

Pennsylvania integrated surveillance for antimicrobial resistance in foodborne pathogens

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Pennsylvania Department of Health



▶ NARMS Overview Agenda

- Welcome and Introduction
- NARMS Overview
- Meat and Human testing
- Molecular Epidemiology
- Antimicrobial Susceptibility Testing
- Collaboration on Environmental Sources
- Ongoing research and wrap up



▶ NARMS Collaborators

- FDA
 - ▣ Heather Tate
 - ▣ Emily Crarey
- USDA
 - ▣ Wu San Chen
- Chester County
 - ▣ Jan Achenbach
- PA Department of Health
 - ▣ Kim Warren

Pennsylvania Department of Health—Role

- Board of Health and Vital Statistics established in 1885¹
 - Monitor mortality, morbidity, births and marriages
- Pennsylvania Department of Health created in 1905
 - Monitor the health status of the population;
 - Identify and eliminate preventable illness and accidents;
- Disease Prevention and Control Law of 1955
 - Established current reporting requirements in chapter 27
 - Surveillance for foodborne pathogens (e.g., *Salmonella*) is mandated

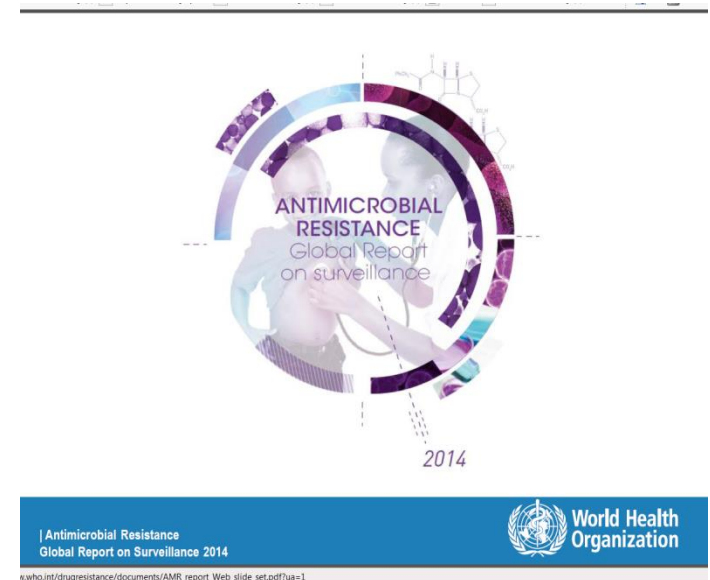
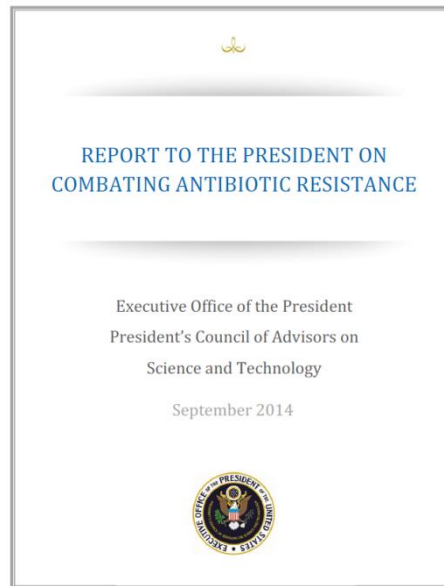
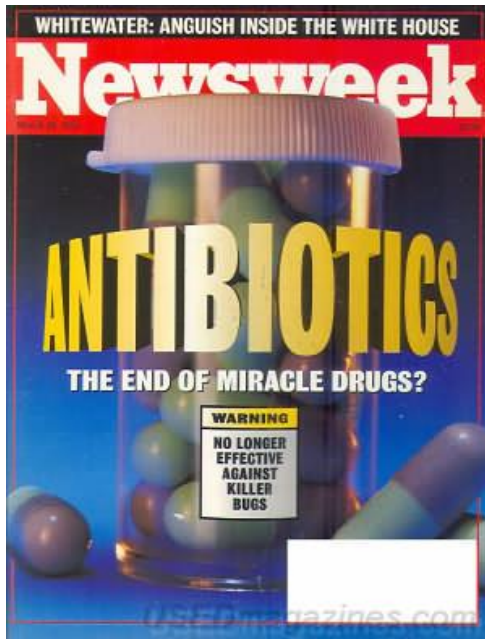


A Guard at Plymouth,
Pennsylvania 1885

Source: Granger Historical
Archive

1. PA State Archives. Records of the Department of Health. Accessed February 26, 2014 at: <http://www.phmc.state.pa.us/bah/dam/rg/rg11.htm>
2. Harvard University. Contagion: Historical View of Diseases and Epidemics. Accessed February 26, 2014 at: <http://ocp.hul.harvard.edu/contagion/>

Growing threat of antimicrobial resistance



Aim of the Collaboration

- Strengthen public health response to antimicrobial resistance in foodborne pathogens

PENNSYLVANIA DEPARTMENT OF HEALTH
2015- PAHAN-308 --04-01-ADV
Shigellosis Outbreak: Southwestern Pennsylvania

DATE: 4/1/2015
TO: Health Alert Network
FROM: Karen Murphy, PhD, RN, Acting Secretary of Health
SUBJECT: Shigellosis Outbreak: Southwestern Pennsylvania
DISTRIBUTION: Southwestern Pennsylvania, Northwestern Pennsylvania
LOCATION: Southwestern Pennsylvania
STREET ADDRESS: N/A
COUNTY: N/A
MUNICIPALITY: N/A
ZIP CODE: N/A

This transmission is a "Health Advisory": provides important information for a specific incident or situation; may not require immediate action.



Specific objectives

- Monitor trends in resistance among bacteria from animals, food and humans
 - Conduct studies to elucidate on antibiotics use and emergence of resistance in food animals and clinical isolates

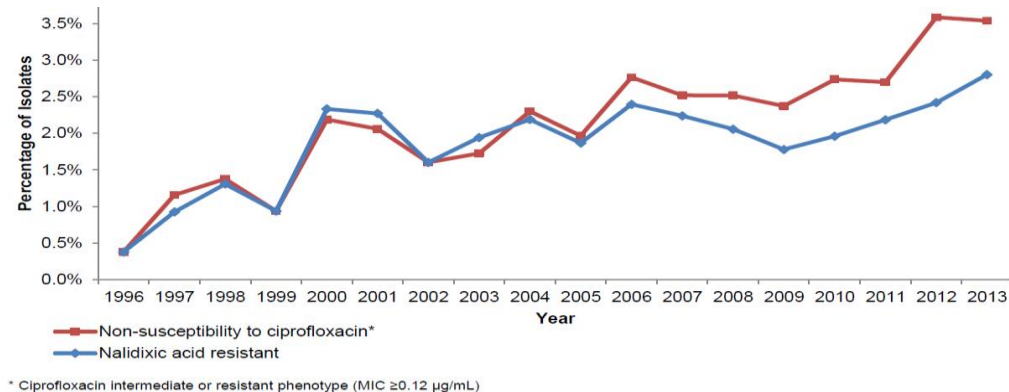


Figure 1. Percentage of nontyphoidal *Salmonella* isolates with resistance to nalidixic acid compared non-susceptibility to ciprofloxacin, 1996-2013
Source: CDC, NARMS 2013 Report

Specific objectives (continued)

- Compare isolates from humans and retail meat to facilitate timely investigations of outbreaks
 - Guide selection of isolates for further study

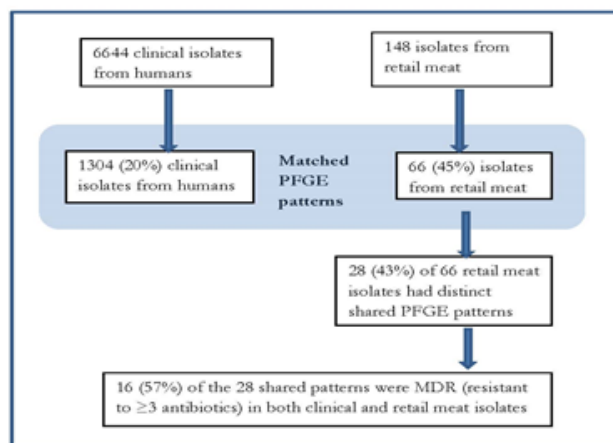
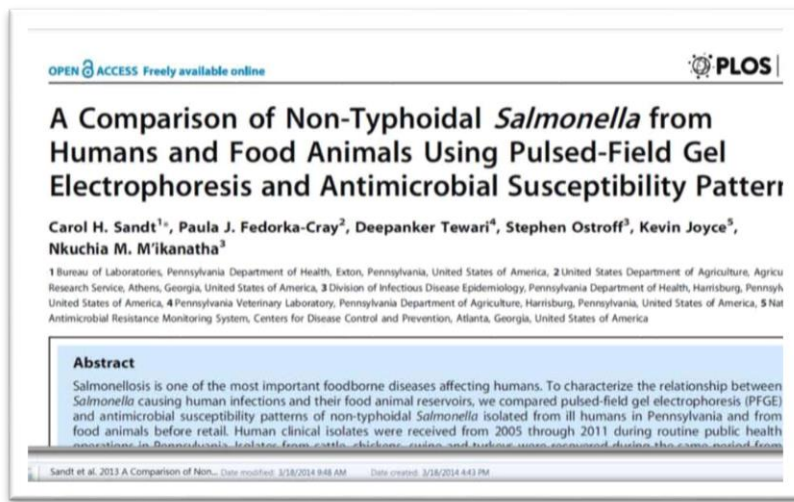


Figure 2. Antimicrobial resistance in retail meat *Salmonella* isolates with PFGE patterns indistinguishable from clinical isolates, Pennsylvania, 2009-2013

Specific objectives (continued)

- Disseminate findings to strengthen antimicrobial stewardship efforts in clinical and agricultural settings
 - Inform research to support communication and public policy on judicious antibiotics use



Sandt et al.

October 8-12 • Philadelphia, PA • www.idweek.org

 **IDWeek** 2014
Advancing Science, Improving Care



PROGRAM SCHEDULE

Navigation

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(create your schedule here)
- Abstracts in PDF
- At-A-Glance
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- Tuesday, October 7th
- Wednesday, October 8th
- Thursday, October 9th

1712
AN INTEGRATED SURVEILLANCE FOR ANTIMICROBIAL-RESISTANCE IN *SALMONELLA* FROM CLINICAL AND RETAIL MEAT SOURCES — PENNSYLVANIA, 2009-2013

• Session: Poster Abstract Session: Public Health

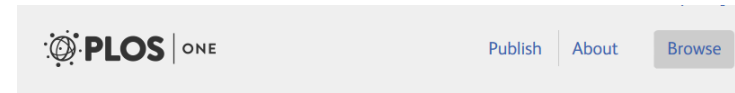
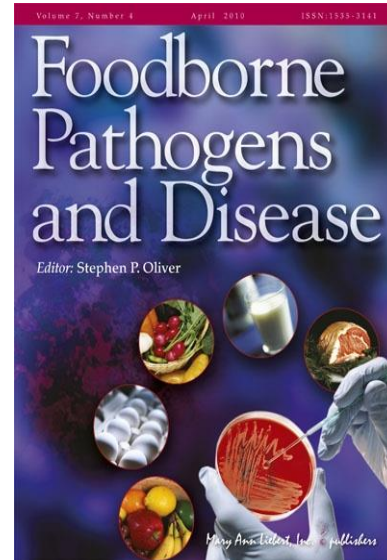
Saturday, October 11, 2014
Room: The Pennsylvania Convention Center: IDEXPO Hall BC

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Background: *Salmonella* is a leading cause of foodborne illness in the United States. Although salmonellosis is often self-limiting, persons with drug-resistant infections are at risk for severe clinical outcomes. Pennsylvania has implemented an integrated system that compares enteric pathogens from ill persons with pathogens recovered from retail meat.

Methods: During August 2009 through June 2013, *Salmonella* isolates from meat (chicken breasts, ground turkey, ground beef, and pork chops, 470 of each) purchased from randomly selected retail outlets in southeastern Pennsylvania were analyzed by pulsed-field gel electrophoresis (PFGE). We compared the PFGE patterns with those of clinical isolates in the Pennsylvania surveillance database. All meat isolates and a subset of matched clinical isolates were tested for susceptibility to antimicrobial agents.

Dissemination



OPEN ACCESS PEER-REVIEWED

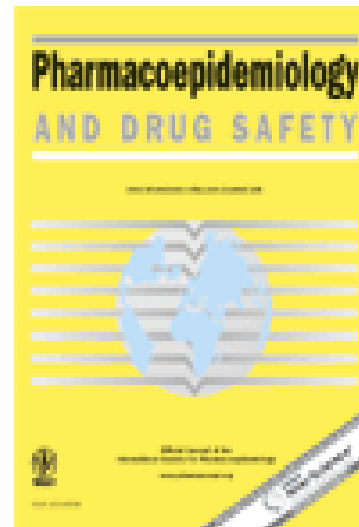
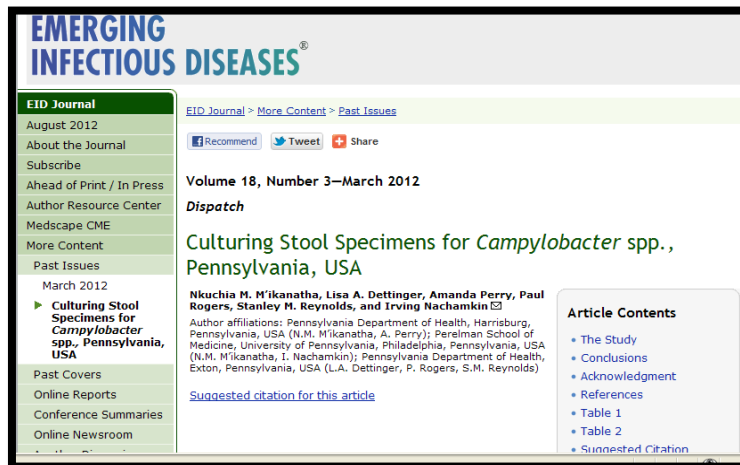
RESEARCH ARTICLE

A Comparison of Non-Typhoidal *Salmonella* from Humans and Food Animals Using Pulsed-Field Gel Electrophoresis and Antimicrobial Susceptibility Patterns

Carol H. Sandt, Paula J. Fedorka-Cray, Deepanker Tewari, Stephen Ostroff, Kevin Joyce, Nkuchia M. M'ikanatha

Published: October 30, 2013 • DOI: 10.1371/journal.pone.0077836

Article	Authors	Metrics	Comments	Related Content



▶ NARMS Retail Meat Testing

- PA is one of 14 states that participate in this program
- Location: catchment area in zip codes within 2-hour driving distance from the Bureau of Laboratories
 - ▮ Chester, Delaware, Lancaster, and Philadelphia counties
- Store sample takes into account population density
 - ▮ Collection by contractor
 - ▮ Frequency: 40 samples bimonthly
- Sample types: Delivered to lab at 2-5° C
 - Chicken breasts
 - Ground turkey
 - Ground beef
 - Pork chops



▶ NARMS Retail Meat Testing_(cont'd)

- Standard Culture protocol for Salmonella and Campylobacter
- Salmonella identification – biochemical and bacterial serotyping
- Campylobacter – gram stain, growth characteristics and PCR speciation
- Salmonella and Campylobacter bacterial isolates shipped monthly to FDA laboratory for antimicrobial susceptibilities studies.
- Quarterly teleconferences with FDA

➤ NARMS Human

Salmonella, Shigella and E.coli O157

- Clinical microbiology labs are required to send all Salmonella, Shigella and Shiga Toxin E. coli (STEC).
- Confirm identification with biochemicals and perform bacterial serotyping, Shiga Toxin PCR.
- 1/5 (20%) non-typhoid Salmonella, Shigella and E. coli O157, all Typhi are shipped quarterly to CDC for antimicrobial studies.
- Import data into CDC website.
- Quarterly teleconferences with CDC



Molecular Epidemiology

➤ *Salmonella* PFGE: Meat and Humans

PFGE-XbaI	Key	SourceType	SourceSite	IsolatDate	Serotype	PFGE-XbaI-pattern	Outbreak
	M10010968001A	Food	Ground Turkey	2010-05-17	Berta	JAXX01.0001	1006NYJAX-1
	M12011598001A	Food	Ground Turkey	2012-06-14	Berta	JAXX01.0001	1205MLJAX-1
	M09020246001A	Human	Stool	2009-08-09	Berta	JAXX01.0001	
	M09020161001A	Human	Stool	2009-08-20	Berta	JAXX01.0001	
	M10024385001A	Human	Blood	2010-10-14	Berta	JAXX01.0001	
	M11009873001A	Human	Stool	2011-03-27	Berta	JAXX01.0001	
	M11023235001A	Human	Stool	2011-09-12	Berta	JAXX01.0001	1108MLJAX-1
	M12022447001A	Human	Urine	2012-11-18	Berta	JAXX01.0001	
	M12022823001A	Human	Stool	2012-11-26	Berta	JAXX01.0001	

Antimicrobial Susceptibility

Key	Source Site	Gen...	Strep...	Amp...	Amox...	Ceftio...	Ceftri...	Cefox...	Trimet...	Chlor...	Cipro...	Nali...	Sulfisox...	Tet...
M10010968001A	Ground Turkey	R	S	R	S	S	S	S	S	S	S	S	R	S
M12011598001A	Ground Turkey	S	S	R	R	R	R	R	S	S	S	S	S	S
M09020246001A	Stool	S	R	R	I	S	S	S	S	R	S	S	R	R
M09020161001A	Stool	R	S	R	I	S	S	S	S	S	S	S	R	S
M10024385001A	Blood	S	S	R	R	R	R	R	S	S	S	S	S	S
M11009873001A	Stool	R	R	S	S	S	S	S	S	S	S	S	R	S
M11023235001A	Stool	S	S	R	R	R	R	R	S	S	S	S	S	S
M12022447001A	Urine	S	R	S	S	S	S	S	S	S	S	S	R	S
M12022823001A	Stool	S	S	R	R	R	R	R	S	S	S	S	S	S

➤ Meat Sources

PFGE-Xbal		Key	Source Site	Store	USDA Estab Name
		M10010968001A	Ground Turkey	Acme Market	CARGILL MEAT SOLUTIONS
		M12011598001A	Ground Turkey	Giant Food Stores	CARGILL MEAT SOLUTIONS

Automated Report

<u>NARMS Sample #</u>	<u>Coll Date</u>	<u>Establishment</u>	<u>USDA Est#</u>	<u>Establ. County</u>	<u>Spec Type</u>
M15009804	7/20/2015	Acme Market	P-7903	Chester	Chicken Breast - Food
<u>Serotype</u>	<u>Xbal Pattern Name</u>	<u>Frequency*</u>	<u>Blnl Pattern Name</u>	<u>Frequency*</u>	
S. Enteritidis	Xbal#JEGX01.0023	1.21%			

Human Samples w/ Matching Patterns: 4

<u>Sample #</u>	<u>Serotype</u>	<u>Col. Date</u>	<u>Age</u>	<u>Sex</u>	<u>Patient County</u>	<u>Xbal Pattern</u>	<u>Blnl Pattern</u>
M15010040	S. Enteritidis	7/10/2015	29 Years	Female	Bucks	Xbal#JEGX01.0023	
M15007513	S. Enteritidis	5/31/2015	63 Years	Male	Philadelphia	Xbal#JEGX01.0023	

*Frequency is the number of occurrences of this particular pattern divided by the number of occurrences of this pattern prefix (left of the decimal point), expressed as a percentage.

Laboratory Deepanker Tewari

Animal Laboratory

- Pennsylvania Veterinary Lab (PVL), Harrisburg
- Participate with national veterinary labs
 - (NAHLN, FERN, VET LIRN)
- Examples of tests performed
 - Influenza
 - Brucellosis
 - Salmonellosis
 - Rabies
 - WNV



Rabies

➤ Collaboration with NARMS

- Antimicrobial resistant testing using NARMS protocol

- ▀ -Susceptibility testing (MIC determination)
- ▀ -Disk diffusion (Breakpoint analysis)

- Special studies

- ▀ *Listeria monocytogenes* (food and human – PA & NY)
- ▀ *Salmonella cerro* (cattle - PA)

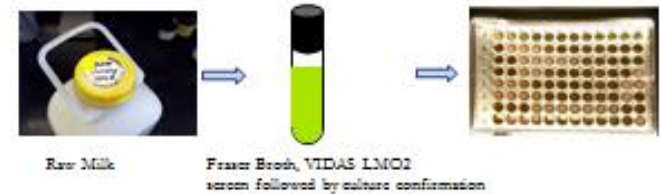


Figure 1: Raw milk tested for *Listeria*, confirmed and antimicrobial susceptibility determined by standard method.

FOODBORNE PATHOGENS AND DISEASE
Volume 9, Number 10, 2012
© Mary Ann Liebert, Inc.
DOI: 10.1089/fpd.2012.1142

Prevalence of *Salmonella* Cerro in Laboratory-Based Submissions of Cattle and Comparison with Human Infections in Pennsylvania, 2005–2010

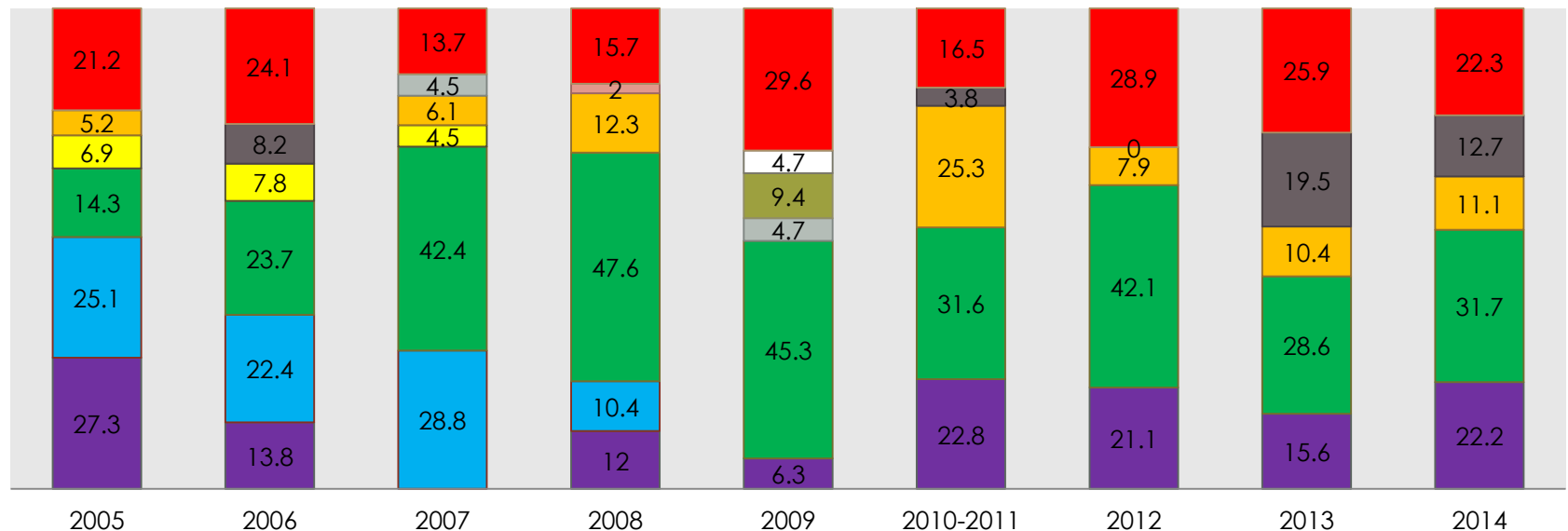
Deepanker Tewari,¹ Carol H. Sandt,² Dawn M. Miller,¹ Bhushan M. Jayarao,³ and Nkuchia M. M'ikanatha⁴

Abstract

The aim of this study was to identify *Salmonella* serotypes infecting cattle in Pennsylvania, to compare infection rates for the predominant serotype, *Salmonella enterica* serotype Cerro, with the infection rates for the same serotype in humans, and to study the clonal diversity and antimicrobial resistance for this serotype in cattle from 2005 to 2010. Clonal diversity among the selected isolates was studied using pulsed-field gel electrophoresis (PFGE) and repetitive (rep)-polymerase chain reaction (PCR). *Salmonella* Cerro showed the single largest increase as a cause of cattle infections over the study period. The proportional distribution of *Salmonella* Cerro serotype among laboratory-submitted *Salmonella* positive cases in cattle was 36.1% in the year 2010 compared to 14.3% in 2005. A simultaneous decrease in serotype Newport infections was also observed in cattle (25% in 2005, to 10.1% in 2010). Studies of clonal diversity for cattle and human isolates revealed a predominant PFGE type but showed some variability. All tested isolates ($n=60$) were susceptible to sulfamethoxazole-trimethoprim, but 2% of cattle isolates ($n=1/50$) and 20% of human isolates ($n=2/10$) showed resistance to tetracycline and sulfisoxazole. One human isolate showed additional resistance to ampicillin and gentamicin. This study suggests an increase in *Salmonella* Cerro infections in the cattle population and a decrease in *Salmonella* Newport infections. The increase in Cerro infections appears to be restricted to the cattle population, but occasional human infections occur.

Salmonella

Salmonella Serotype % rate in PA Cattle over 10 years



Environmental Collaboration

David Hewitt

➤ Ongoing Research

Ongoing Research

➤ Ongoing Research

Molecular biology and genomics of foodborne pathogens



- Primary Investigator: Edward Dudley, Penn State; Dept. of Food Science, CoAS/CIDD
- Studying genomics for tracking foodborne pathogens – Part of FDA GenomeTrakr
- Understanding the impact of microbiome on toxins expression by *E. coli* O157:H7

Collaboration on Environmental Sources

Drug resistant bacteria in the environment



Image from Reuters

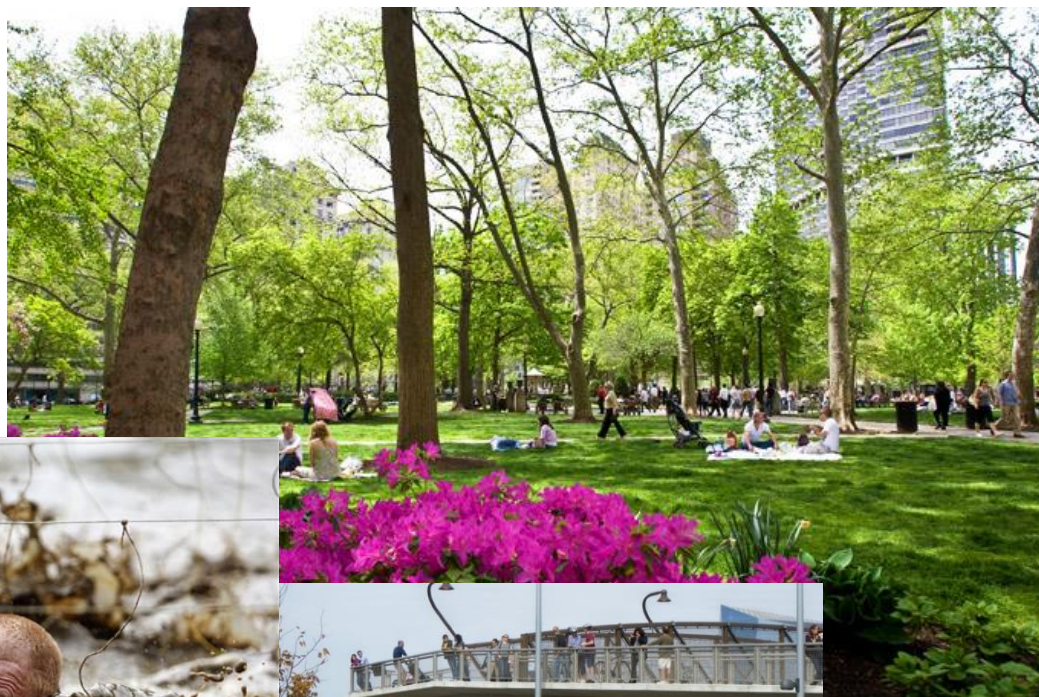


Image from GPTMC

Image from FSRP

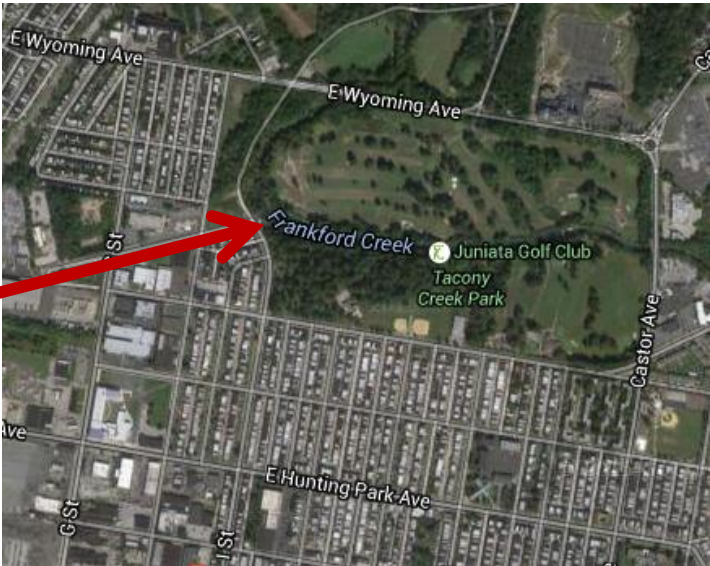
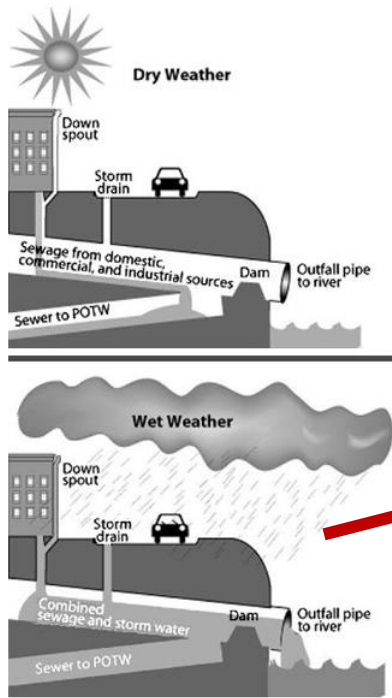
David Hewitt, in collaboration with Jeff Townsend (Yale University) and Ryan Kerney (Gettysburg College)

Collaboration on Environmental Sources (cont'd)

An additional concern in urban areas



Combined sewer systems



Images from US EPA, Google Maps, and Vanessa Couvreur

➤ Ongoing Research

Consumer perspectives on antibiotic usage in retail meats



- Primary Investigator: **Rachel Smith, PhD**, Penn State; CASHDF & CIDD
- Studying psychosocial determinants of consumers' behaviors, and their intentions to encourage other people's consumption.

Science and Opinions

There are in fact two things, science and opinion; the former begets knowledge, the latter ignorance.

- Hippocrates (c460-c.377 BCE)
Greek physician. Law



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Source: Science Blog