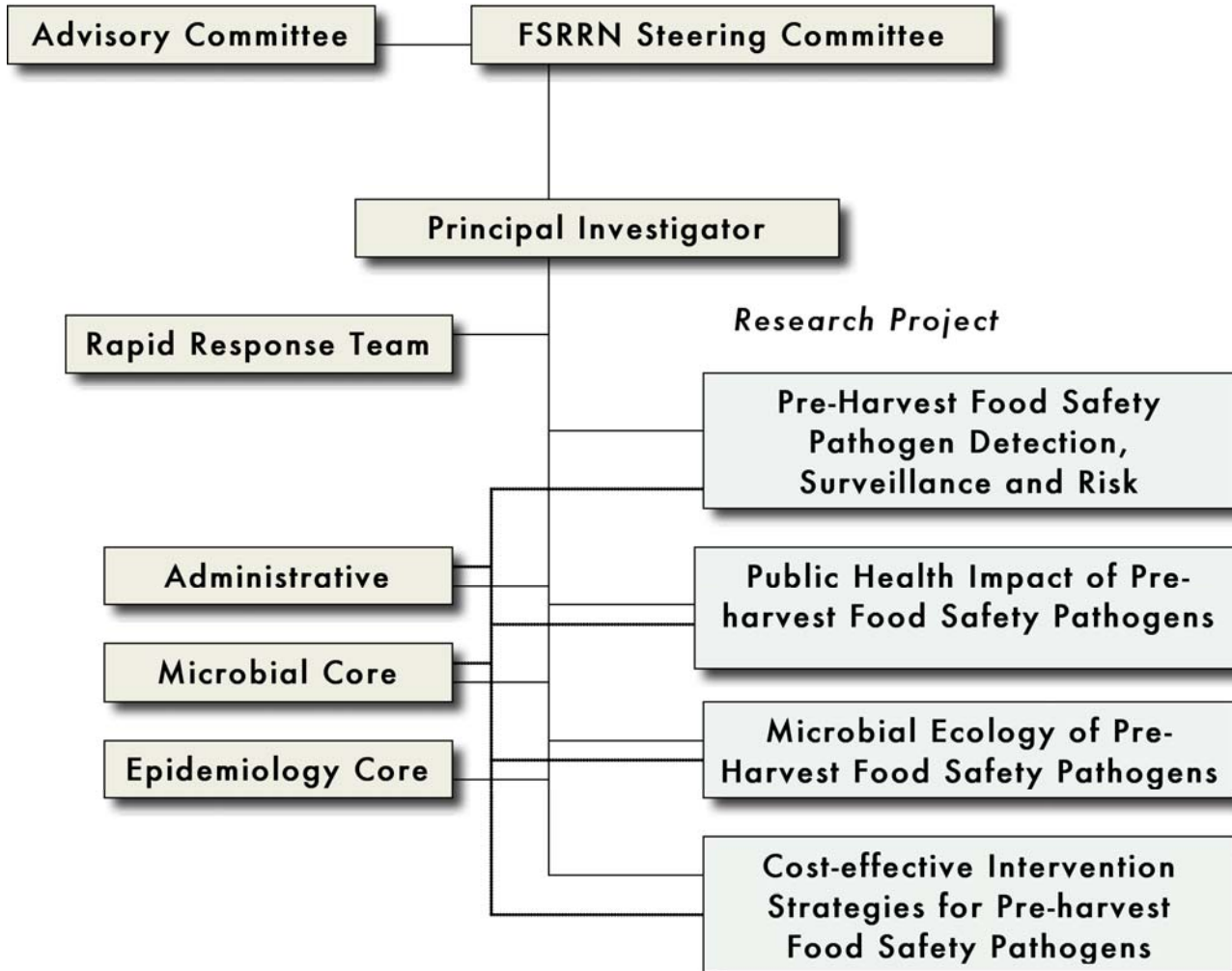


# FSRRN Objectives

- **Foster research synergy-  
multidisciplinary cooperation**
- **Bridge research with real-world  
applications**
- **Respond to emerging challenges and  
opportunities**
- **Maximize resources**



**Food Safety Research and Response Network (FSRRN)  
Project Management Plan**

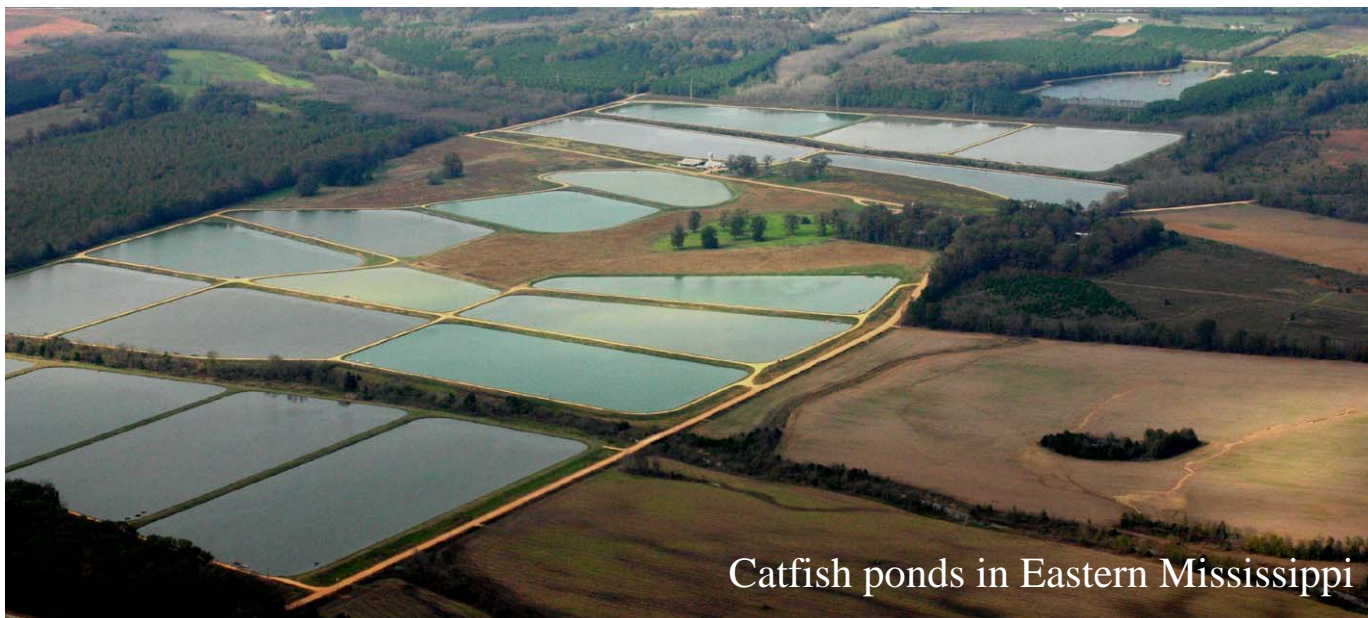




# Initial FSRRN Research Themes

## Pre-harvest focused

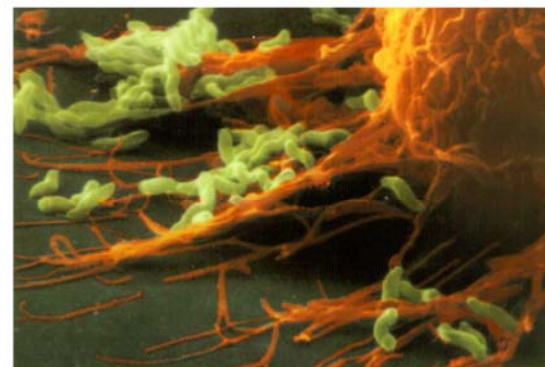
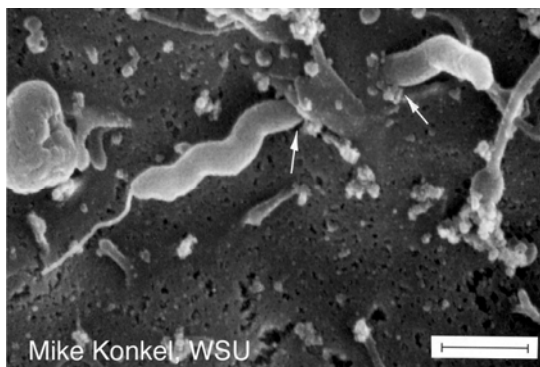
- 1) **Public Health Impact Food Safety Pathogens;**
- 2) **Microbial Ecology Food Safety Pathogens;**
- 3) **Food Safety Pathogen Detection, Surveillance & Risk Assessment;**
- 4) **Cost-effective Intervention Strategies for Food Safety Pathogens**



Catfish ponds in Eastern Mississippi

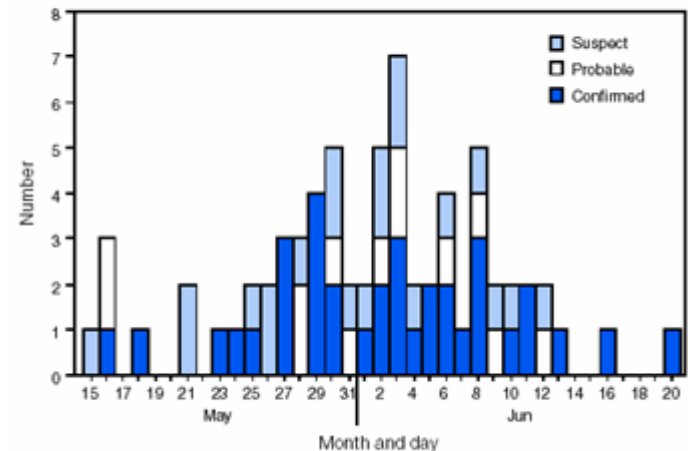
# Microbial Core

- Standardization of pathogen detection protocols
- New assay development
- Developing techniques for pathogen extraction from complex matrices
- Refining techniques for pathogen quantification
- Providing training



# Epidemiology Core

- Study design
- Study design standardization
- Information management
- Data analysis
- Risk assessment
- Epidemiologic modeling
- Spatial analysis



# Potential

- Targeted projects to aid other Federal agencies
- Flexibility to respond to emerging research questions, data needs or food safety issues
- Flexibility to get or develop needed expertise
- Training of our “future”
- Fund “high risk” research



**The significant  
problems we face  
cannot be solved  
at the same level  
of thinking we  
were at when we  
created them.**

- Einstein

