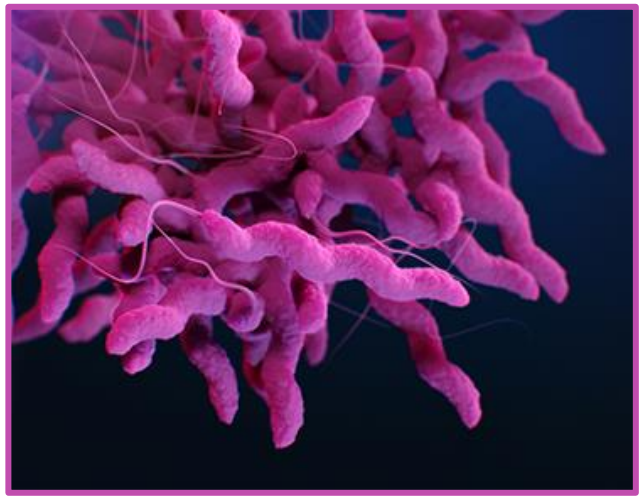
National Center for Emerging and Zoonotic Infectious Diseases
Division of Foodborne, Waterborne, and Environmental Diseases

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**

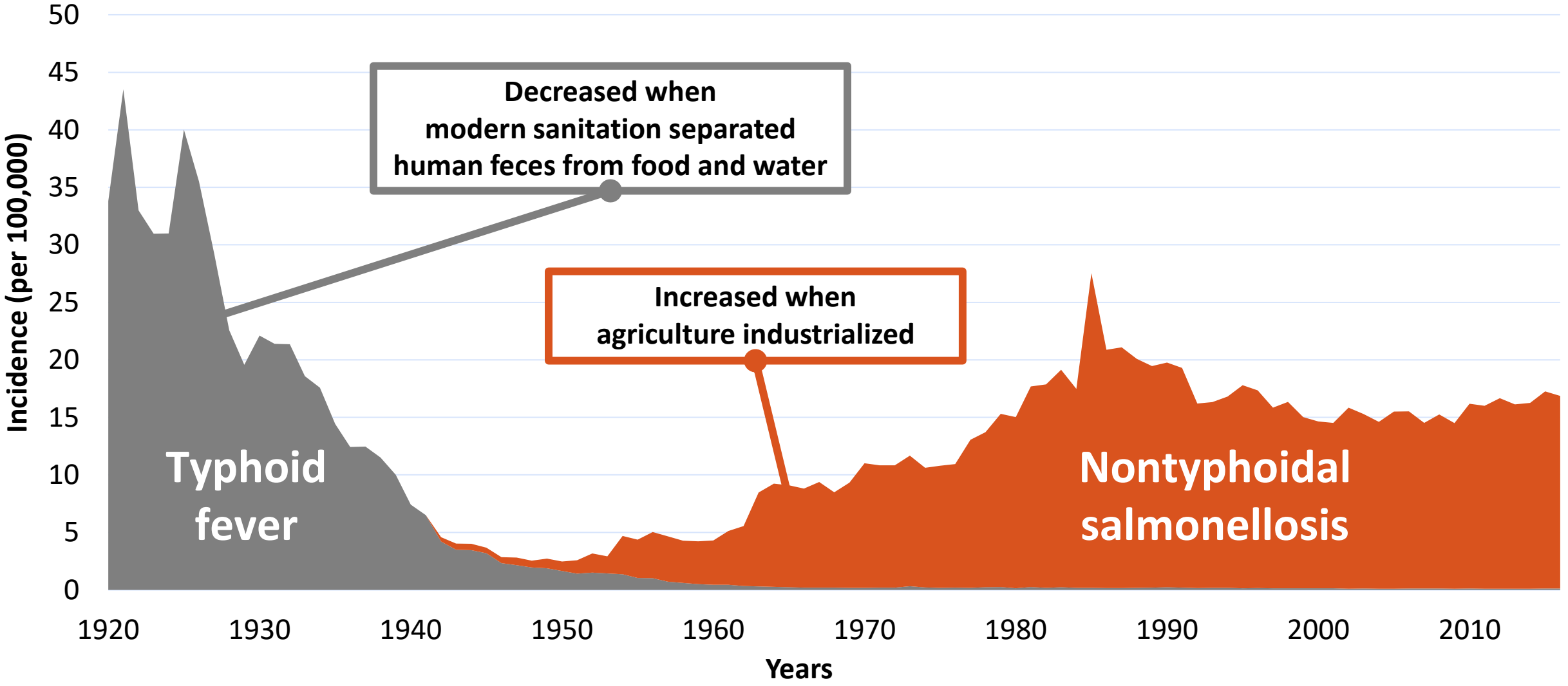
Salmonella is the biggest bacterial foodborne illness challenge in the United States

----------CDC annual estimates----------

Pathogen	Foodborne illnesses	Foodborne hospitalizations	Foodborne deaths
Salmonella	**1,000,000**	**19,000**	**380**
Campylobacter	845,000	8,500	80
***E. coli* O157**	63,000	2,100	20
Listeria	1,600	1,500	260

Scallan, Emerg Infect Dis, Jan 2011

By the mid-20th century typhoid fever (caused by *S.* Typhi) had declined, but **nontyphoidal salmonellosis was rising. It is now our major foodborne disease problem.**



National Enteric Disease Surveillance, 1920-2016

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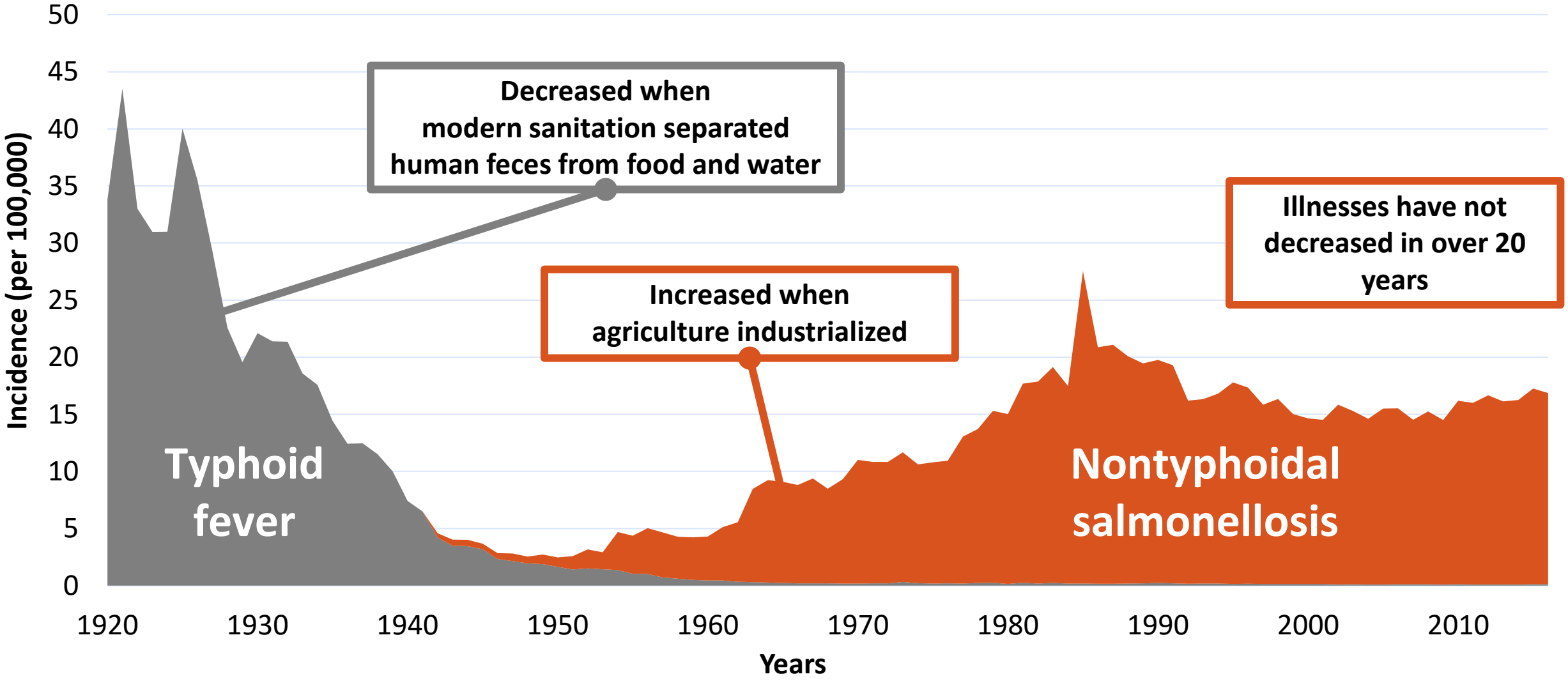


National Enteric Disease Surveillance, 1920-2016

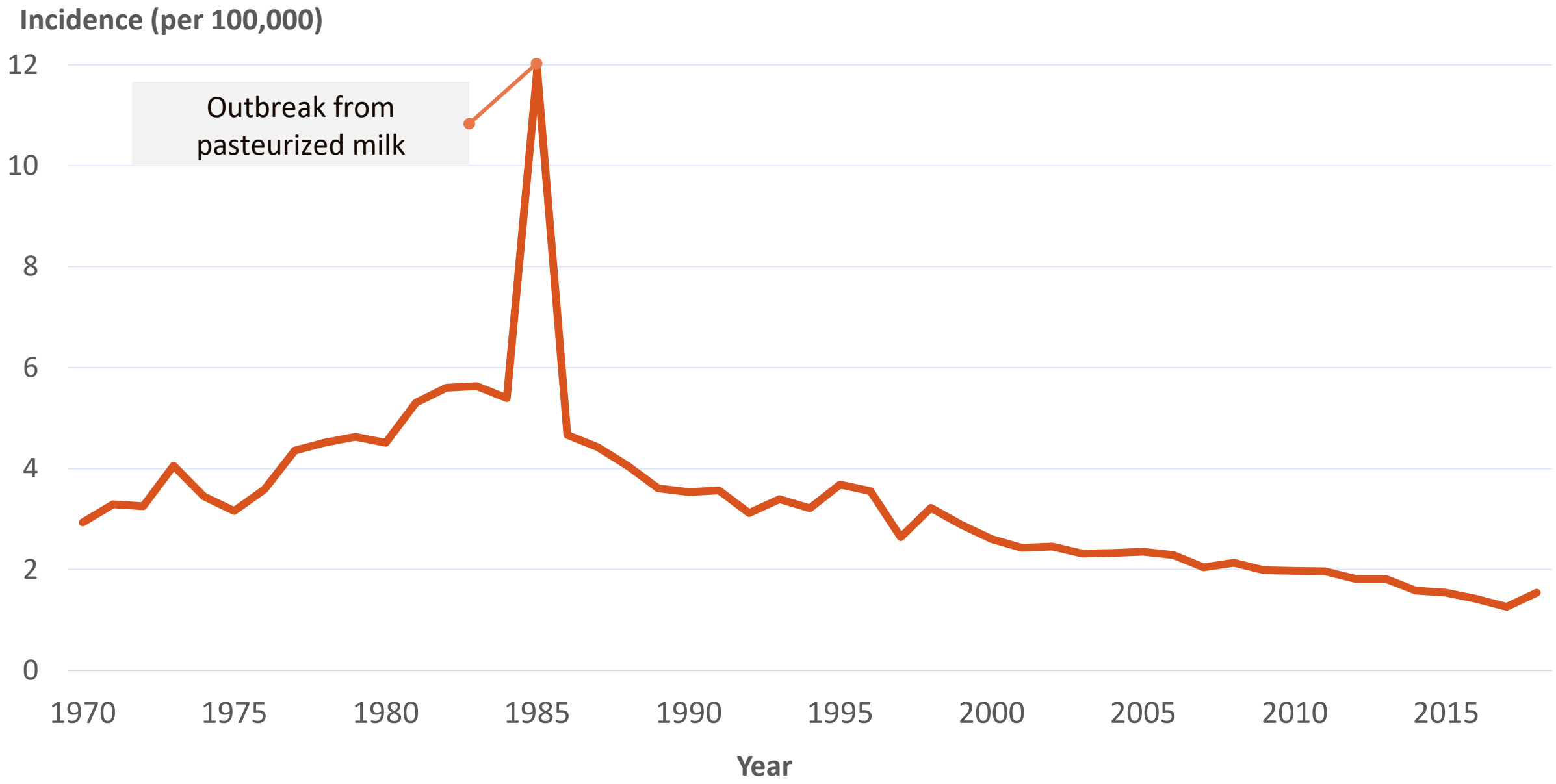
Highly resistant *Salmonella* strains continue to emerge in a **wide variety** of food animals. People are **"incidental hosts."**

Chickens

Cattle

Pigs

Incidence of serotype Typhimurium infections has declined



Both *Salmonella* Typhimurium and Heidelberg infections are declining

Typhimurium

#1 until 2008

↓

Now #2

Heidelberg

#4 in 2003

↓

Now #15

Why? Possible reason:

- Both targeted by same poultry vaccine, used on many broiler farms
- Chicken is a major source of these infections

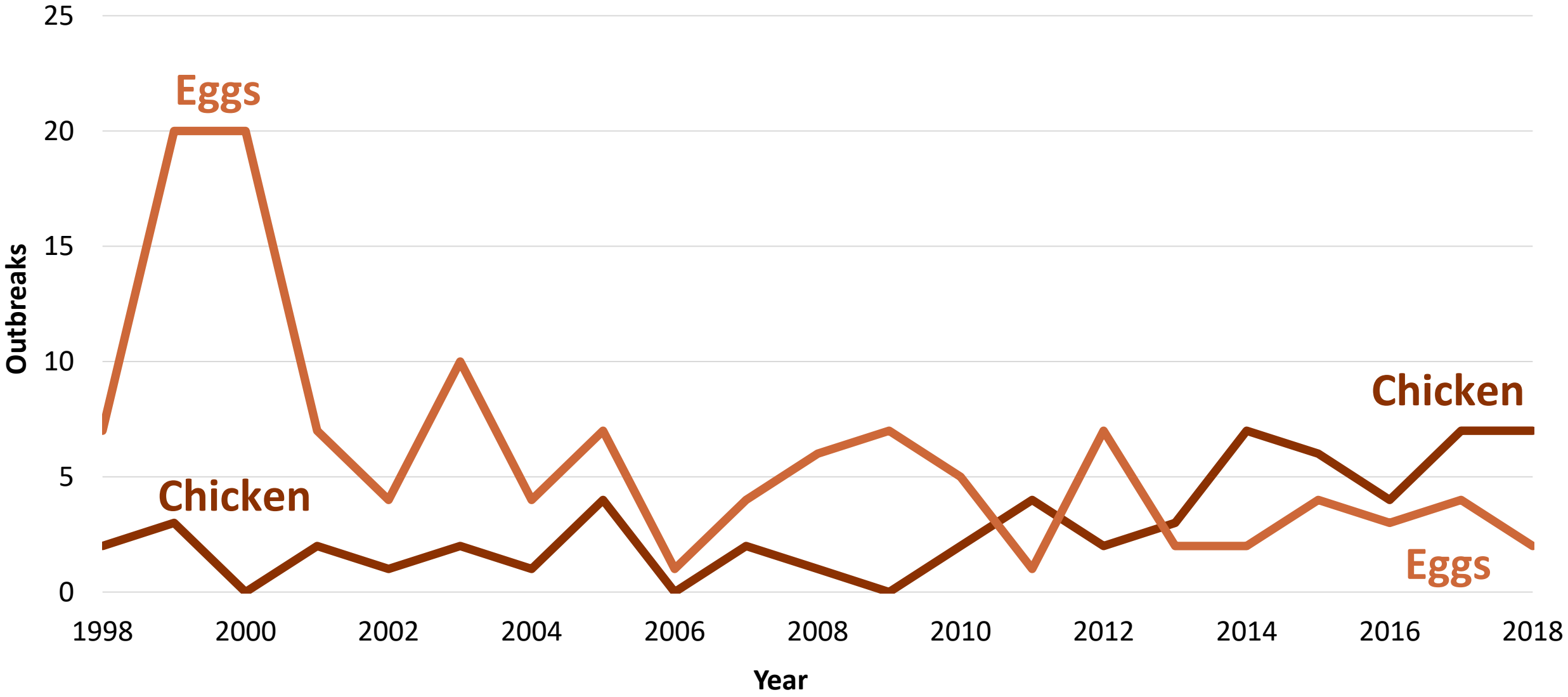
In 2008, Enteritidis surpassed Typhimurium as the most common *Salmonella* serotype causing human illness

Annual incidence of infection with *Salmonella* | by serotype, USA

	Serotype	Incidence lab-confirmed infections (per 100,000 pop. per year)	% of total	% with international travel
1	Enteritidis	3.0	19	22
2	Typhimurium	1.7	11	6
3	Newport	1.6	10	5
4	Javiana	1.4	9	3
5	4,[5],12:i:-	0.9	6	10
	Top 5	–	**56**	–
	All	**16.9**	**100**	**11**

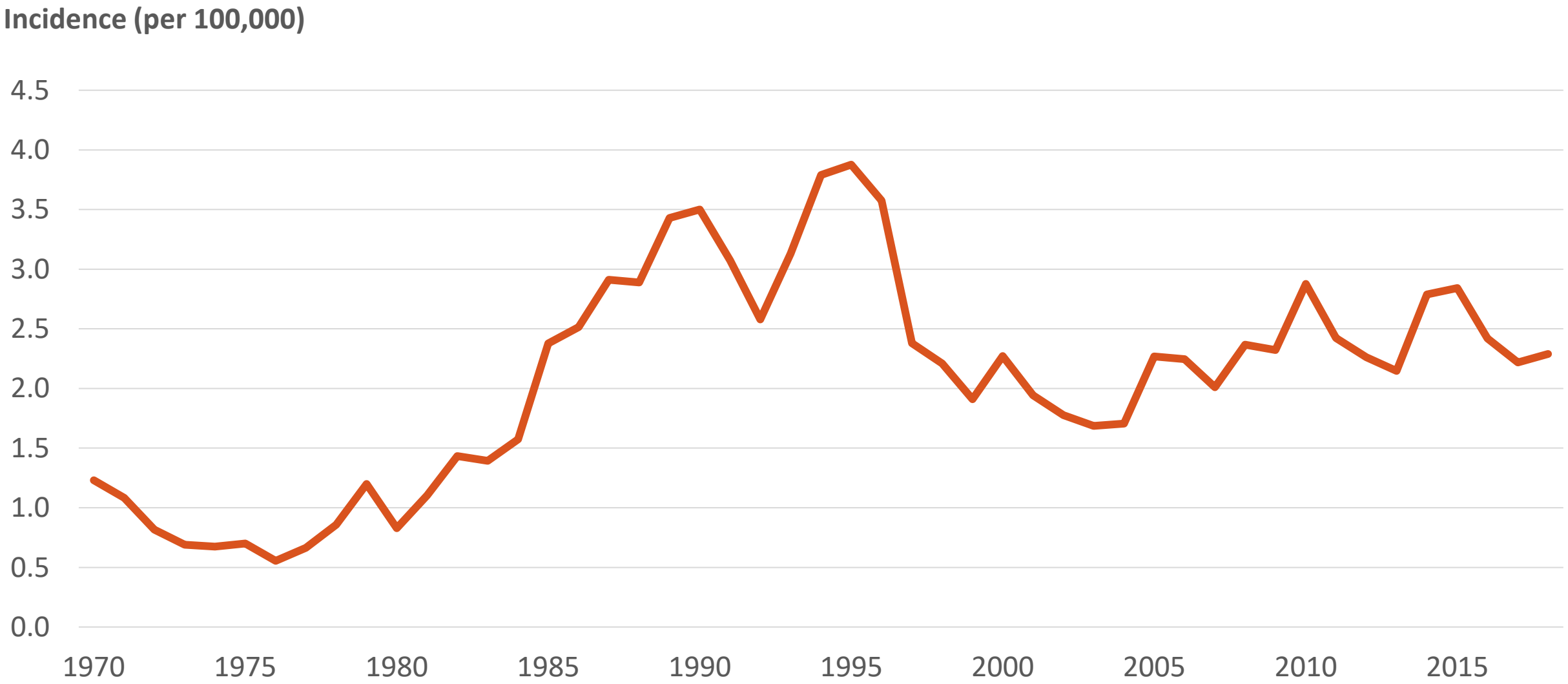
Compiled using data from both FoodNet (data from 10 sentinel sites, 15% of US pop) and Laboratory-based Enteric Disease Surveillance (data from every U.S. jurisdiction), 2017-2019

Enteritidis used to cause many egg outbreaks, now it causes more chicken than egg outbreaks

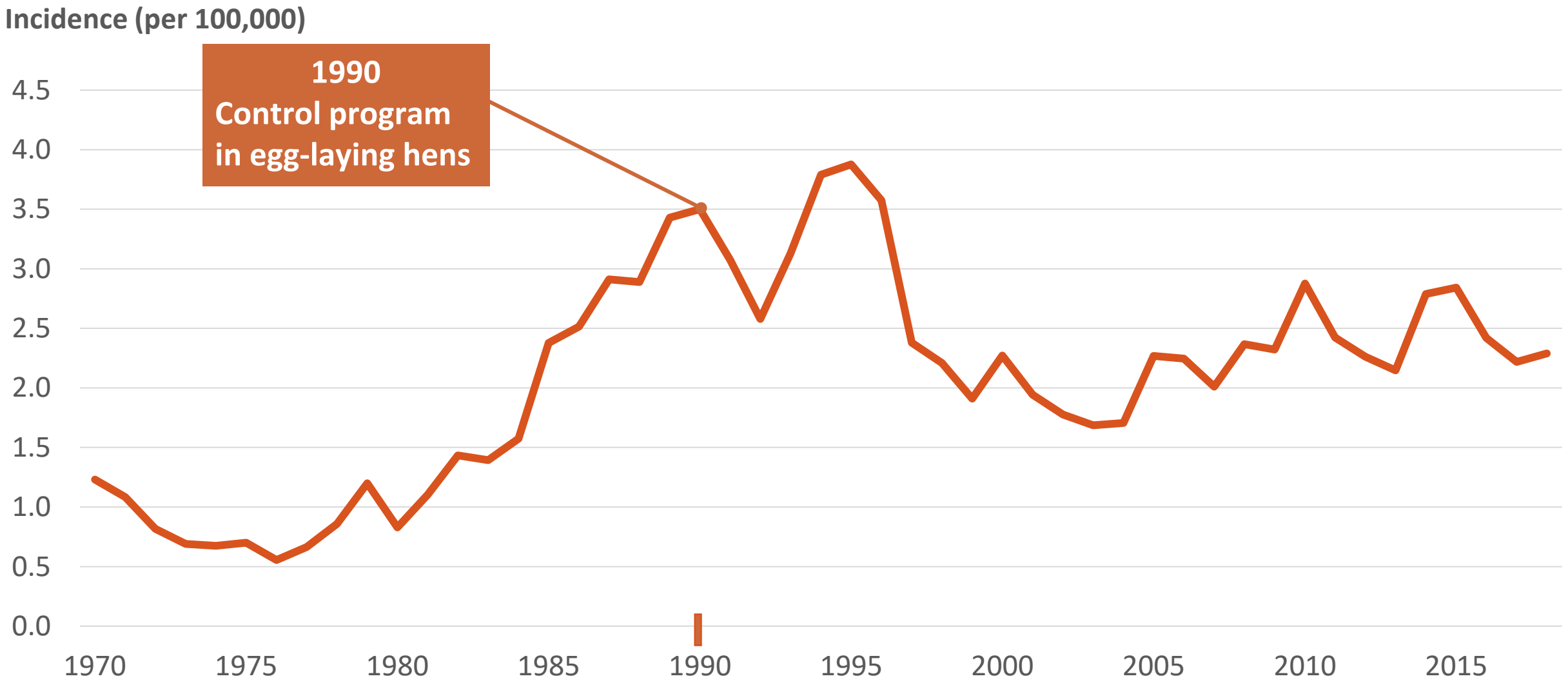


National Outbreak Reporting System, 1998–2018

Incidence of Enteritidis infections has varied with its sources



1980s through early 2000s were the egg years



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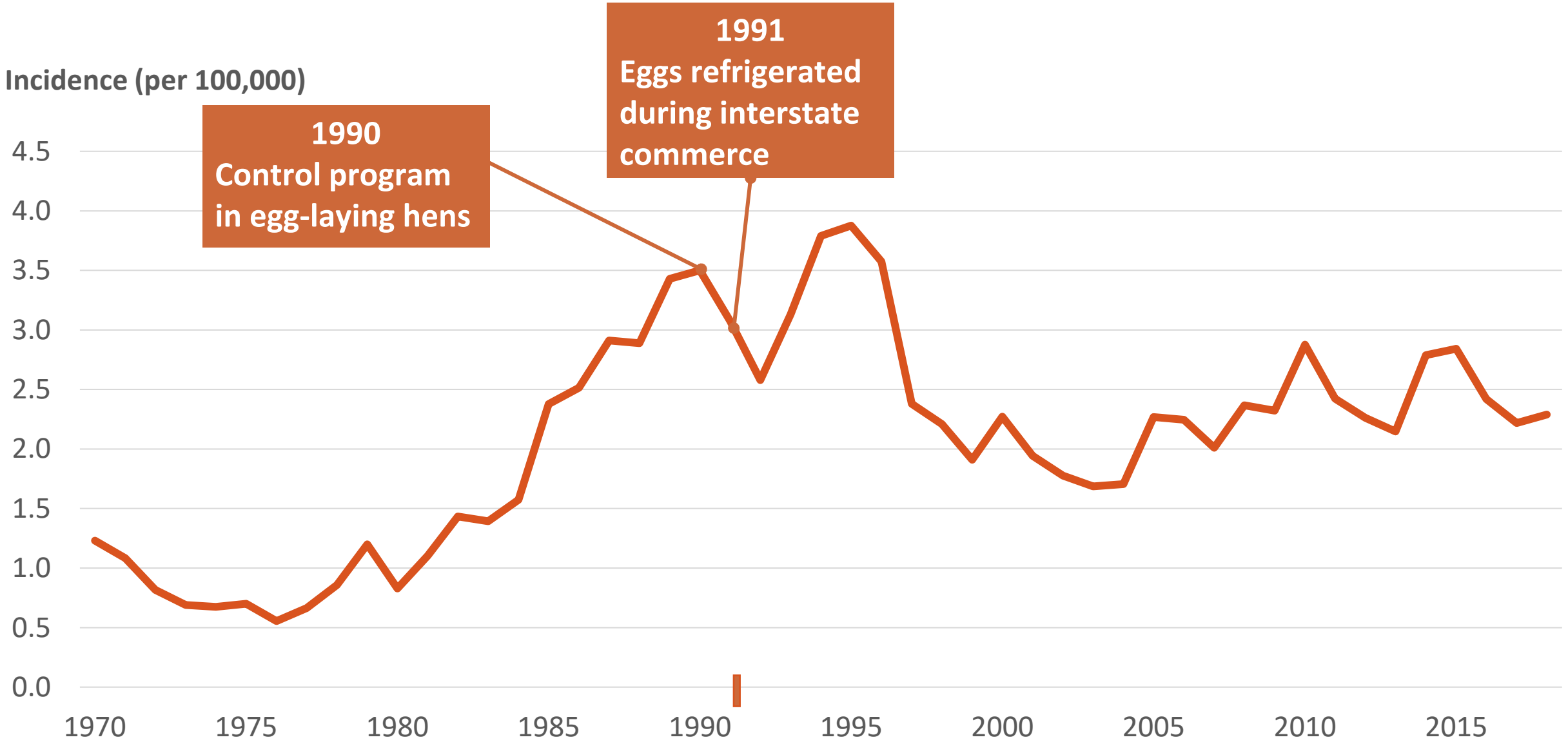

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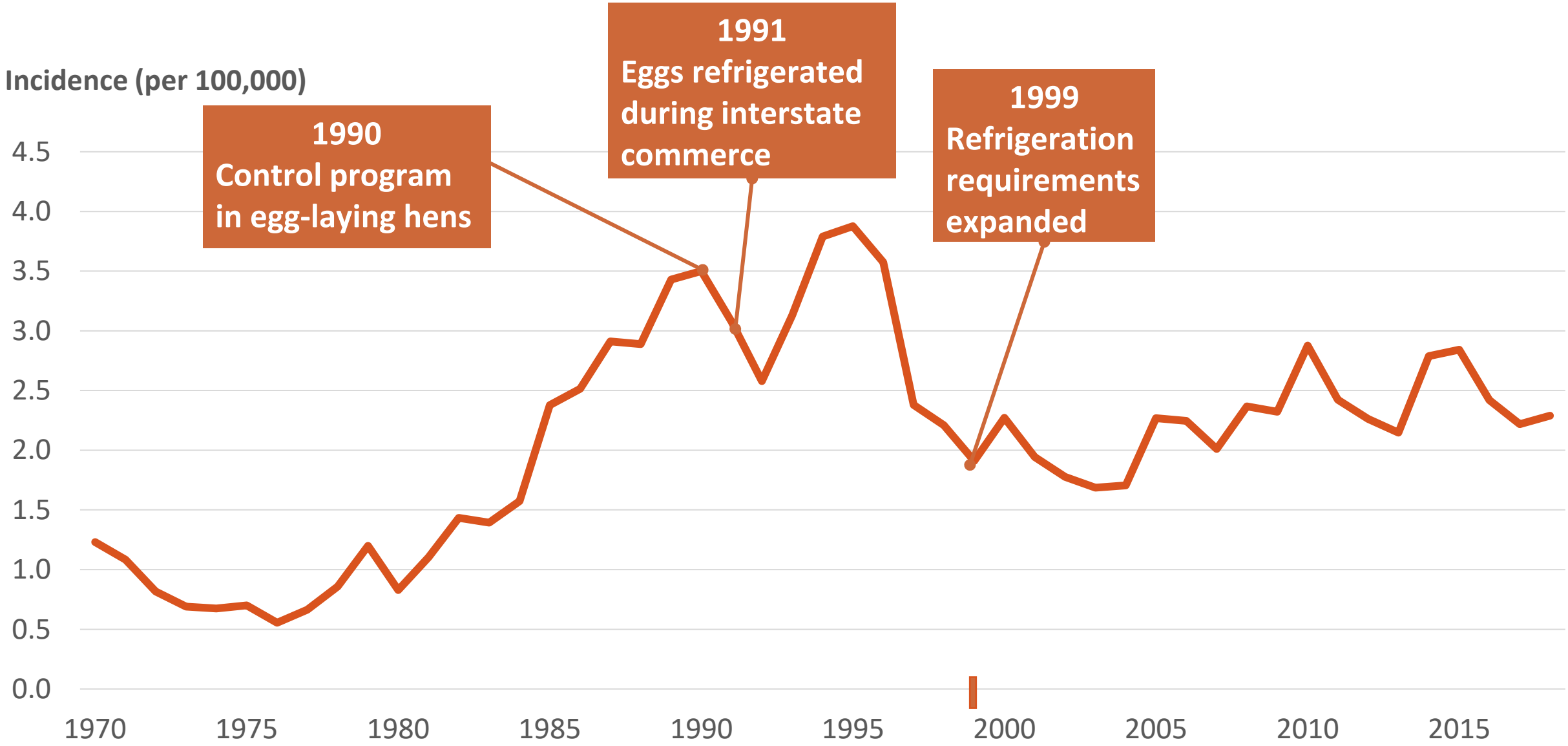

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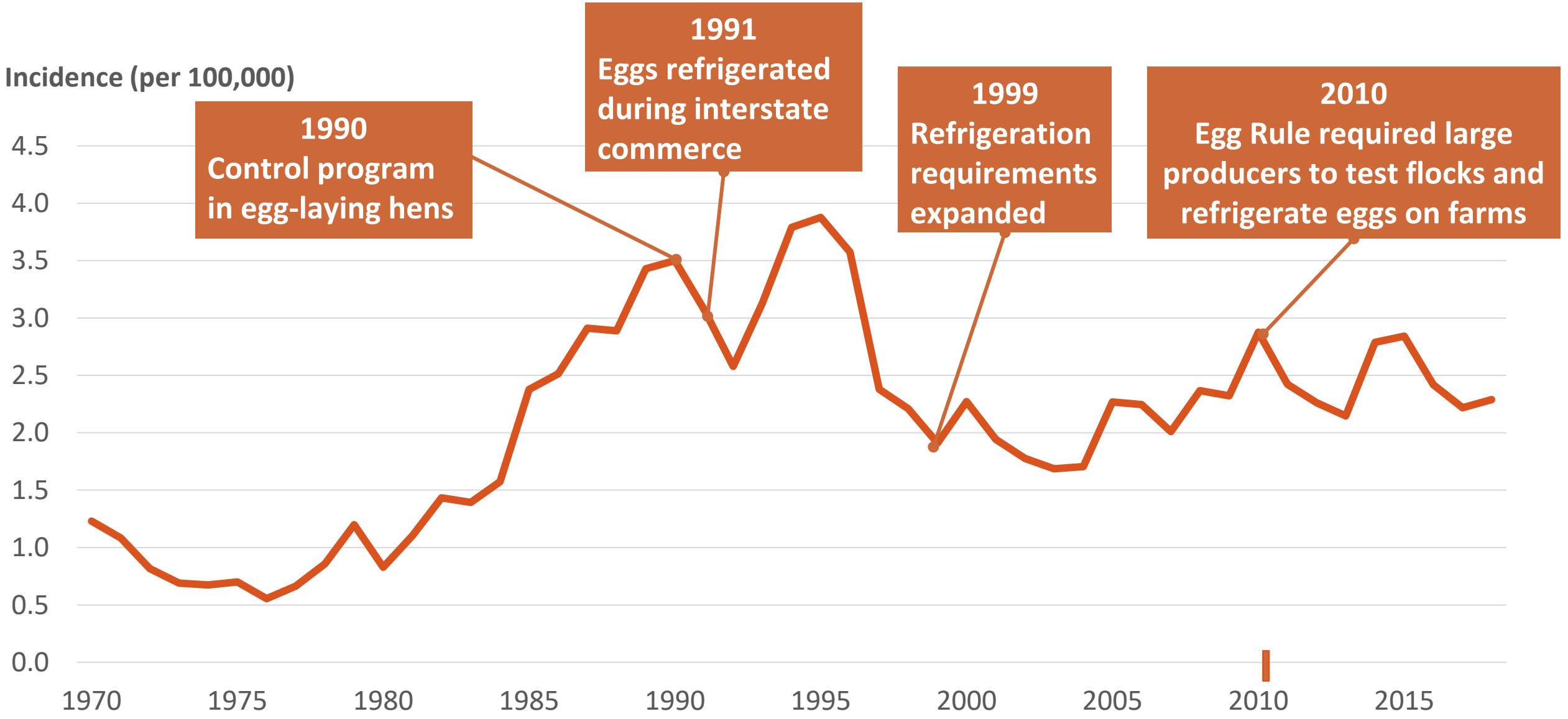
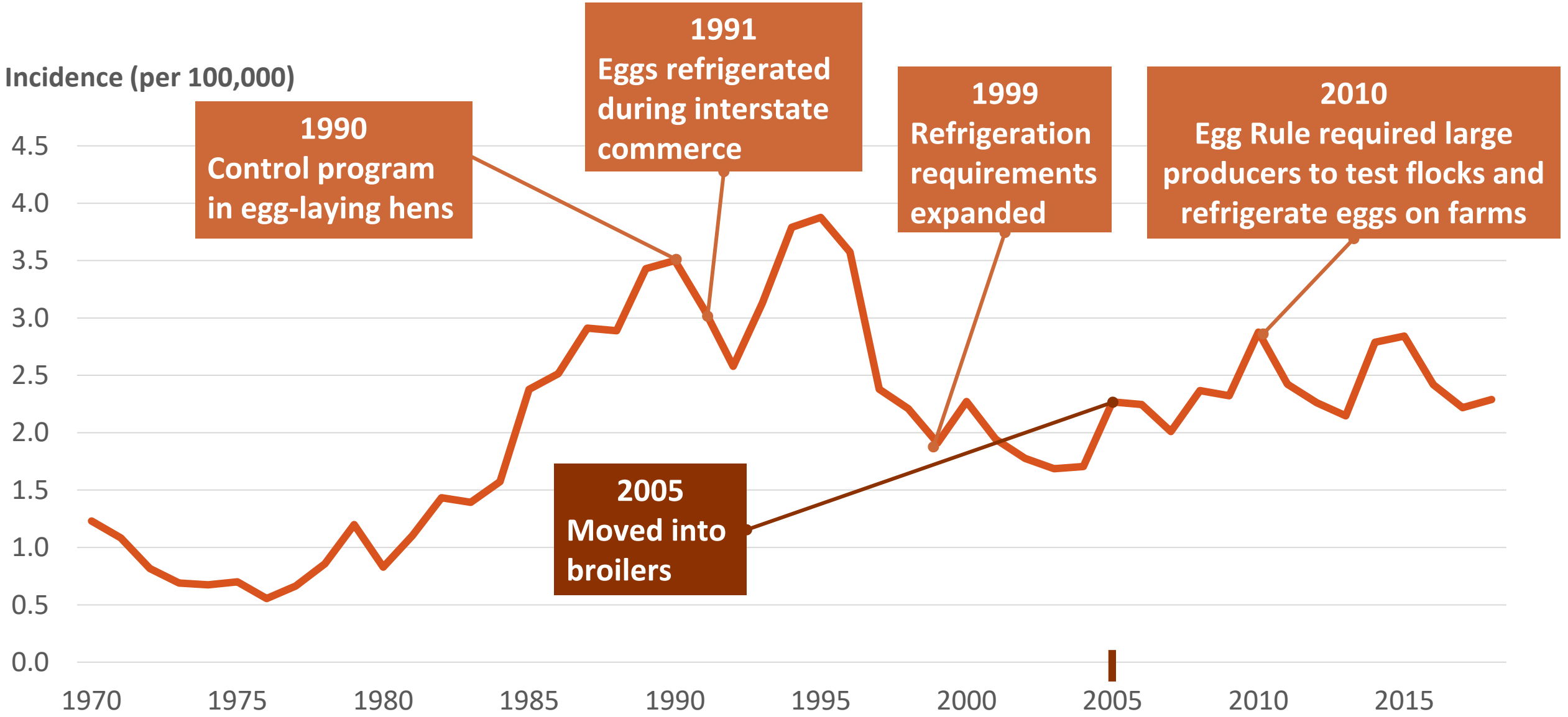


2005 began the chicken years



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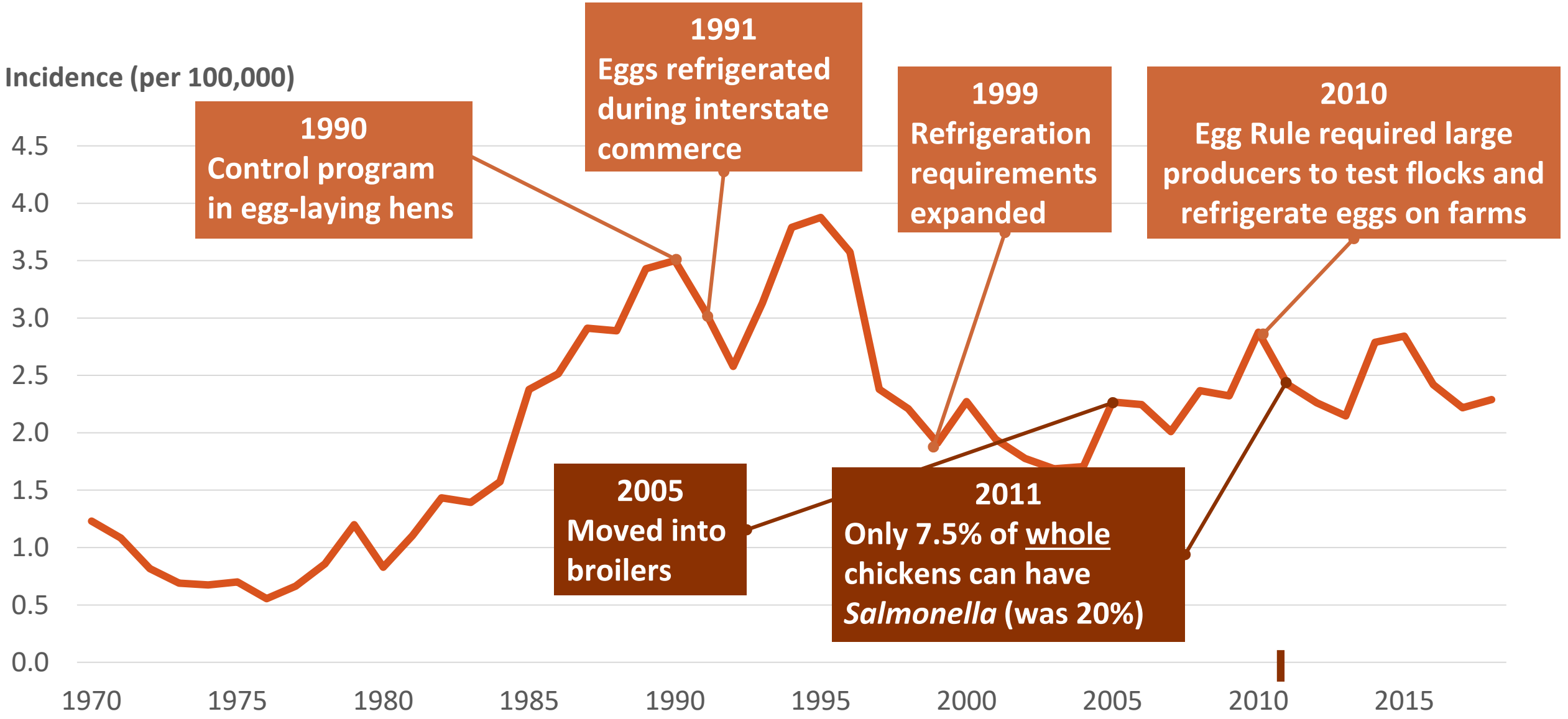

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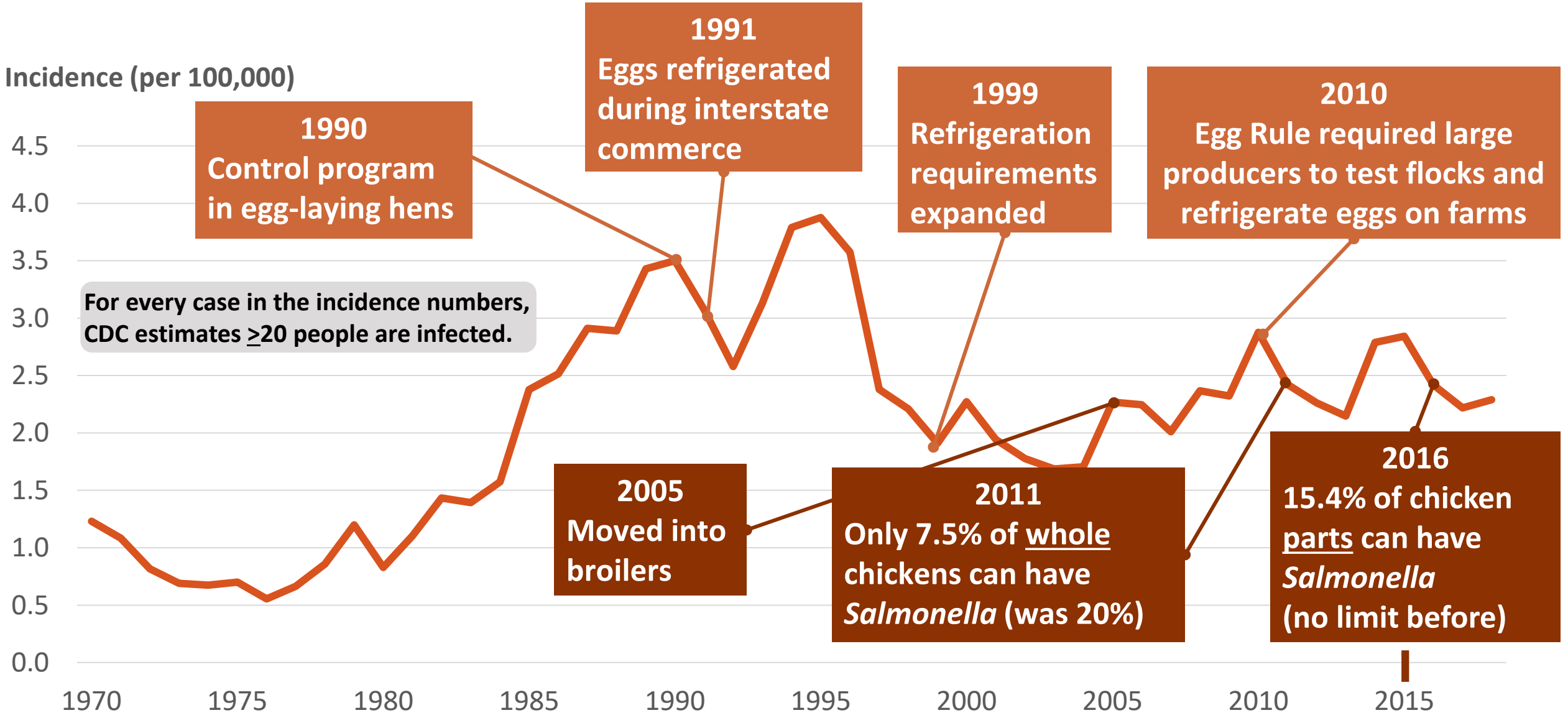
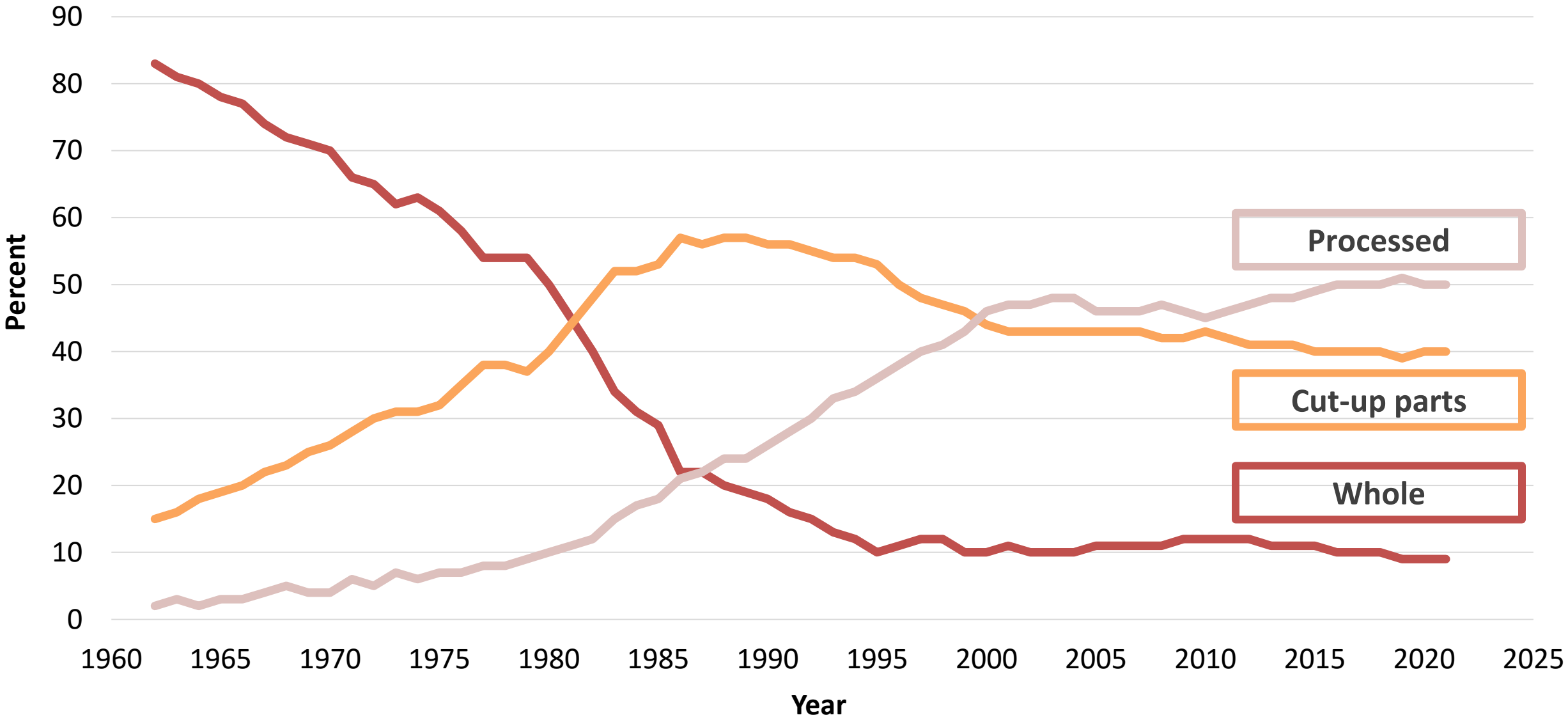
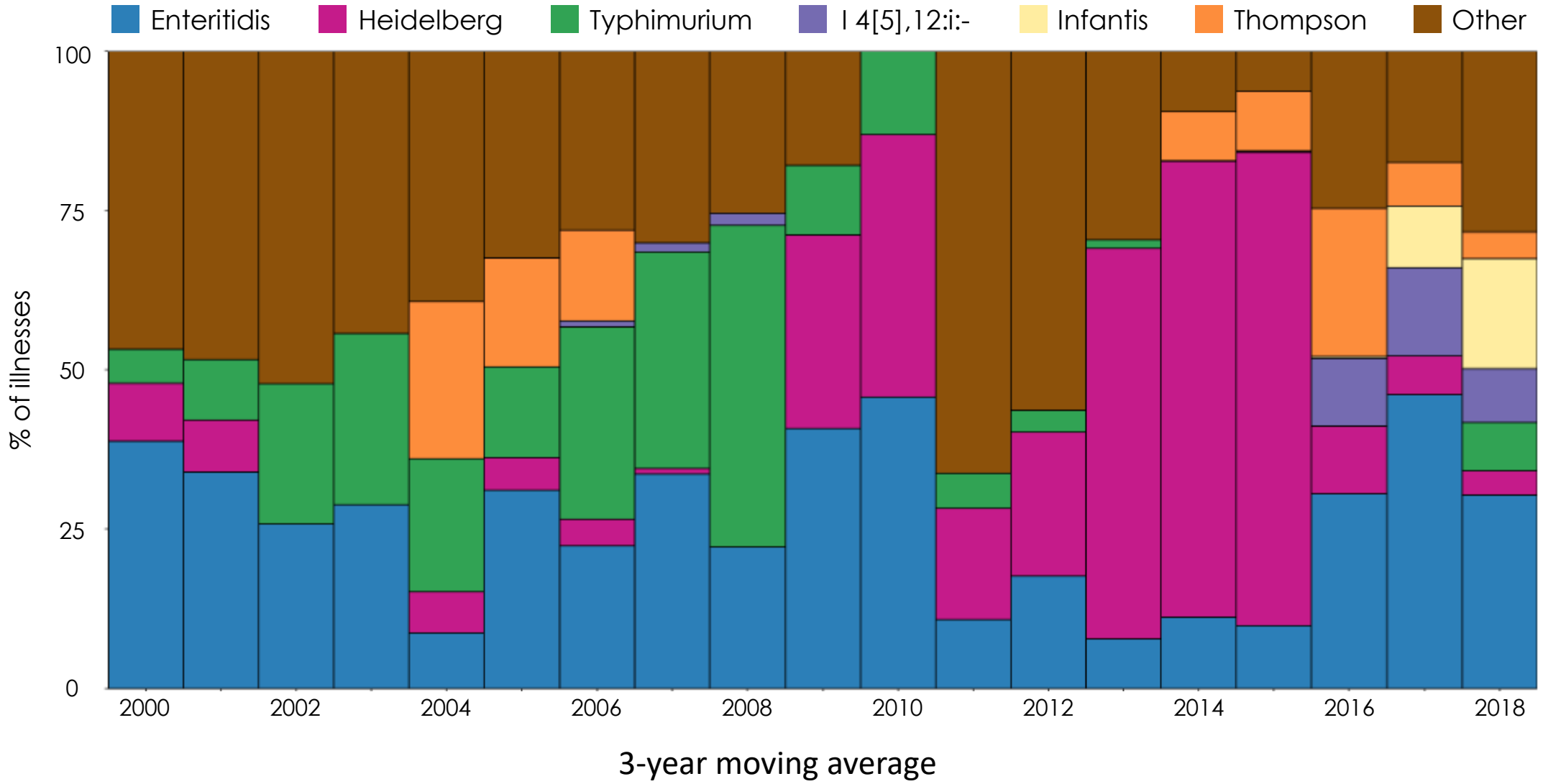


We used to buy mostly whole chickens, now buy most as cut-up parts or processed



Source: National Chicken Council, 1962–2015

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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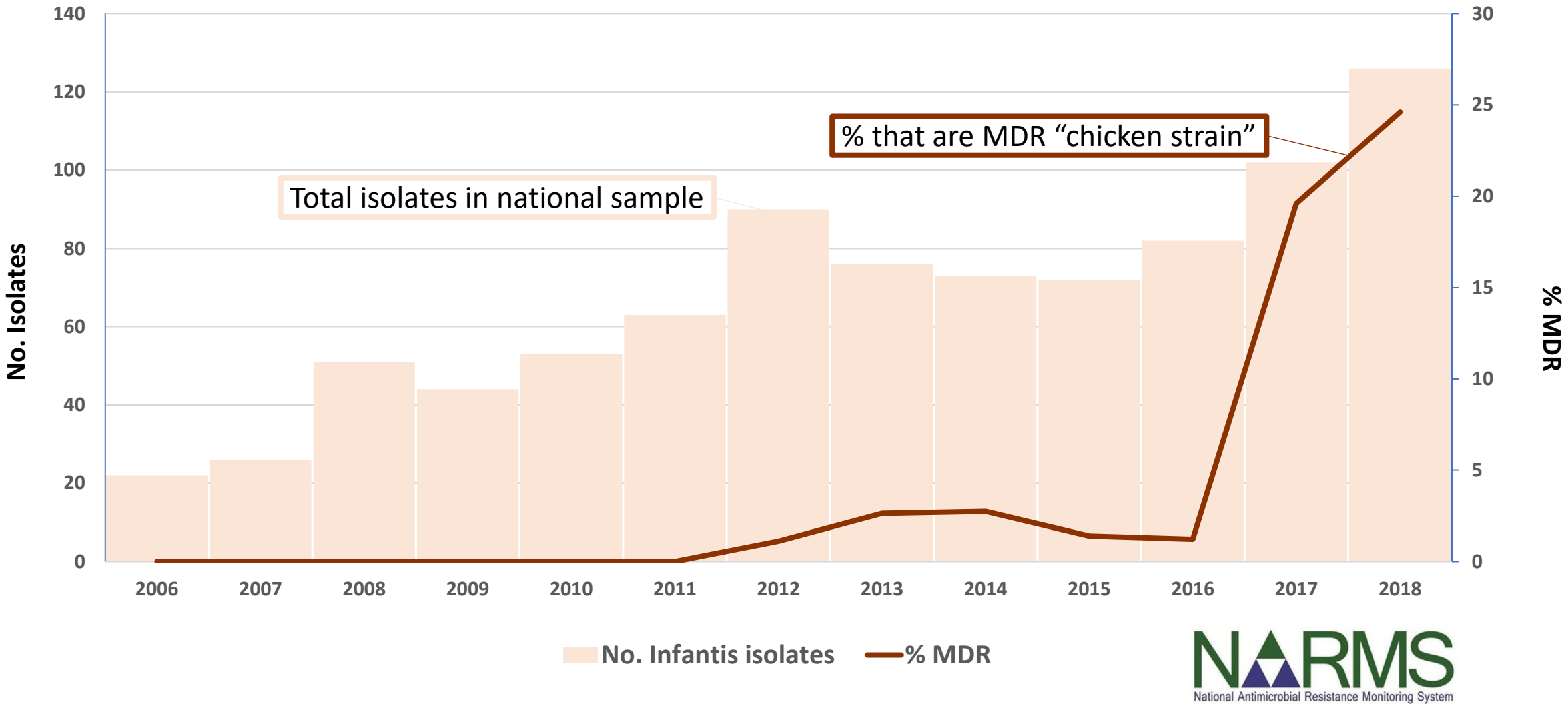
6	Infantis	0.5	3	10
	Top 6	–	**59**	–
	All	16.9	100	11

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

Multidrug resistant (MDR) *Salmonella* Infantis infections have spiked since 2016



NARMS
National Antimicrobial Resistance Monitoring System

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

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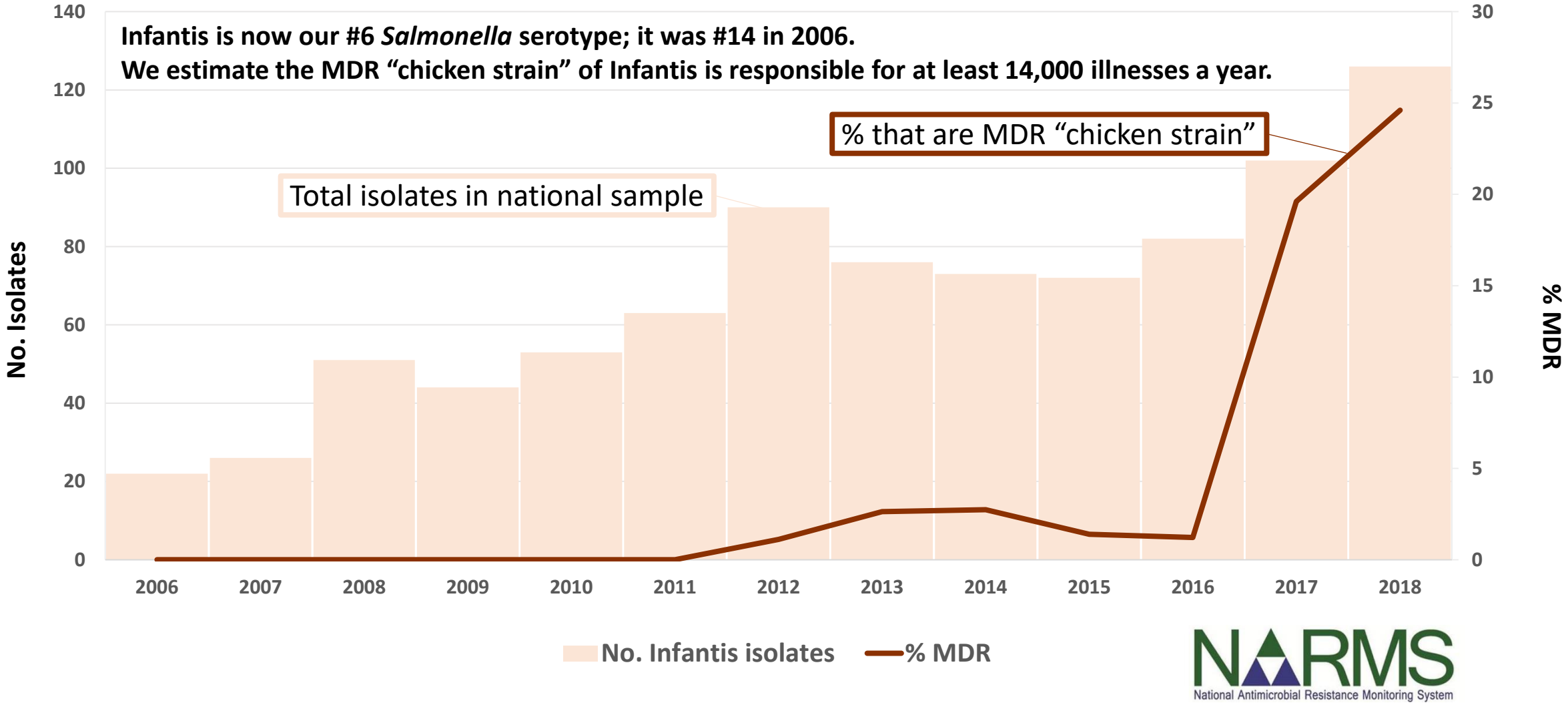

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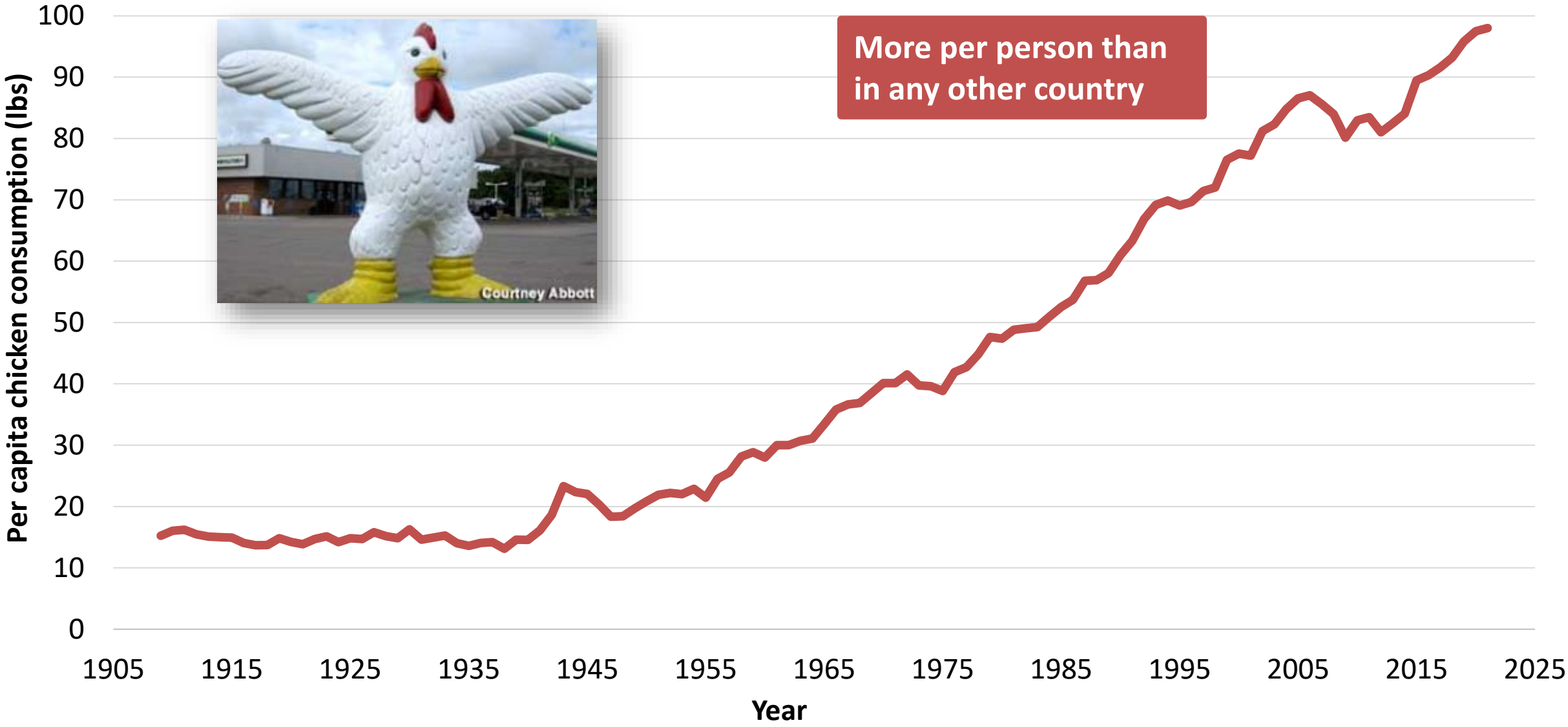
Chicken consumption has increased markedly since 1909

Now the #1 protein eaten in USA

More per person than in any other country



Source: USDA Economic Research Service + National Chicken Council

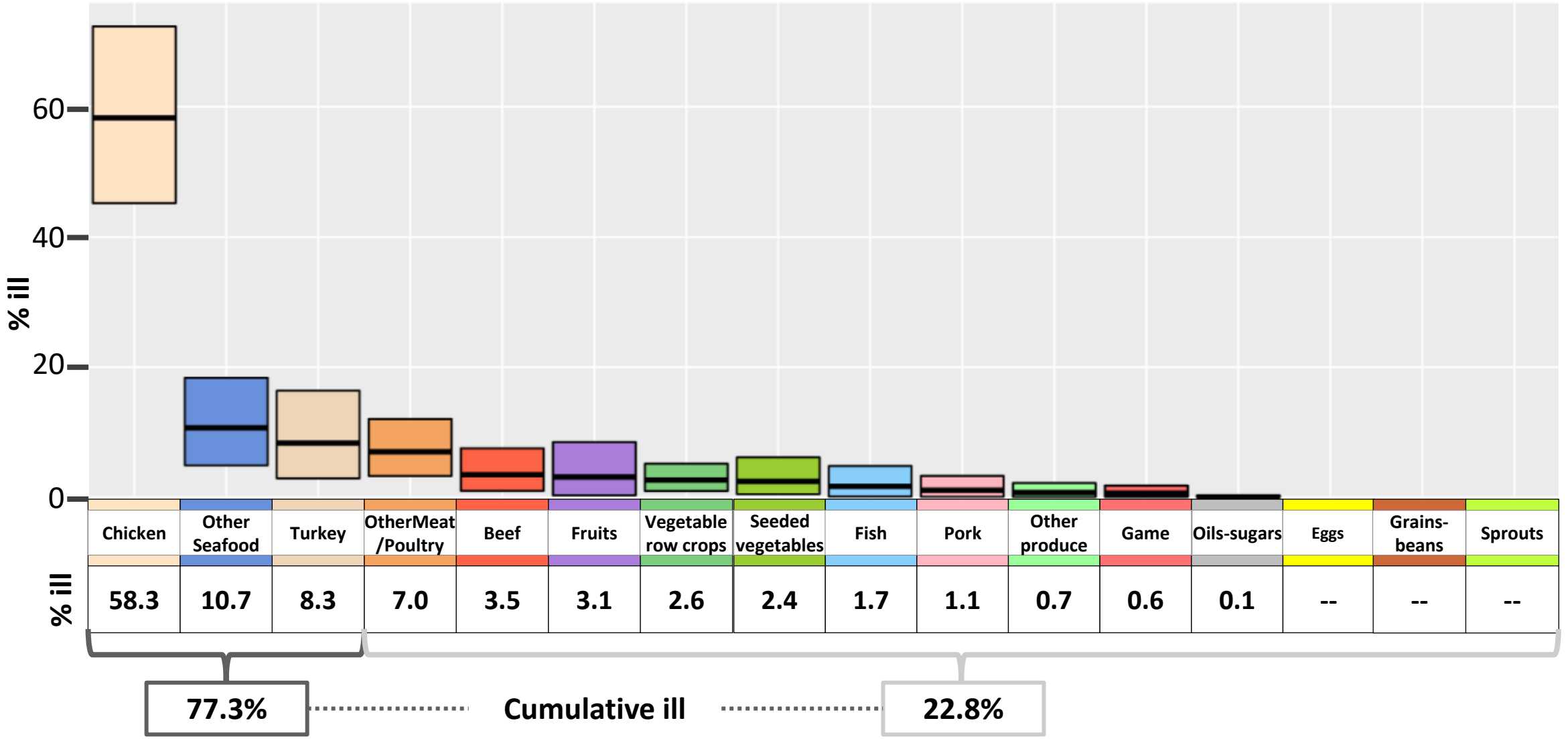
IFSAC estimates that **chicken is one of the top 2 sources of all *Salmonella* illnesses**

Campylobacter is the #2 cause of bacterial foodborne illnesses in the United States

	CDC annual estimates		
Pathogen	**Foodborne illnesses**	**Foodborne hospitalizations**	**Foodborne deaths**
Salmonella	1,000,000	19,000	380
Campylobacter	**845,000**	**8,500**	**80**
***E. coli* O157**	63,000	2,100	20
Listeria	1,600	1,500	260

Scallan, Emerg Infect Dis, Jan 2011

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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Scallan, Emerg Infect Dis, Jan 2011; IFSAC estimates https://www.cdc.gov/foodsafety/ifsac/pdf/P19-2018-report-TriAgency-508.pdf

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

THE NEW YORKER

Annals of Food | FEBRUARY 2, 2015 ISSUE

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**

Enteric Diseases Epidemiology Branch

For more information, contact CDC
1-800-CDC-INFO (232-4636)
TTY: 1-888-232-6348 www.cdc.gov