U.S. FOOD & DRUG ADMINISTRATION

NARMS
National Antimicrobial Resistance Monitoring System

NARMS Update and Request for Science Board Subcommittee Review

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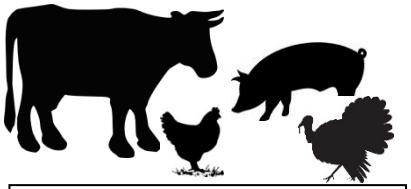
November 15, 2016

Origins of NARMS

- Established in 1996 under the recommendation of an FDA Veterinary Medical Advisory Committee reviewing concerns over the approval of fluoroquinolones in food animals.
- Originally intended to function as a post-approval safety monitoring system for FDA-regulated products
- Partnership of FDA-CVM, CDC, and USDA
- Primary Objectives:
  - Monitor trends in antimicrobial resistance among foodborne bacteria from humans, retail meats and animals
  - Disseminate timely information on antimicrobial resistance to promote interventions that reduce resistance among foodborne bacteria
  - Conduct research to better understand the emergence, persistence, and spread of antimicrobial resistance
  - Assist the FDA in making decisions related to the approval of safe and effective antimicrobial drugs for animals



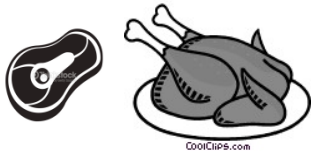
Animal Population
Slaughterhouse

Cecal Sampling (2013)

HACCP (1997)

USDA

Chicken only



Retail Meats (2002)
Grocery Store
- Chicken
- Ground turkey
- Pork chop
- Ground beef

Imported Foods
Distributors
- Spices
- Seafood
- Produce
- Feed
- Etc.

18 State and University labs

ORA Denver lab

Chicken and Turkey only

FDA

Human Population (1996)
Medical Office

Physician Visit

Local Lab

State Lab

CDC

* Other organisms surveyed

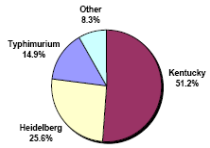
- Campylobacter
- Salmonella

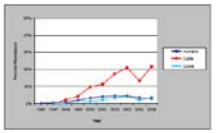
pathogenic

- Enterococcus
- E. coli

indicator

Data Integration





NARMS
National Antimicrobial Resistance Monitoring System

2014

Integrated Report

CDC FDA USDA

2007 Science Board Subcommittee Review

- The Science Board Advisory Committee to the FDA established a subcommittee to:
  - Evaluate the NARMS program
  - Address four questions relevant to continued success of the program:
    - Are there inherit biases in the sampling strategies employed in NARMS? If so, how can they be improved to ensure that the data and interpretation are scientifically sound given current resources?
    - Are there epidemiological and/or microbiological research studies that would better serve the goals of NARMS and the regulatory work of FDA?
    - Are current plans for data harmonization and reporting appropriate? If not, what are the top priorities for advancing harmonized reporting?
    - Are the current NARMS international activities adequate to address the worldwide spread of antimicrobial-resistant food-borne bacteria?

Subcommittee Recommendations

The science board provided a number of recommendations- all of which have been addressed or are still in progress

Recommendations	Status
Redesign the food animal sampling strategy to become nationally representative	Nationally representative cecal sampling program developed in 2013
Adjust the retail meat sampling strategy to allow broader interpretation and inference of data	The retail meat program expanded in 2013 and again in 2017 to now include 20 sites
Expand hypothesis-driven research including research on the flow of resistance genes and resultant human health impact	In 2014, WGS analysis was implemented in all arms of NARMS. Historical retail isolates are being sequenced. Since 2007, NARMS has published over 100 peer-reviewed articles.
Create a real-time integrated database	An integrated database was created and finalized in 2016
Move toward a database that can be readily shared with researchers and other users	Deployed NARMSNow: Integrated Data in 2015 which allows others to access isolate level NARMS data. Interactive visualizations have been utilized since 2008 to give stakeholders greater autonomy in viewing and interpreting the data.

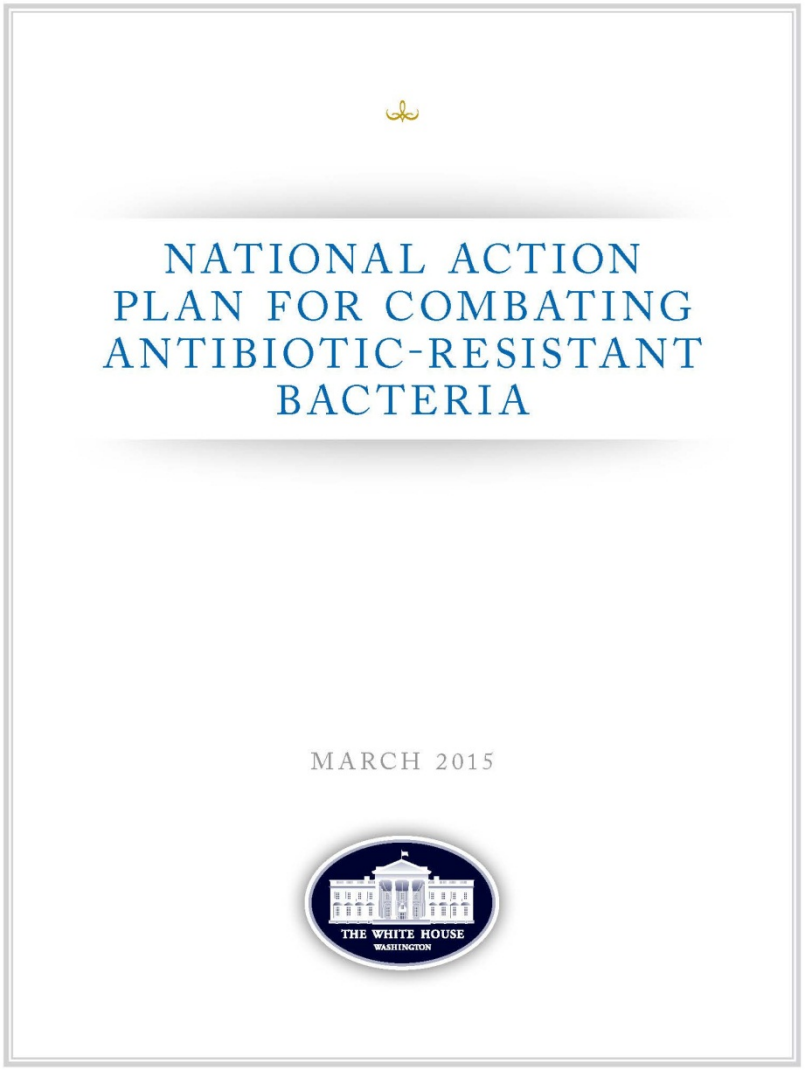
Subcommittee Recommendations, cont.

Recommendations	Status
Improve speed of reports	Lag in reporting time has been reduced(now 1-2 years) and will continue to improve with increased reliance on new testing and reporting technologies
Continue and expand NARMS international activities	NARMS representation on several international committees, trainings, and forums
Develop a 10 year plan	NARMS developed a 2012-2016 strategic plan. A 2017-2021 plan is in development

New developments

Global challenge of antibiotic resistance has received increased visibility

New developments



- Slow the Emergence of Resistant Bacteria and Prevent the Spread of Resistant Infections
- Strengthen National One-Health Surveillance Efforts to Combat Resistance **NARMS**
- Advance Development and Use of Rapid and Innovative Diagnostic Tests for Identification and Characterization of Resistant Bacteria
- Accelerate Basic and Applied Research and Development for New Antibiotics, Other Therapeutics, and Vaccines
- Improve International Collaboration and Capacities for Antibiotic-resistance Prevention, Surveillance, Control, and Antibiotic Research and Development

New developments

Changing lab technologies

Organism ID

Serotype

Antibiotic Susceptibility Testing

Speciate

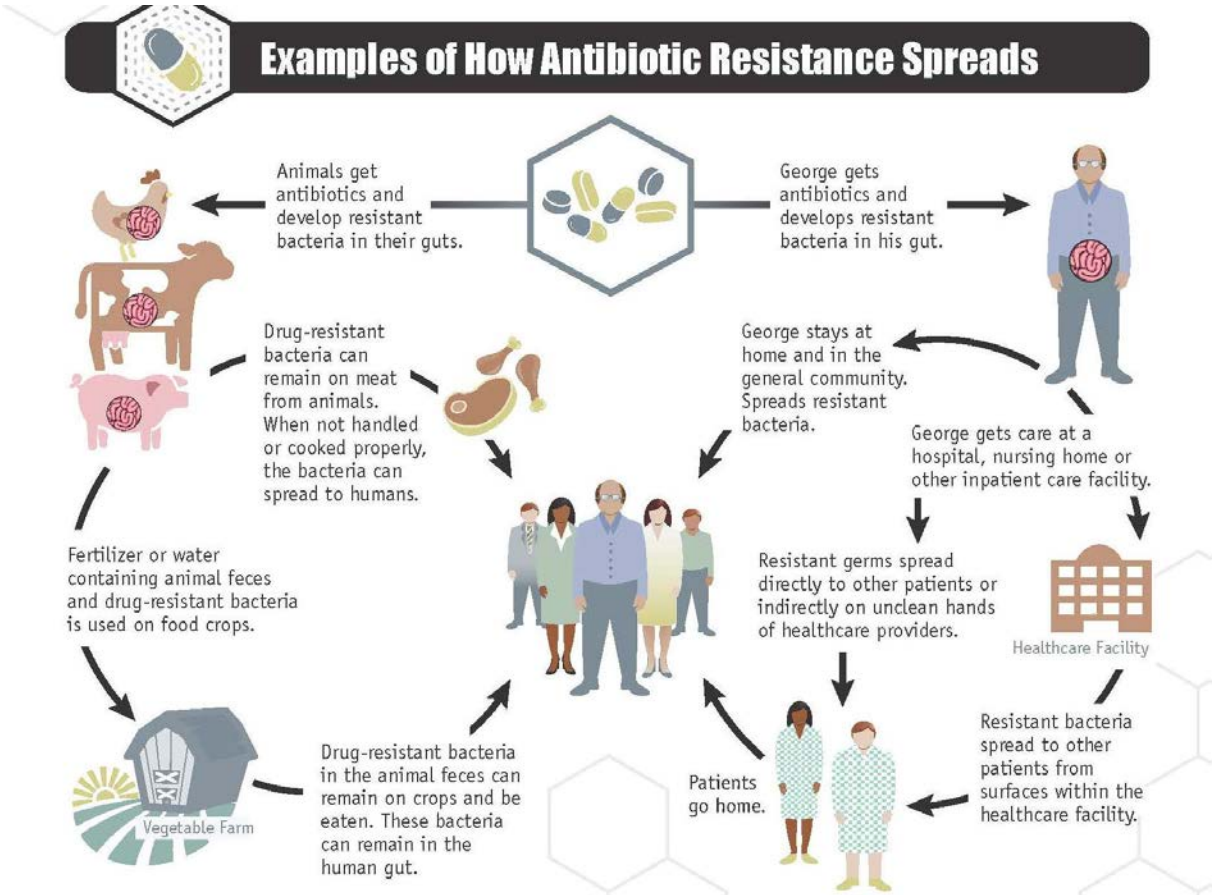
Whole Genome Sequencing

- Confirm all organisms
- ID Serotype and Species
- ID resistance genes and mutations; also plasmid types

2016 Science Board Request

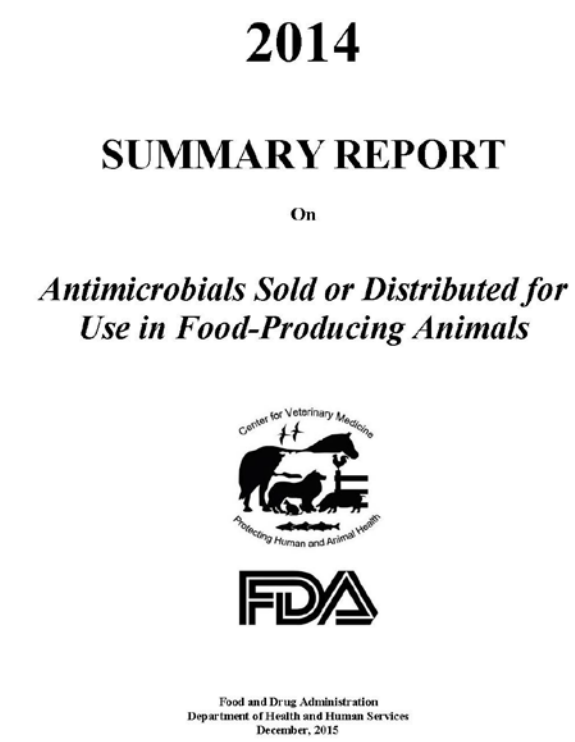
- The Science Board establish a new subcommittee to answer the following questions:

NARMS is focused on specific commodities and sampling intervals. Could changes to sampling strategies improve our understanding of resistance dynamics within a One Health paradigm?



CDC, Antibiotic Resistance Threats Report, 2013

FDA publishes annual antimicrobial sales and resistance data. Is our analysis and presentation of these data adequate? What is the best way to report relationships between antimicrobial sales data and antimicrobial resistance in our national surveillance?



2014

SUMMARY REPORT

On

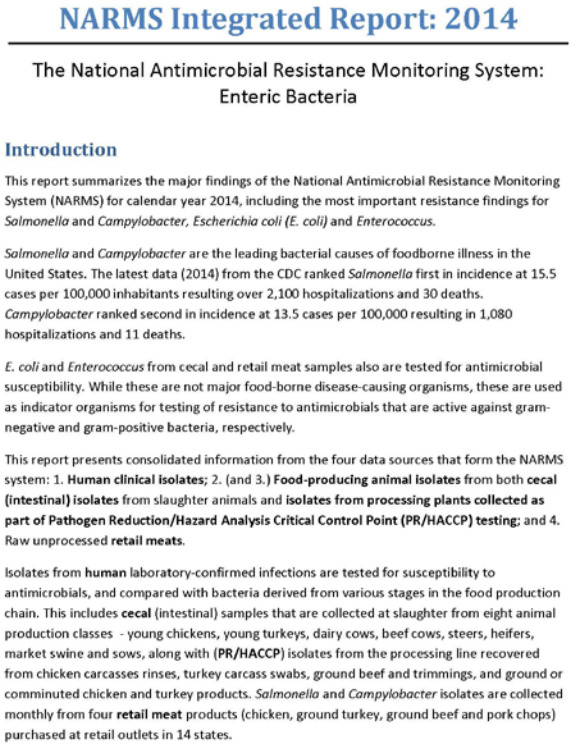
Antimicrobials Sold or Distributed for Use in Food-Producing Animals

Center for Veterinary Medicine

Protecting Human and Animal Health

FDA

Food and Drug Administration
Department of Health and Human Services
December, 2015



NARMS Integrated Report: 2014

The National Antimicrobial Resistance Monitoring System: Enteric Bacteria

Introduction

This report summarizes the major findings of the National Antimicrobial Resistance Monitoring System (NARMS) for calendar year 2014, including the most important resistance findings for *Salmonella* and *Campylobacter, Escherichia coli (E. coli)* and *Enterococcus*.

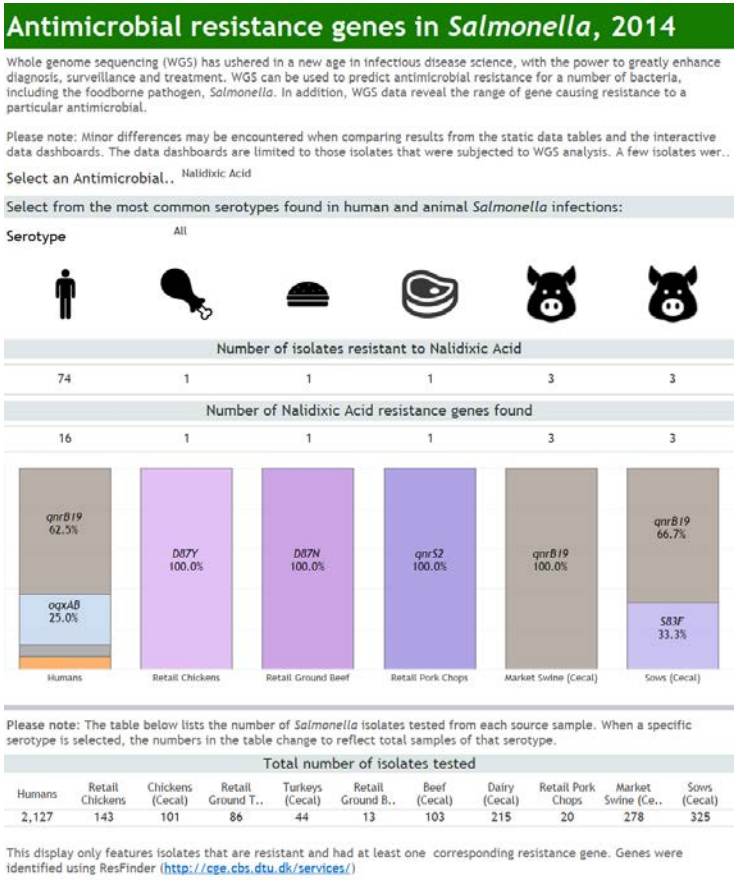
Salmonella and *Campylobacter* are the leading bacterial causes of foodborne illness in the United States. The latest data (2014) from the CDC ranked *Salmonella* first in incidence at 15.5 cases per 100,000 inhabitants resulting over 2,100 hospitalizations and 30 deaths. *Campylobacter* ranked second in incidence at 13.5 cases per 100,000 resulting in 1,080 hospitalizations and 11 deaths.

E. coli and *Enterococcus* from cecal and retail meat samples also are tested for antimicrobial susceptibility. While these are not major food-borne disease-causing organisms, these are used as indicator organisms for testing of resistance to antimicrobials that are active against gram-negative and gram-positive bacteria, respectively.

This report presents consolidated information from the four data sources that form the NARMS system: 1. **Human clinical isolates**; 2. (and 3.) **Food-producing animal isolates** from both **cecal (intestinal) isolates** from slaughter animals and **isolates from processing plants collected as part of Pathogen Reduction/Hazard Analysis Critical Control Point (PR/HACCP) testing**; and 4. Raw unprocessed **retail meats**.

Isolates from **human** laboratory-confirmed infections are tested for susceptibility to antimicrobials, and compared with bacteria derived from various stages in the food production chain. This includes **cecal** (intestinal) samples that are collected at slaughter from eight animal production classes - young chickens, young turkeys, dairy cows, beef cows, steers, heifers, market swine and sows, along with **(PR/HACCP)** isolates from the processing line recovered from chicken carcasses rinses, turkey carcass swabs, ground beef and trimmings, and ground or comminuted chicken and turkey products. *Salmonella* and *Campylobacter* isolates are collected monthly from four **retail meat** products (chicken, ground turkey, ground beef and pork chops) purchased at retail outlets in 14 states.

NARMS now does whole genome sequencing as a routine part of surveillance. What is the best way to report whole genome sequence data, and trends in the resistome?



Antimicrobial resistance genes in *Salmonella*, 2014

Whole genome sequencing (WGS) has ushered in a new age in infectious disease science, with the power to greatly enhance diagnosis, surveillance and treatment. WGS can be used to predict antimicrobial resistance for a number of bacteria, including the foodborne pathogen, *Salmonella*. In addition, WGS data reveal the range of gene causing resistance to a particular antimicrobial.

Please note: Minor differences may be encountered when comparing results from the static data tables and the interactive data dashboards. The data dashboards are limited to those isolates that were subjected to WGS analysis. A few isolates wer..

Select an Antimicrobial.. Nalidixic Acid

Select from the most common serotypes found in human and animal *Salmonella* infections:

Serotype All

Number of isolates resistant to Nalidixic Acid

Humans	Retail Chickens	Retail Ground Beef	Retail Pork Chops	Market Swine (Cecal)	Sows (Cecal)
74	1	1	1	3	3

Number of Nalidixic Acid resistance genes found

Humans	Retail Chickens	Retail Ground Beef	Retail Pork Chops	Market Swine (Cecal)	Sows (Cecal)
16	1	1	1	3	3

Please note: The table below lists the number of *Salmonella* isolates tested from each source sample. When a specific serotype is selected, the numbers in the table change to reflect total samples of that serotype.

Total number of isolates tested

Humans	Retail Chickens	Chickens (Cecal)	Retail Ground T..	Turkeys (Cecal)	Retail Ground B..	Beef (Cecal)	Dairy (Cecal)	Retail Pork Chops	Market Swine (Ce..	Sows (Cecal)
2,127	143	101	86	44	13	103	215	20	278	325

This display only features isolates that are resistant and had at least one corresponding resistance gene. Genes were identified using ResFinder (http://cge.cbs.dtu.dk/services/)

2016 Science Board Request

- We would like to share the results at the next NARMS public meeting (September 2017)
- The subcommittee response will help us finalize our 2017-2021 NARMS Strategic Plan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