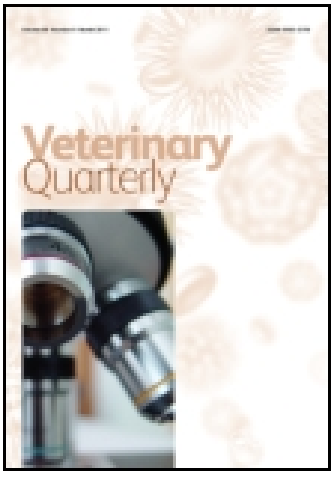

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Public health aspects of microbial contaminants in food

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Public health aspects of microbial contaminants in food

H. J. Beckers[1]

SUMMARY *Food-borne diseases affect the health and welfare of hundred thousands of people and result in considerable economic loss. Salmonella and Campylobacter are by far the most important causes of food-borne illness. Raw foods of animal origin are the major sources of these pathogens. Mishandling of foods in kitchens contributes to food-borne disease outbreaks. More education is necessary. But because of the inevitable risk of recontamination of cooked foods in every kitchen, more emphasis should be placed on pathogen-free raising of food animals and good manufacturing practices during slaughter. This will minimise contamination of raw foods of animal origin, thus reducing the contamination pressure in the kitchen and more effectively controlling food-borne diseases.*

EPIDEMIOLOGY OF FOOD-BORNE DISEASES

Magnitude

In the Netherlands about 8000 cases of food-borne disease are registered each year (Table 1). *Salmonella* spp are responsible for approximately 80% of food-borne illnesses, but the recorded number of *Campylobacter jejuni* has increased since 1979.

Table 1. Numbers of cases of food-borne diseases registered with the chief medical inspectorate.

Aetiology	1979	1980	1981	1982	1983
Salmonella	6174	6348	7496	6795	6083
Campylobacter jejuni	202	531	1496	1728	2406
Yersinia enterocolitjca	116	264	262	274	284
Clostridium perfringens	6	19	13	22	66
Staphylococcus aureus	–	–	28	2	6
Bacillus Cereus	–	7	27	3	–
Total	6498	7169	9322	8824	8845

The reason for this significant increase of Campylobacter is the improved methodology of detection. Since 1977 the method for the isolation of Campylobacter has been simplified and medical microbiologists began to examine faecal samples for Campylobacter, especially when *Salmonella* spp. could not be detected.
Success in one laboratory initiated similar examinations in others, and at this time Campylobacter is isolated from faecal samples of patients with gastro-enteritis as frequently as Salmonella, or even more often. However, in the Netherlands Campylobacter is recorded less frequently, in contrast to Great Britain, where Campylobacter now outnumbers Salmonella (Figure 1).
Patients of food-borne illness can be divided into three groups: one group consults a general practitioner, a second group registers a complaint with a regional Food

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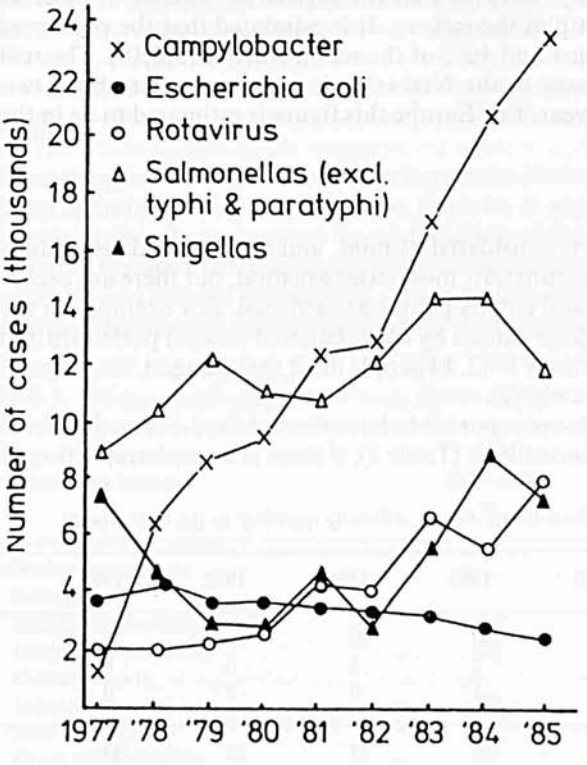

Fig. 1 Surveillance of gastro-intestinal infections: 1977-'85.

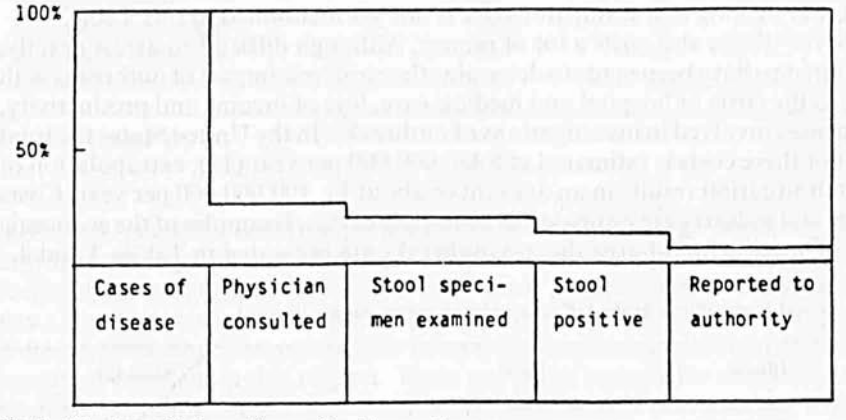

Fig. 2 The loss of information on food-borne diseases.

Inspection Service, and a third group does nothing. This latter group is the largest, meaning that there is a considerable loss of epidemiological information (Figure 2). It appeared from survey into selfmedication (9) that only one quarter of people suffering from diarrhoea for some days attend their physician; those who consult their doctor will not always be examined for pathogenic bacteria. If attempted,

examination will not always result in isolation of a pathogenic bacterium, and successful isolation is not always registered with the public health authorities.
For these reasons it is generally accepted that the registered number of cases of food-borne illness is only the tip of the iceberg. It is estimated that the registered numbers of cases vary between 1 and 10% of the real incidence (5,6,10). The real incidence of food-borne diseases in the Netherlands is estimated at about two hundred thousand cases each year. For Europe this figure is estimated to be in the order of 10 million.

Social and economic impact

In general, food-borne illness is considered as mild, and after some days of diarrhoea full recovery follows. Fortunately, most cases are mild, but there are exceptions, especially when infants and elderly people are affected. For example, in the sensational outbreak of shigellosis caused by contaminated cooked peeled shrimp from South-East Asia, at Christmas 1983, 14 people died; the youngest was 71 years old, the rest were over 80 years old (2).
Each year some 30 to 35 people are reported to have died of food-borne disease in the Netherlands, mainly of salmonellosis (Table 2); if there is an underreporting of

Table 2. Numbers of fatal cases of food-borne disease, officially reported[1] in the Netherlands

Aetiology	1979	1980	1981	1982	1983
Salmonella	24	23	28	20	33
Yersinia enterocolitica	6	2	3	0	0
Other food-borne diseases	0	1	0	2	0
Total	30	26	31	22	33

[1] Source: CBS (Netherlands Central Statistical Office)

fatal cases, the real mortality of food-borne diseases may be much greater. In this context it is striking that Campylobacter is not yet mentioned in this Table.
Food-borne illness also costs a lot of money. Although difficult to assess exactly, several attemps have been made to determine the economic impact of outbreaks with respect to the costs of hospital and medical care, loss of income and productivity, and expenses involved in investigations of outbreaks. In the United States the total amount of these costs is estimated at $ 480,000,000 per year (11); extrapolation of the Dutch situation results in an amount of about Fl. 100,000,000 per year. Costs for trade and industry are estimated as a multiple of this. Examples of the economic impact of specific food-borne disease outbreaks are presented in Tables 3 and 4.

Table 3. Food-borne illness in the UK: examples of the economic impact[1]

Year	Illness	Food	Cost (£)
1964	Typhoid	Canned corned beef	25 million
1974	Salmonellosis	Cold roast pork	350,000
	Salmonellosis	Cooked ham, pork and beef	50,000
1978	Botulism	Canned salmon	2 million
1979	Staphylococcal food poisoning	Canned corned beef	1 million

[1] Source: Gilbert (4)

Table 4. Food-borne illness in the Netherlands: examples of the economic impact

1981	Salmonellosis	Cold buffet	1 million
1982	Viral gastro-enteritis	Cold buffet	23,000
1983	Shigellosis	Shrimp	10 million

Factors

From the epidemiological investigations in the Netherlands and elsewhere, such as Great Britain, the United States or Canada, it appeared that most food-borne disease outbreaks are caused by mishandling of food at places where the food is prepared for immediate consumption, such as restaurants, cafetarias, institutions, canteens and private households. These studies have shown that the faulty procedures presented in Table 5 frequently lead to food-borne disease outbreaks. In

Table 5. Factors contributing to food-borne disease incidents[1]

Contributing factors	USA 1961–1976 %	Engeland-Wales 1969–1976 %
Affecting presence		
Survival		
Inadequate cooking	16	21
Inadequate reheating	12	28
Contamination		
Infected person	20	16
Raw ingredients	11	15
Cross contamination	7	9
Inadequate sanitising	7	7
Affecting growth		
Improper cooling	46	77
Improper hot-holding	16	10
Preparation in advance	21	64
Use of leftovers	4	–

[1] Source: ICMSF (7)

particular, practices enabling pathogens to multiply to large numbers, such as improper cooling and preparation in advance, contribute to outbreaks.

Foods of animals origin, such as meat and meat products and poultry, especially play a significant role in outbreaks of food-borne disease. The continuous presence of Salmonella and Campylobacter in raw foods of animal origin is the most important problem in this respect. There are many reasons for contamination of products of animal origin with food-borne pathogens. Food animals which are symptomless excretors are by far the most important source of food contamination. Infection of animals, frequently resulting in clinically healthy carriers of these food-borne pathogens, is due to contaminated feeds and the existence of contamination cycles in which water, sewage, soil, dust and air, as well as insects, rodents, birds and man play an important role. The contamination which occurs along the slaughter-line and during further handling is also important with respect to the presence of food-borne pathogens in raw meat and poultry.

If properly cooked, all foods will be virtually free from pathogenic bacteria. But introduction of these raw foods of animal origin into the kitchen leads to enhanced contamination pressure and increased risk of recontamination. This was clearly demonstrated by de Wit *et al.* (12) in a study of the extent to which frozen broilers may cause contamination in the kitchen. Frozen broilers, artificially contaminated with an indicator organism (*E. coli* K12, nalidixic acid-resistant) were distributed to 60 households. The broilers were thawed and prepared as usual. During and after preparation, a number of objects in these kitchen were sampled and examined for the indicator organism. The indicator organism could be isolated from many objects, even after rinsing (Table 6), demonstrating the normally occurring spread of bacteria in kitchens, and the consequent risk of recontamination of properly cooked foods with pathogenic bacteria.

Table 6. Contamination of objects during preparation of frozen chickens[1] (cross contamination).

Object	Number of samples	Percentage demonstrated (cross) contamination
Taps	56	82
Utensils (handles)	81	68
Plates, dishes, strainers, etc.	29	90
– ditto after rinsing	32	72
Cutting boards	17	100
– ditto after rinsing	13	77
Dressers	209	65
Boxes with spices, herbs, etc.	85	60
Door handles	67	24
Rags	38	74
Towels	51	14
Sinks	49	67

[1] Source: De Wit et al. (12)

PREVENTION

To prevent food-borne illness, there are a number of lines of approach, beginning at the farm and going right through to the kitchen.
These include:

— prevention of the entry of food-borne pathogens such as salmonellae and campylobacters into flocks of turkeys and chickens and into herds of cattle and pigs;
— redution in the spread of intestinal content to meat during slaughter;
— destruction of pathogens in foods of animal origin by processing, such as pasteurisation, sterilisation and radicidation, or by cooking;
— prevention of recontamination after processing or cooking.

The control of food-borne diseases presently depends completely on hygiene in the kitchen as the final line of defence. This puts the ultimate and full responsibility for control on all those who handle and prepare foods for immediate consumption, and control of food-borne illness will thus depend on their knowledge. Unfortunately, this is very limited: a Gallup survey in the United States, (1), based on interviews with 816 women, revealed that 74% did not know what Salmonella was (at that time Campylobacter was unknown, even to the experts), 66% did not know to minimise the spread of such bacteria in the kitchen (Table 6), and 39% thought

that raw meat and poultry are regularly inspected for the presence of Salmonella by federal or state inspectors.

It is commonly believed that meat and poultry can be kept at room temperature after cooking and that refrigeration is unnecessary. In a national survey in the United States (8), 46% of homemakers were not concerned about leaving cooked meat at room temperature for 2 hours or longer. Moreover, temperature control in domestic refrigerators is commonly poor. The same survey revealed that in 32% of household refrigerators the temperature remained above 7°C. Yet these practices, permitting susceptible foods to remain between 7°C and 60°C for hours, are the most frequent contributing factors in food-borne disease outbreaks (Table 5). It is therefore necessary to educate homemakers and other handlers how to apply the basis principles of food hygiene in daily practice. However, taking into account the hundreds of thousands if not millions of people contracting food-borne illness each year, *every* effort should be made to prevent or at least minimise contamination of (particulary raw) foods of animal origin with food-borne pathogens at *every* phase of production.

Summarising, food-borne diseases affect health and welfare of hundred thousands of people and result in considerable economic loss. Salmonella and Campylobacter are by far the most important causes of food-borne illness. Raw foods of animal origin are the major sources of these pathogens. Mishandling of foods in kitchens contributes to food-borne disease outbreaks. More education is needed. But prevention should not be directed only toward education of food handlers. Taking into account the inevitable risk of recontamination of cooked foods with pathogens in every kitchen, public health authorities should place more emphasis on pathogenfree raising of food animals and good manufacturing practices during slaughter to minimise the contamination of raw foods of animal origin, thus reducing the contamination pressure in the kitchen and finally, more effectively controlling food-borne diseases.

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