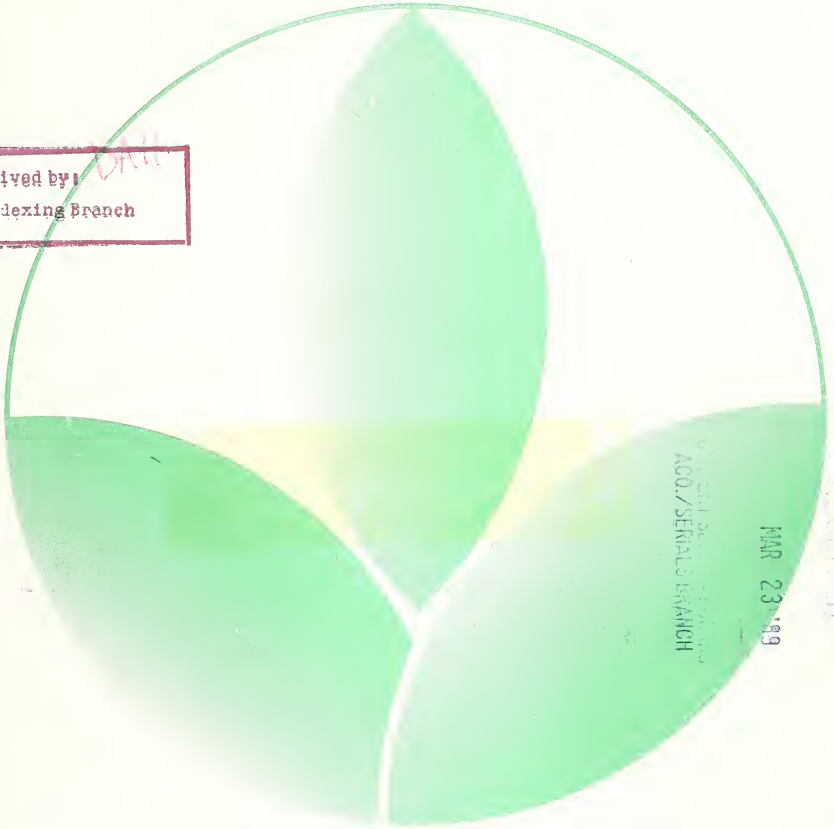
Proceedings



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FOODBORNE DISEASE: A LOOK AT A CONTINUING PROBLEM

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Introduction

Foodborne disease (i.e., disease caused by infectious agents or toxins in or on foods) is a topic of continuing concern to both producers and consumers. Given the number of different pathogens that can be associated with food, it is difficult to accurately assess the extent of the foodborne disease problem in this country. In a recent review, Archer and Kvenberg (1) estimated that there were between 24 and 81 million cases of foodborne disease per year in the United States. A somewhat more conservative estimate of 6,496,000 cases/year has been proposed by Bennett et al (2). Bennett's estimate is based primarily on data available for known foodborne pathogens such as Salmonella, Campylobacter, and Staphylococcus aureus (Table 1), and makes use of fairly well established multiplication factors for calculating incidence based on reported numbers of cases. The estimate of Archer and Kvenberg includes a broader range of potential pathogens, and uses somewhat more speculative factors in calculating incidence; the actual incidence of foodborne disease probably lies somewhere between these estimates.

Clinically, most of the major foodborne pathogens cause gastroenteritis (diarrhea, vomiting, abdominal pain). It should be emphasized, however, that symptoms of foodborne illness are not necessarily confined to the gastrointestinal tract. Pathogens such as Salmonella may get into the bloodstream (septicemia), particularly in older or debilitated patients or infants. Yersinia enterocolitica can cause mesenteric adenitis, producing abdominal pain that mimics appenditicitis; Streptococci carried by food can cause pharyngitis. Botulism can result in neuromuscular paralysis, as can Paralytic Shellfish Poisoning. Enterohemorrhagic E. coli produce a toxin that can cause intravascular hemolysis and renal failure (the hemolytic-uremic syndrome). A patient's immune response to certain pathogens can also cause illness: some persons are predisposed to development of a reactive arthritis (Reiter's Syndrome) after infection with pathogens such as Salmonella or Shigella, while Y. enterocolitica has been implicated as a cause of erythema nodosum, polyarteritis, and a variety of other autoimmune conditions.

A. Major Foodborne Pathogens

While we are still trying to define the role of some microorganisms in foodborne disease, several bactrerial species have come to be well recognized as major causes of foodborne illness. As shown in Table 1, Campylobacter and Salmonella are probably the two most important of these.

TABLE 1: MAJOR FOODBORNE PATHOGENS AND THEIR ESTIMATED ANNUAL INCIDENCE

ETIOLOGIC AGENT	estimated cases/year
Campylobacter	2,100,000
Salmonella	1,920,000
Staphylococcus	1,513,000
Streptococcus Group A	500,000
Trichinosis	100,000
Shigella	90,000
E. coli - pathogenic	50,000
Clostridium perfringens	10,000

(Data from Bennett et al [2])

1) Campylobacter

Campylobacter jejuni is a recently recognized bacterial species that can cause diarrhea, abdominal pain, fever, nausea, and vomiting (3). Up to 50% of patients with Campylobacter infections report having bloody diarrhea. Illness can range from mild diarrhea lasting less than 24 hours to severe, bloody diarrhea with abdominal pain and fever lasting several weeks; in one study the average duration of illness was 13.5 days (4).

C. jejuni appears to be present in the intestinal tract of most mammalian and avian species. A number of early C. jejuni outbreaks were associated with consumption of raw milk or untreated water (5). More recent epidemiologic data suggest that up to 48% of C. jejuni cases are attributable to consumption of chicken (4). The organism has been isolated at many points during the slaughter and processing of broiler chickens, and a significant proportion of broiler chicken carcasses available for retail sale carry C. jejuni (Table 2).

Because of the lack of a good national reporting system, it is difficult to determine whether the overall incidence of Campylobacter infections is increasing or decreasing. However, it is clear that C. jejuni constitutes a significant foodborne problem: there is a definite need for further epidemiologic data (including incidence data) on this organism.

2) Salmonella

Salmonella are bacteria that cause diarrhea, abdominal pain, fever, nausea, and vomiting (6). Diarrhea usually lasts less than 7 days, but occasionally persists for as long as several weeks; in one recent study the average duration of illness was 10.25 days (4). Bacteremia (presence of bacteria in the blood) occurs in less than 5% of adults with gastroenteritis. This rate may be higher in children and persons with major underlying diseases (including AIDS). The case fatality ratio for Salmonella has been estimated to be approximately 0.1% (2).

Salmonella is present in the gastrointestinal tract of mammalian and avain species, and is often transferred to the surface of animal carcasses during slaughter and processing. Using broiler chickens as an example, nationwide surveys in conducted in 1967 and 1979 demonstrated extreme variability in the Salmonella contamination rates among various lots of birds, with an incidence range of 7.5% to 73.7% in 1967 and 2.5% to 87.5% in 1979 (7). Data on rates of contamination of chicken carcasses from several published studies are shown in Table 2.

TABLE 2: RATES OF SALMONELLA AND CAMPYLOBACTER CONTAMINATION OF CHICKEN CARCASSES

Microorganism	Part of Chicken Sampled and Stage of Procedure	No. Sampled	Percent Positive	Reference
Campylobacter	chicken livers	40	30%	8
	mechanical deboning of chicken	40	12.5%	8
	chicken livers from giblet chiller	36	69.4%	9
	wings ready for packaging	36	66.7%	9
	wings on arrival at supermarket	94	82.9%	10
	chicken; supermarket shelf	862	23.1%	11
Salmonella	chicken; supermarket shelf	862	4.3%	11
	whole, eviscerated chickens; chill tank exit			
	in 1967	597	28.6%	7
	in 1979	601	36.9%	7
	whole, eviscerated chickens; chill tank exit	215	11.6%	12
	whole, eviscerated chickens; chill tank exit	171	20.5%	13

(From: National Research Council, Poultry Inspection: The Basis for a Risk-Assessment Approach [14])

There has been a slow but steady increase in the overall incidence of Salmonella cases reported to the Centers for Disease Control during the past several decades, from approximately 4/100,000 population in 1955 to 22/100,000 in 1987 (Figure 1)(15). It has been estimated that these reported cases represent 1%-2% of the actual number of cases that occur (accounting for the projected incidence of approximately 2 million cases given in Table

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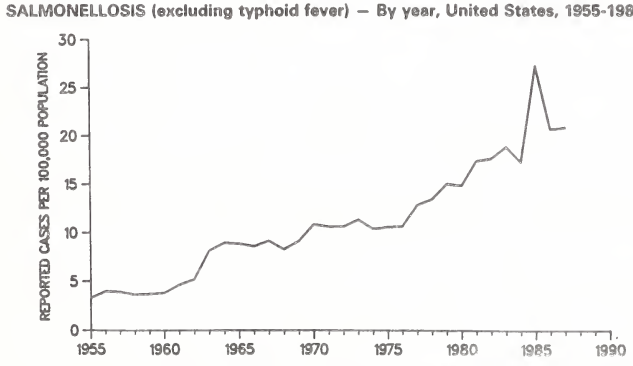

(From: Centers for Disease Control, Summary of Notifiable Diseases, United States, 1987 [15])

1 [2]). While these numbers are clearly subject to a variety of ascertainment and reporting biases, this slow, steady increase (which has not been seen with other enteric pathogens, such as Shigella) is disturbing. These data emphasize the need for continuing research on Salmonella, and the importance of implementing appropriate control programs for this pathogen.

In contrast to the slow increase that has been seen in the overall incidence of Salmonella, the incidence of one particular serotype, Salmonella enteritidis, has shown a striking increase since the early 1980's, particularly in Northeast and Middle Atlantic states: in the Northeast the reported isolation rate for this serotype increased from 1.12/100,000 population in 1976 to 7.16/100,000 population in 1986 (16). Epidemiologic studies have shown a strong link between S. enteritidis infections and consumption of Grade A eggs (16,17). S. enteritidis has been isolated from bulk raw eggs, and from egg contents (primarily yolk) of individual eggs. The organism has also been isolated from ovarian tissue of hens, and there have been experiments suggesting that transovarian transmission of S. enteritidis can occur (personal communication, Paul Blake, Lisa Lee, CDC). These data are quite disturbing, and, if transovarin transmission of S. enteritidis can be conclusively demonstrated, suggest that existing efforts (disinfecting, grading) to control Salmonella contamination of eggs may be inadequate to prevent spread of the infection.

B. Control of Foodborne Diseases

Control of foodborne disease can be accomplished at two levels. At the producer level, efforts can and should be made to minimize contamination of food with potentially pathogenic microorganisms. The National Academy of Sciences/National Research Council has published a series of reports that deal with this problem: "An Evaluation of the Salmonella Problem" (18); "An Evaluation of the Role of Microbiologic Criteria in Foods and Food Ingrediants" (19); "Meat and Poulty Inspection: The Scientific Basis of the Nation's Program" (20); and "Poultry Inspection: The Basis for a Risk-Assessment Approach" (14). Recommendations in these reports should be reviewed and serious consideration given to their implementation. As already pointed out, there is also a need for continuing government and industry sponsored research on the incidence and control of specific microorganisms such as Salmonella and Campylobacter.

Assuming that total elimination of pathogenic organisms from the nation's food supply is not a realistic short-term goal, there is also a need for continuing consumer education on appropriate food preparation practices. Contaminating microorganisms are in most instances destroyed by cooking: the risk of illness is negligible if food is adequately cooked, cross-contamination of foods within the kitchen is avoided, and food is handled properly after cooking (i.e., there is no time-temperature abuse). Again, both government and industry should be active in educating consumers about the risk and means of preventing foodborne disease.

In summary, foodborne illness is a significant and continuing problem in this country. There is no indication that the incidence of foodborne disease is decreasing, and, if anything, there may be a slow increase in the incidence of infection with organisms such as Salmonella. At the producer level, eforts need to be made to minimize carriage and transmission of potentially pathogenic microorganisms; at the same time, consumers should be made aware of the importance of good food preparation practices in minimizing the risk of foodborne illness.

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