The large burden of *Salmonella* and *Campylobacter* infections from poultry

Patricia M. Griffin, MD | Chief, Enteric Diseases Epidemiology Branch
Virtual National Food Policy Conference Series, held by the Consumer Federation of America | March 23, 2021
Topics

▪ **Salmonella**
  – Most important bacterial foodborne pathogen
  – Three serotype short stories
    • Typhimurium decreasing
    • Enteritidis increasing
    • Infantis increasing

▪ **Chicken**
  – The major U.S. source of protein
  – A major source of *Salmonella* illness
  – The reason for *Salmonella* serotype decreases and increases
  – The major source of *Campylobacter* illness

▪ **Campylobacter**
  – 2nd most common cause of bacterial foodborne illness
  – Chicken is the major source

▪ **Summary and conclusion**
Salmonella is the biggest bacterial foodborne illness challenge in the United States

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CDC annual estimates

Scallan, Emerg Infect Dis, Jan 2011
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Highly resistant *Salmonella* strains continue to emerge in a wide variety of food animals. People are “incidental hosts.”

Chickens  
Cattle  
Pigs
Incidence of serotype Typhimurium infections has declined

Laboratory-based Enteric Disease Surveillance
Both *Salmonella* Typhimurium and Heidelberg infections are declining

Why? Possible reason:

- Both targeted by same poultry vaccine, used on many broiler farms
- Chicken is a major source of these infections
In 2008, *Enteritidis* surpassed *Typhimurium* as the most common *Salmonella* serotype causing human illness.
### Annual incidence of infection with *Salmonella* by serotype, USA

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Compiled using data from both FoodNet (data from 10 sentinel sites, 15% of US pop) and Laboratory-based Enteric Disease Surveillance (data from every U.S. jurisdiction), 2017-2019
Enteritidis used to cause many egg outbreaks, now it causes more chicken than egg outbreaks.
Incidence of Enteritidis infections has varied with its sources

Incidence (per 100,000)

National Enteric Disease Surveillance
1980s through early 2000s were the egg years

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- 1999: Refrigeration requirements expanded
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- **1990**: Control program in egg-laying hens
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- **1999**: Refrigeration requirements expanded
- **2000**: Egg Rule required large producers to test flocks and refrigerate eggs on farms
- **2005**: Moved into broilers
- **2011**: Only 7.5% of whole chickens can have *Salmonella* (was 20%)

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Incidence (per 100,000)

For every case in the incidence numbers, CDC estimates >20 people are infected.

- 1990: Control program in egg-laying hens
- 1991: Eggs refrigerated during interstate commerce
- 1999: Refrigeration requirements expanded
- 2010: Egg Rule required large producers to test flocks and refrigerate eggs on farms
- 2011: Only 7.5% of whole chickens can have *Salmonella* (was 20%)
- 2016: 15.4% of chicken parts can have *Salmonella* (no limit before)

National Enteric Disease Surveillance
We used to buy mostly whole chickens, now buy most as cut-up parts or processed.

Among *Salmonella* illnesses transmitted by chicken in outbreaks, % of caused by the most common serotypes, by year

Preliminary estimates using data from National Outbreak Reporting System (NORS), 2000–2018
Emergence of multidrug-resistant (MDR) *Salmonella* Infantis from chicken

- **2014**
  - FDA isolated MDR Infantis from *retail chicken*
  - CDC identified a few cases of MDR Infantis in *humans* who had not traveled
  - Distinctive, similar PFGE subtype patterns

- **Later investigations**
  - Found MDR Infantis in many poultry flocks
  - Isolates from chickens and humans very similar by whole-genome sequence
  - Human illness is most often linked to consumption of chicken
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Multidrug resistant (MDR) *Salmonella* Infantis infections have spiked since 2016

MDR chicken isolates have typical pulsed-field gel electrophoresis (PFGE) or whole genome sequence (WGS) pattern; Data are preliminary, from the National Antimicrobial Resistance Monitoring System (NARMS) and PulseNet.
Multidrug resistant (MDR) *Salmonella* Infantis infections have spiked since 2016.

Infantis is now our #6 *Salmonella* serotype; it was #14 in 2006. We estimate the MDR “chicken strain” of Infantis is responsible for at least 14,000 illnesses a year.

MDR chicken isolates have typical pulsed-field gel electrophoresis (PFGE) or whole genome sequence (WGS) pattern; Data are preliminary, from the National Antimicrobial Resistance Monitoring System (NARMS) and PulseNet.
Chicken consumption has increased markedly since 1909
Now the #1 protein eaten in USA

More per person than in any other country

Source: USDA Economic Research Service + National Chicken Council
IFSAC estimates that chicken is one of the top 2 sources of all *Salmonella* illnesses.
**Campylobacter** is the **#2 cause** of bacterial foodborne illnesses in the United States

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IFSAC estimates that chicken is responsible for 58% of Campylobacter illnesses.

IFSAC = The Interagency Food Safety Analytics Collaboration, 2018 estimates
Estimates of chicken-associated illnesses caused by *Salmonella* and *Campylobacter*

*Salmonella*: 14.3% of 1,000,000 = 143,000

*Campylobacter*: 58.3% of 845,000 = 492,000

635,000 illnesses each year

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A central problem: lack of surveillance & investigation on farms

- Few incentives for decreasing carriage of human pathogens by farm animals
- No routine, ongoing surveillance on farms for pathogens that cause foodborne illness
- Typically, by the time CDC finds that many people are getting sick, a pathogen has spread widely on farms
  - Only 1 of ~20-29 human infections diagnosed

Investigations of human illness usually stop outside the farm, so we don’t learn how to prevent illness

FSIS=Food Safety and Inspection Service, USDA; NARMS=National Antimicrobial Resistance Monitoring System
Summary

- Chicken is #1 protein consumed in United States
- *Salmonella* is our most important foodborne bacterial cause of illness and death
  - Typhimurium infections have been declining (now #2)
    • likely related to vaccination of chickens
  - Enteritidis infections increased (now #1)
    • when it got into broiler flocks
  - Infantis infections markedly increased (#14 → #6)
    • due to emergence of a highly resistant strain in broiler flocks
Summary

- **Campylobacter** is 2nd most common cause of bacterial foodborne illnesses
  - Most infections, ~58%, attributed to chicken
  - Most important source of chicken-associated illnesses

- The burden of chicken-associated illnesses is large
  - ~635,000 illnesses/year caused by *Salmonella* and *Campylobacter*
We can and must markedly decrease illnesses

- **Need multi-pronged approach**
  - Farm measures, e.g., vaccination, hygiene, audits
  - Slaughterhouse methods, e.g., standards
  - Retail methods, e.g., buying agreements, industry standards

- **Reasons for optimism**
  - Vaccination can be effective
  - Poultry industry has eradicated from flocks some *Salmonella* serotypes that make poultry sick
  - The UK & France have markedly decreased *Salmonella* infections using vaccination of poultry, targeting of particular serotypes, hygiene measures on farms, legislation, and investigation.
Let’s collaborate to fix this bug in the food safety system

A Bug in the System
Why last night’s chicken made you sick.
BY WIL S. HYLTON
Current and former members of these groups contributed to this work

- CDC’s enteric diseases epidemiology, outbreak, and laboratory branches
- State and local public health departments
- Food Safety and Inspection Service, U.S. Department of Agriculture
- U.S. Food and Drug Administration

For more information, contact CDC
1-800-CDC-INFO (232-4636)

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.