MEDDOCS Open Access Publisher

ISSN: 2639-4391

Annals of Epidemiology & Public Health

Open Access | Research Article

The Rise of an Invisible Enemy (*Salmonella*) in the United States

Christian Small; Satesh Bidaisee*

St. George's University, Grenada, West Indies.

***Corresponding Author(s):** Satesh Bidaisee
St. George's University, Grenada, West Indies.
Email: SBidaisee@sgu.edu

Received: Jul 12, 2021

Accepted: Aug 12, 2021

Published Online: Aug 15, 2021

Journal: Annals of Epidemiology and Public health

Publisher: MedDocs Publishers LLC

Online edition: http://meddocsonline.org/

Abbreviations: CAFO: Concentrated or Confined Animal Feeding Operations; CDC: Center for Disease Control and Prevention; FDA: Food and Drug Administration; USDA: United States Department of Agriculture.

Abstract

Background: 1945 marked the end of World War II; however, the United States was unaware of an upcoming battle with an invisible pathogen which would linger for decades to come. The war's conclusion meant thousands of troops returning to the United States. It was quickly realized the need for urgency in shoring up food production. To keep pace with the increasing population, farms and slaughterhouses took sanitary shortcuts. This led to an increasing food contamination which resulted in the emergence of zoonotic diseases across the country. One of those pathogens realized, from the transference between domesticated animals and humans, was *Salmonella*. Due to the widespread spikes in illness, in 1962, the government created the National Salmonella Surveillance System to monitor laboratory confirmed illnesses via the information provided by states and county cases. This intra-country tracking system which is still in existence feeds data to the Center of Disease Control and Prevention has played a major role with compiling and publishing information which assists in minimizing future *Salmonella* outbreaks.

Purpose: The paper will provide insight to the rise of the zoonotic *Salmonella* trend realized after World War II and continues, albeit on the decline, today.

Method: Data by decade was collected from literature and reviewed to provide a comparison to the emergence of *Salmonella* after World War II to its stabilization in the 21st century.

Conclusion: *Salmonella* continues to be a zoonotic pathogen, with deadly consequences for humans, when not carefully controlled at the host level one of those being domesticated animals.

Cite this article: Small C, Bidaisee S. The Rise of an Invisible Enemy (*Salmonella*) in the United States. A Epidemiol Public Health. 2021; 4(1): 1061.

Introduction

World War II troops returning home to the United States ushered in a set of events, which accelerated the onslaught of salmonella, a foodborne zoonotic pathogen, which a half century later still wreaks havoc.

Prior to World War II, poultry was provided by local farms. As people did not return to farm living after the war, family farms were sold and consolidated into conglomerates known as CAFOs (Concentrated Animal Feeding Operations) [1]. CAFOs much preferred for the common person to think of them as small farms rather than "factory farming, or confinement based industrialized agriculture" [1]. It is not uncommon, to find in a CAFO, 10,000–20,000 chickens corralled in a pen [2].

As CAFOs became prevalent, sets of regulations regarding inspection of chicken and turkey for public consumption were implemented, in 1957 and 1968, by the United States Department of Agriculture [3]. People felt government oversight meant reliable inspections were taking place to mitigate contamination; therefore, by having poultry "Stamped inspected for wholesomeness by U.S. Department of Agriculture" meant food would be safer to consume [3].

Research spearheaded by Xiangyu Deng suggested a strain of salmonella became widely prevalent once the CAFOs were firmly established as the food production norm in the United States [4]. For CAFOs to sustain high production output of poultry, they realized early in the beginning of their formation in the 1940's, the need for growing chickens faster and healthier. Their solution was to turn to Growth Promoting Antibiotics (GPAs), antimicrobials and sub-therapeutics [5].

There are 2,500 known types of Salmonella of which 100 could materialize into illness. ***Salmonella* serotype Enteritidis is "**The most common non-typhoidal *Salmonella* serotype strain in the U.S. food supply" and **is the catalyst realized by the consumption of eggs and poultry** [6]**.**

This high demand for poultry production, "Intensive animal farming", resulted in a rise of zoonotic organisms such as salmonella [7]. As a result of CAFOs' use of GPAs and antimicrobials, salmonella no longer has the volatile outbreaks realized before the twenty-first century; however, the measures taken to combat salmonella in poultry has resulted in a greater risk to people's ability to fight illnesses.

Materials and methods

A case study design was employed because it best represented the method by which to showcase the validity of the impact that the ending of World War II had on the emergence of *Salmonella* in the United States. The design lent the best method by which to demonstrate how an event can be the change agent as a catalyst to spawn a zoonotic pathogen which continues to exist 60+ years later. A comprehensive literature research review was utilized across varied subjects such as history and veterinary as well as human medicine, to highlight the understated health connection, which exists between humans and domesticated animals. Year-over-year data, from 1968-2011, was sourced from the Center of Disease Control (CDC) to obtain statistical information on *Salmonella* trends and outbreaks.

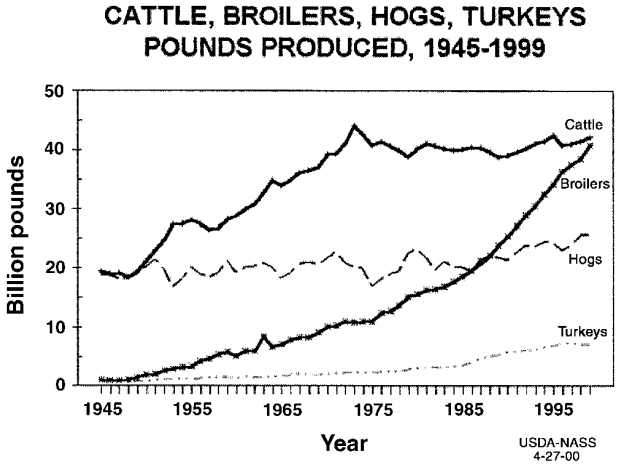
Trends were analyzed to seek a correlation between the year and the outbreak occurrences. Additional numerical data from journal articles were used to compare as well as validate the data documented in the Center of Disease Control's reports. Articles were sourced as it relates to the working conditions of the farms and meatpacking business during the time of the reestablishment of the troops returning and the impact on overall population. Additionally, *Salmonella* case data numbers were investigated on the post-world war population's downstream affects throughout the baby boom era (1946-1964) into the 2000's. Minor interest was shown to an article's relevance on the role of farm convergence played at the end of the World War II. Information prior to 1955 was excluded as old and possibly no longer relevant. Material between 1956 and 2015 was purposely reviewed to obtain a holistic understanding of how *Salmonella* affected the United States generationally and the role of U.S. government regulations. Countries outside of the United States were determined as not applicable. Other zoonotic pathogens were considered out of scope to allow for focus on one specific pathogen type. Data which was commissioned by companies with a financial interest in the report's outcome were considered as not credible sources.

Analysis

By the numbers

To be considered an outbreak, at least two people must be stricken with an illness by a general sourced food [8]. The 1994 CDC Summary of Notifiable Diseases Morbidity and Mortality Weekly Report, United States, depicts salmonella outbreaks trending upward from the onset of the initial 1955 publication. As family farms gradually phased out (around 1955) and CAFOs became the dominate producers of sourced meat, to keep pace with consumers' demand for poultry (Table 1), salmonella outbreaks began to occur [2,9]. There is evidence, which suggests as the production processing lines increased in speed so did the number of humans becoming ill [10].

Table 1



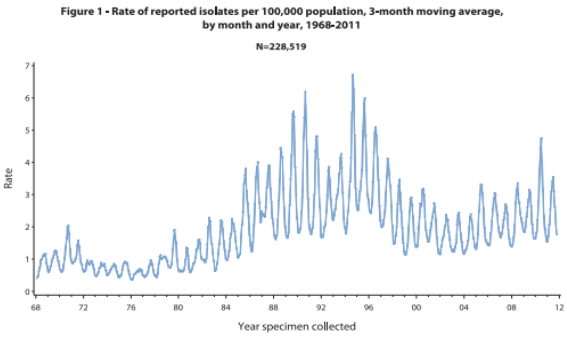
Illness outbreaks upward trajectory remained for forty years, until 1995, before a consistent plateauing started to occur (Table 2). The rise realized in the 1980's is corroborated in that "health officials found salmonella in 1/3 all poultry and estimated that 33,000,000 Americans experienced at least one episode of foodborne microbial illness each year" [3]. However, in comparison, another study calculated every year approximately **1 million people have a n**on-typhoidal **Salmonella episode [11].** The contradiction in studies may be a result of the former includes all pathogen related illnesses.

Tables 1 and 2 align in depicting the relationship between poultry processing and outbreak frequency. As food production increased the number of outbreaks followed. Moving into the 1990's, as shown in Table 2, the CDC identified outbreaks on the

rise between 1986 and 1995 with a significant spike in 1994 attributed to ice cream which coincides with the fact that "illnesses from contaminated eggs rose five-fold through 1995" [9,12].

Table 2

***Salmonella* serotype Enteritidis**



As outbreaks became frequent after 1975, the geographical location of the outbreaks began to migrate from the Northeast coast of the United States. By 1995, the rise as well as the number of outbreaks had reached the West coast of the United States [13].

After 1995, intermittent outbreaks occurred yet rebounded to a consistent normalcy from 1999 through 2012 [14]. Between 1998 and 2008, eggs and poultry comprised 78% of the outbreaks compared to 23% for the other 14 food products combined [15]. In that timeframe, a noticeable outbreak occurred in 2010, when people became ill and 550 million eggs were identified requiring recollection [12]. Nestle, noted in Safe Food "in the U.S., 45% of all egg laying flocks are now infected with this pathogen, which largely replaced less virulent forms of the bacteria in chicken flocks during the 1960's" [3].

Use of antimicrobials and growth promoting antibiotics

In 1951, poultry producers are permitted, by the FDA, to use certain antimicrobials, from the birth through processing cycle, Table 3 [16,2]. CAFOs have become dependent upon using antimicrobials to enhance growth and deter disease within their poultry production process.

Table 3

Purpose	Approved Antimicrobial
Treatment of various infections	Erythromycin
Treatment of various infections	Fluoroquinolone
Treatment of various infections	Gentamicin
Treatment of various infections	Neomycin
Treatment of various infections	Penicillin
Treatment of various infections	Spectinomycin
Treatment of various infections	Tetracyclines
Treatment of various infections	Tylosin
Treatment of various infections	Virginiamycin
Growth and feed efficiency	Bambermycin
Growth and feed efficiency	Bacitracin
Growth and feed efficiency	Chlortetracycline
Growth and feed efficiency	Penicillin
Growth and feed efficiency	Tylosin
Growth and feed efficiency	Virginiamycin

Entering the 1990's, the outbreak stabilization trend aligned with the argument that ***Salmonella* serotype Enteritidis** could be considered under control.

One watch dog group believes more antimicrobials are used for non-therapeutic purposes on food animals than for humans: 24.6 million pounds vs. 3.0 million pounds respectively [17]. There is commonality with the use of tetracycline and penicillin as a wellness treatment plan for animals used as a food source as well as humans [17].

The multitude of antimicrobials used in the life span of chickens provides insight as to how salmonella has been kept under control with minimal spikes after 2000. There could be a notable relationship between the reduction in reported sickness and use of antimicrobials by CAFOs. One of the driving forces behind the lower level consistency of outbreaks is due to the use of therapeutics such as fluoroquinolones which began in 1995. Fluoroquinolone is considered effective with aiding in the health of chickens as a sub-therapeutic. However, it is also recognized as causing antibiotic resistance in humans [18]. In one study, it was concluded that humans, who consume poultry as part of their dietary intake, and then administered fluoroquinolone to aid in an illness recovery, had built a resistance to the antibiotic [19]. Hence, for some that would, in turn, lead to hospitalization or death. It is worth noting that since 2000, the FDA has banned fluoroquinolone in the use of chicken farming [20]. Similarly, the World Health Organization (WHO) advised fluoroquinolone derivatives are considered necessary in the cure of critical human illnesses and should not be exploited in casual use with chickens [21].

Conclusion

The numerous outbreaks as well as the geographical spread across the country corroborates the hypothesis that Salmonella became prevalent after World War II and although the United States is more technologically and medically advance since the 1950's, the pathogen still remains a public health concern.

The eradication of salmonella is riddled with uncertainty due to competing issues: (1) people's appetite for poultry is greater than any other food animal product, (2) CAFOs meeting consumer demand by using therapeutics and (3) food animal groups and humans becoming resistant to antibiotics.

For the WHO to publish guidance and the FDA to enact regulations on the use of antimicrobials in the agricultural industry is a barometer on the level of concern. The awareness that 70% of manufactured antibiotics are fed to farm controlled animals is an alarming finding [6]. This indicator added to the explanation as to how people were becoming resistant to antibiotics used as common remedies for illnesses. Armed with this type of data, institutions employed enforceable measures on the food processing industries.

There are studies which suggest alternatives to using antimicrobials for the care of chickens used as a food source. In one such research performed by a Perdue Farms scientist, which was not introduced for this paper but can be introduced now as plausible remedy, concluded that reduction of deaths and improved food digestion was realized simply by sanitizing the flooring during flock rotations. [16].

Researchers are analyzing the feasibility of creating a Salmonella vaccine; yet, must first determine the correct antigen which can provide benefit across multiple Salmonella vectors

[22]. Conversely, another train of thought which is getting consideration is to create a vaccine which enables day old baby chicks to sustain immunity, with levels bottoming to zero, at time of processing [22].

The current solutions in place to minimize the outbreaks and illnesses may not suffice much longer. There is a lesser known hobby called backyard poultry which, if not dealt with sooner than later, may hinder the progress made by the WHO and the FDA to curtail salmonella from spreading. In March 2020, the CDC reported several multi-state outbreaks due to owners having chickens and fowl as well as consuming the chicken eggs [23]. This new trend is counterproductive to the US Department of Health and Human Services 2020 objective of reducing Salmonella illnesses by 25% [15].

By knowing when one of the most famous wars in modern history ended will forever time stamp when salmonella quietly crept into existence in the United Sates. For the past 70 years, the pathogen has spread across the United States and caused illness as well as death. Numerous strategies have been implemented and are underway to combat the bacteria. However, as of now, we are still only able to hinder its impact.

References

1. Imhoff D. The CAFO Reader. New York: Watershed Media. 2012.
2. McEwen SA, Fedorka-Cray PJ. Antimicrobial use and resistance in animals. Clin Infect Dis. 2002; 34: 93–106.
3. Nestle M. Safe food. Berkeley, Calif.: University of California Press. 2010.
4. Deng X, Desai PT, den Bakker HC, Mikoleit M, Tolar B, et al. Genomic Epidemiology of Salmonella enterica Serotype Enteritidis based on Population Structure of Prevalent Lineages. Emerging Infectious Diseases. 2014; 20: 1481-1489.
5. Hao H, Cheng G, Iqbal Z, Ai X, Hussain HI, et al. Benefits and risks of antimicrobial use in food-producing animals. Frontiers in microbiology. 2015; 5: 288.
6. Forkus B, Ritter S, Vlysidis M, Geldart K, Kaznessis Y. Antimicrobial Probiotics Reduce Salmonella enterica in Turkey Gastrointestinal Tracts. Scientific Reports. 2017; 7.
7. Nyachuba DG. Foodborne illness: is it on the rise? Nutrition reviews. 2010; 68: 257–269.
8. Brown AC, Grass JE, Richardson LC, Nisler AL, Bicknese AS, et al. Antimicrobial resistance in Salmonella that caused foodborne disease outbreaks: United States, 2003-2012. Epidemiology and infection. 2017; 145: 766–774.
9. Center for Disease Control and Prevention (CDC). 1995.
10. Fitzgerald A. A Social History of the Slaughterhouse: From Inception to Contemporary Implications. 2010.
11. Scallan E, Hoekstra RM, Angulo FJ, Tauxe RV, Widdowson MA, et al. Foodborne illness acquired in the United States--major pathogens. Emerging infectious diseases. 2011; 17: 7–15.
12. Duncan C. Eat, Drink, And Be Wary. Lanham: Rowman and Littlefield. 2015.
13. Cdc.gov. 2013. Available at: <https://www.cdc.gov/salmonella/pdf/enteritidis-508c.pdf>.
14. Adams DA, Thomas KR, Jajosky RA, Foster L, Baroi G, et al. Summary of Notifiable Infectious Diseases and Conditions — United States, (2015). MMWR Morb Mortal Wkly Rep. 2017; 64: 1–143.
15. Jackson BR, Griffin PM, Cole D, Walsh KA, Chai, SJ. Outbreak-associated Salmonella enterica serotypes and food Commodities, United States, 1998-2008. Emerging infectious diseases. 2013; 19: 1239–1244.
16. Silbergeld E. Chickenizing farms & food. Baltimore: John Hopkins University Press. 2016.
17. Landers T, Cohen B, Wittum T, Larson E. A Review of Antibiotic Use in Food Animals: Perspective, Policy, and Potential. Public Health Reports. 2012; 127: 4-22.
18. Iovine NM, Blaser MJ. Antibiotics in animal feed and spread of resistant Campylobacter from poultry to humans. Emerging infectious diseases. 2004; 10: 1158–1159.
19. Smith KE, Besser JM, Hedberg CW, Leano FT, Bender JB, et al. Quinolone-resistant Campylobacter jejuni infections in Minnesota, 1992-1998. Investigation Team. The New England journal of medicine. 1999; 340: 1525–1532.
20. Collignon P. Fluoroquinolone use in food animals. Emerging infectious diseases. 2005; 11: 1789–1792.
21. World Health Organization. Critically important antimicrobials for human medicine. 2011.
22. Boyle EC, Bishop JL, Grassl GA, Finlay BB. Salmonella: From pathogenesis to therapeutics. Journal of bacteriology. 2007; 189: 1489–1495.
23. Outbreak of Salmonella Infections Linked to Backyard Poultry | CDC. 2020.