

# SAFER EATING

Microbiological Food Poisoning and its Prevention

- Why is bacterial food poisoning rising?
- What parts of the food chain are involved?
- Prevention strategies

Food safety has been an increasing focus of parliamentary and public debate, with the Pennington Group inquiry on *E. coli*O157, concerns over rising levels of food poisoning in general, standards of hygiene in abattoirs etc., as well as the debate over the Food Standards Agency (FSA) and its remit.

**An important part of this debate concerns bacterial food poisoning, which POST has just reviewed. This note summarises the full report<sup>1</sup> and its findings.**

## TRENDS IN BACTERIAL FOOD POISONING

To get the overall picture, the full report reviews available information from three sets of statistics:

- notifications<sup>2</sup> from doctors ('formal') and other sources ('otherwise ascertained');
- results of laboratory tests;
- investigations by UK Surveillance Centres<sup>3</sup> into 'general outbreaks' of infectious intestinal disease (IID), which account for ~10% of all cases.

Recent trends are shown in **Figure 1** and reveal significant rises in all regions. In England and Wales, total notifications have risen more than fivefold between 1982 and 1996 (from 14,000 to 83,000); those for Scotland from 2,700 to over 10,000, with a similar upward trend apparent in Northern Ireland (~100 to 1,300). When population is taken into account (**Figure 2**), it is clear that there are major geographical variations, with Northern Ireland showing much lower rates than either England and Wales or Scotland.

Turning to **trends in specific bacteria**, the full report looks at the origin, behaviour and symptoms of 11 of the most important food poisoning organisms. Recent trends in the number of laboratory reports (**Figure 3**) highlight *Campylobacter*, *Salmonella* and *E.coli* O157 as the bacteria of greatest concern.

*Campylobacter* is now the commonest bacterium giving rise to food poisoning, with 47,600 cases in 1996. Fortunately, most involve only relatively mild symp-

1. The full report "Safer Eating" (80pp) is available from POST, 7, Millbank, London SW1P 3JA; free to Parliamentarians; £14 otherwise (contact Parliamentary Bookshop on 0171-219-3890).

2. To the Office for National Statistics (ONS) in England and Wales, the Scottish Centre for Infection and Environmental Health (SCIEH) and the Department of Health and Social Services in Northern Ireland (DHSSNI).

3. The Public Health Laboratory Service's (PHLS) Communicable Disease Surveillance Centre (CDSC) in E&W, SCIEH, and DHSSNI.



POST  
REPORT  
SUMMARY

104  
October  
1997

This is a summary of a 80-page report available from the PARLIAMENTARY OFFICE OF SCIENCE AND TECHNOLOGY (extension 2840).

Figure 1 UK NOTIFICATIONS OF FOOD POISONING

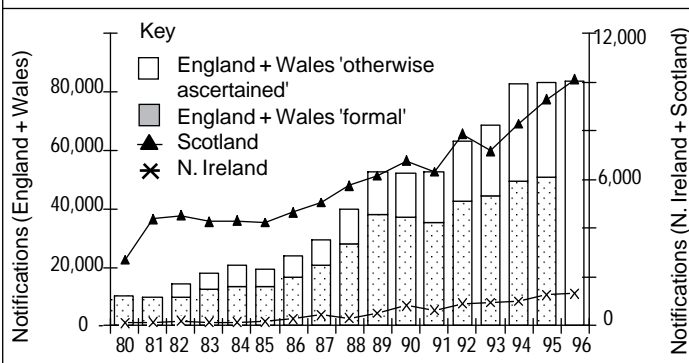
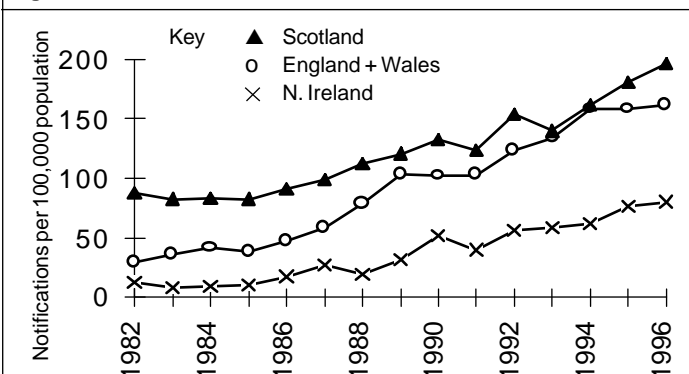


Figure 2 NOTIFICATIONS ADJUSTED FOR POPULATION



toms, and only ~1% require medical intervention. Nearly all *Campylobacter* infections are isolated cases rather than part of outbreaks, because the bacterium does not normally multiply in food at room temperatures.

*Salmonella* cases grew steadily during the 1980s, peaking at over 35,000 per year in 1992, but have declined slightly since (Figure 3). The main one of (over 2,000) different 'sub-types' responsible for much of the increase is *S. enteritidis* phage type 4 (SePT4). The increase in human cases mirrors trends in infections among farm animals (particularly in poultry where control measures led to the slaughter of nearly 400 flocks (2 million infected birds) between 1989 and 1993). More recently, another subtype has emerged - *S. typhimurium*DT104 (StDT104) - in both animals (StDT104 is now the most common *Salmonella* found in cattle) and humans (where infections have risen from around 800 in 1992 to ~4,000 in 1996). In addition to causing food poisoning this sub-type carries resistance to a wide range of commonly used antibiotics. *Salmonella* is also the most common source of general outbreaks of food poisoning, with poultry, eggs, red meat and meat products being among the most commonly implicated.

*E. coli* O157 was virtually unknown prior to the 1980s, but since then, overall UK rates have risen to over 1,100 cases in 1996 (Figure 3). Although it affects far fewer people than either *Campylobacter* or *Salmonella*, it causes more serious illness and requires fewer numbers of bacteria to cause disease. Scotland shows the highest rate (9.5 cases per 100,000 population in 1996), followed by England and Wales (1.3) and then Northern Ireland (0.8). Scotland has also suffered a disproportionate number of outbreaks (24 between 1987-96), of which the worst was the 1996 outbreak in Central Scotland affecting 496 people, 20 of whom died - the largest total of deaths associated with any such outbreak worldwide.

The overall picture is thus of a large rise in food poisoning notifications, which now affect almost 100,000 people each year, with fatalities running at 100-200 annually. *Campylobacter* has replaced *Salmonella* as the predominant bacterium involved, and new threats are emerging in the form of *E. coli* O157 and novel *Salmonella* sub-types (SePT4, StDT104).

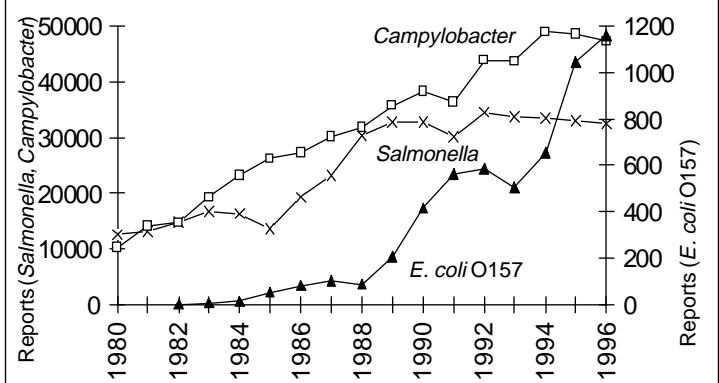
## UNDERLYING FACTORS

The full report delves beneath the headline figures into what is actually driving the observed trends. The first question is **how real are the increases revealed in Figure 1** - large numbers of cases of food poisoning go un-recorded, so changes in the reporting rate could lead to an apparent increase. When the detailed trends are examined however, there are few grounds for dismissing them, although it is possible that the real increase is not as large as the 'headline' rate of a five-fold increase in the last 15 years. **The key to resolving this question lies in the results of a pilot study of the rates of infectious intestinal disease in 90 GP practices carried out in 1996.** The results of this are being analysed but publication is not expected before the end of 1997/early 1998.

In the meantime, the apparent increases run counter to the increasing regulation of food production, processing, handling, retailing and sale outlets, and the extent of technology in the food chain. The full report finds no simple, single answer to this anomaly but some trends do appear more important than others.

Some important trends do seem to be linked to **changes in agricultural sources**. With *Salmonella*, upwards trends in specific sub-types isolated from humans have coincided with similar trends in the same sub-types among farm animals (e.g. SePT4 in poultry and StDT104 in cattle). Links between human and farm animal infections with *E. coli* O157 or *Campylobacter* (poultry is thought to be the source of around two thirds of human infections) also appear likely, though they remain un-proven because of the lack of the necessary scientific data<sup>4</sup>.

Figure 3 LABORATORY REPORTS OF *Campylobacter*, *Salmonella* and *E. coli* O157 (UK, 1980-1996)



In the **slaughterhouse or abattoir** poor hygiene can allow infection in one animal to spread to others. Various enquiries have shown much room for improvement, and a number of measures have been introduced to improve standards (see full report). **The link between better hygiene in abattoirs and the microbiological quality of the meat produced is not however straightforward** - recent research suggests that the very best abattoirs achieve no more than a 50% reduction in bacterial count in meat compared to the very worst (relatively insignificant in microbiological terms). Even the most comprehensively optimised hygiene practices achieve only a ~fivefold reduction in count. On the other hand, **meat from a faecally-soiled animal can have up to 1,000 times more bacteria than meat from a clean animal.**

These findings underline the **importance of taking a holistic view and of underpinning regulations with sound science**. While MAFF are now assigning a high priority to animal cleanliness, EU regulations have contributed in the past to a substantial reduction in the number of abattoirs from 1385 in 1975 to 384 in 1996, leading to substantial increases in the distance travelled from farm to abattoir, and associated stress and soiling of animals presented for slaughter. The above research shows that even small increases in the number of soiled animals could reverse any improvements in microbiological quality of meat resulting from the regulations, and the **net effect may well have been the opposite of that intended.**

The full report also looks at the **complexity, scale and length of the modern food chain**. In theory, the trend towards sourcing raw materials from all over the world, of lengthening shelf lives and distribution chains could all act to increase the potential for bacteria to grow. However while this may well open up extra opportunities in specific cases, this could not account for the large increase in *Campylobacter* food poisoning (because this bacterium does not generally grow in food).

4. With *E. coli*, the sub-type most commonly found in humans (*E. coli* O157:H7) is also present in cattle, but there is no information on how infection rates vary from one region to another. With *Campylobacter*, it has been difficult to identify specific sub-types until recently.

The full report examines trends in origins of outbreaks (where they are traced back to their source) to see if they shed light on the most important sources in the food, catering and retail sectors (Figure 4). These show that **44% of outbreaks originate from the consumer buying meals from restaurants, hotels and other catering establishments.** In contrast, domestic catering accounted for 17% of outbreaks and shops and retailers only 6%. These statistics suggest that eating out remains a very important source of food poisoning, possibly dwarfing that originating from shops and retailers which are the current focus of concern following the *E.coli* outbreaks<sup>5</sup>. A general lesson from the outbreaks data is that **most were easily preventable, having arisen mainly from inappropriate storage, inadequate heating or cross-contamination.**

Moving to the **consumers** themselves, the last 10-15 years have seen many changes which could have a bearing on food poisoning trends - more shop at supermarkets on a weekly (or less frequent) basis, relying increasingly on fridges and freezers to store food in the home; more people eat out; new products (e.g. chilled foods) or preparation techniques (e.g. microwaves) require storage and preparation instructions to be closely followed; some consumers want more 'natural' foods with fewer chemical preservatives; demographic trends may mean one meal being 'stretched' over days.

Despite highly publicised outbreaks traceable to the food industry, the vast majority of cases of food poisoning still affect individuals or small family groups and are thus very influenced by the practice of the consumers themselves. With the trends above however, the combinations of foods and circumstances which can give rise to a risk of food poisoning are increasing so that, **if anything, consumers need to be more aware of the principles of food hygiene than in earlier years.**

## REVERSING THE TRENDS

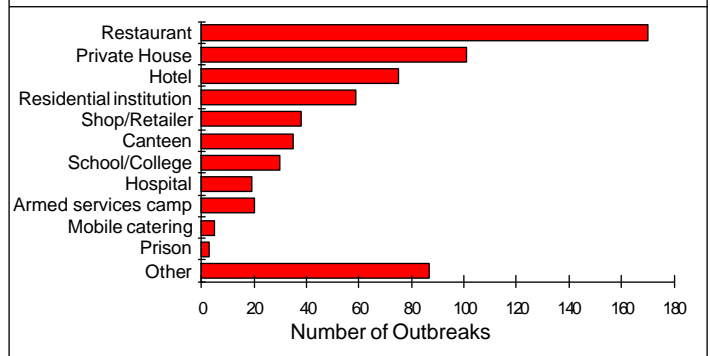
There are many changes underway or under consideration following recent enquiries (particularly from the Advisory Committee on the Microbiological Safety of Foods review of poultry meat and the Pennington Group review of the *E.coli* outbreak in Scotland). Measures to improve hygiene span the length of the food chain - from the 'farm to the fork'.

### On the farm:

- An awareness programme on the existence, potential prevalence and nature of *E. coli* O157.
- The need for care in the use of untreated slurry and animal manure.
- Minimising contamination in feed and improved hygiene in production systems.

<sup>5</sup> However, outbreaks only account for 1 in 10 cases and the importance of eating out may reflect in part the relative ease of identifying it as a source of infection.

Figure 4 SOURCES OF GENERAL OUTBREAKS



### In the slaughterhouse:

- Clean animals/birds.
- Reduce scope for cross-contamination by better tools and machinery and training.
- Consideration of end-process treatments such as steam pasteurisation to kill bacteria.
- Better implementation of Hazard Analysis of Critical Control Points (HACCP).

### Food processing, distribution and retail:

The main approach here is through better implementation of HACCP, which the Pennington Review showed to be patchily applied - particularly in smaller outlets. Much emphasis is placed on HACCP's application more generally through regulations and the underlying EU Directives (although the full report does point to some practical questions over implementing HACCP in smaller operations). Interim measures are under consideration to help tighten existing legislation - firstly, to clarify the position regarding which premises are intended to be covered by the Meat Products (Hygiene) Regulations 1994. Secondly, that selective licensing arrangements should be introduced for premises not covered by the clarified 1994 regulations.

On this last point, one current issue concerns the separation of cooked and raw meats in butchers shops, where complete physical separation (using different preparation areas, utensils, staff, etc.) could be difficult and expensive to apply in smaller businesses, threatening their viability in some cases. **The Government is consulting on how to strike a balance between the Pennington Group's original proposals and their economic and social impact** (which according to a survey by the Meat and Livestock Commission could be as much as £187M in capital costs and £160M p.a. in revenue costs in Great Britain).

### Consumer issues:

Despite improvements in hygiene, surveys show that food reaching the consumer still has a good chance of being contaminated (e.g. 33-41% of chickens on retail sale are contaminated with *Salmonella*) and consumers need to always assume a potential for contamination. While surveys show that on the whole, consumers are aware of the main principles of food hygiene, they



don't always put them into practice - moreover, as discussed above, factors such as the emergence of *E. coli* O157, increasing complexity of food technology, demands for ever longer shelf-lives, etc., demand high standards of hygiene from consumers, and more complex educational campaigns. In this context, general educational campaigns are likely to be of continuing importance (e.g. MAFF's Food Sense campaign and the annual National Food Safety Week), but there is continued debate over **whether food hygiene education in schools is too dispersed** (e.g. in science) or should have a single focus (as used to be the case within Home Economics).

#### Research Issues:

The full report shows the importance of sound science in defining regulatory strategy on the one hand and the major gaps which still exist in our knowledge of some of the underlying phenomena relevant to bacterial food poisoning on the other. Thus the exact origins of some of the organisms of current public health concern have not been established, there is no explanation of the major regional differences (Figure 2), and data to inform a strategy to reverse the rise of recent years is only starting to become available. The full report reviews the extensive R&D programmes supported by DH, MAFF and others (e.g. MRC and BBSRC), and also developments in the private sector where science and technology may have a role in avoiding problems in the home - whether through intelligent packaging (which senses when it has not been safely stored) or antibacterial surface coatings. Other possible 'technical fixes' include interventions to reduce infections in animals (vaccines, competitive excluders, etc.) and contamination in carcasses (e.g. steam pasteurisation). Food irradiation remains a technology capable of eliminating bacteria in many foods at the point of retail sale.

### THE FOOD STANDARDS AGENCY

Although the FSA's remit will be much wider than just bacterial food safety, the full report nevertheless looks at what lessons may be pertinent to the developing debate over the Agency's remit, its structure, organisation and accountability. Some considerations which flow from the scientific analyses in this report include:

- As already mentioned, the importance of basing decisions on **sound science** may have implications for the structure of the Commission; members will need scientific skills rather than be there to represent different interest groups; and parallel concerns will be to understand both the scientific issues relating to risk and to develop a better public dialogue over how to address those risks.
- A point of scientific debate is **whether the FSA's remit should include nutrition**. Those in favour

point to the human cost of poor nutrition and the advantages of having one agency bring a coherent and consistent approach to all food issues. The counter view is that the agency should restrict itself to the primary consumer concern of food safety (issues such as BSE, and chemical and microbiological contamination), where its **regulatory** functions would be paramount, leaving nutrition with other health-based **educational** strategies with the Department of Health.

- How far the new structure is capable of addressing the 'bottom line'. For instance:
  - would the FSA be better prepared against emerging threats such as *E. coli* O157, *S. typhimurium* DT104, *S. enteritidis* PT4, etc.?
  - would the FSA improve our knowledge of the most effective preventative strategies?
  - balances still need to be struck e.g. - between consumer and industry interests and between regulation, enforcement and costs. How would the FSA achieve a more objective balance, and avoid merely being seen as unbalanced in a different direction?

### IN CONCLUSION

The full report confirms that the underlying drivers of increasing bacterial food poisoning are complex, and that a whole host of measures are in hand, proposed, or possible as a result of future research, ranging from wholesale reorganisation of regulatory structures (the FSA), through amendments to regulations and enforcement, to a myriad of potential technical measures at all stages of the food chain. In this mass of complexity, it is easy to become focused on process rather than outcome and lose sight of the overall goal of reducing the levels of food poisoning. While many measures may take years to have an effect (if at all), there are some relatively simple measures which seem to stand out as offering particularly good value for money. For instance, at the farm/slaughterhouse end, dirty animals stand out clearly as one of the key (and most obvious) contributors to the contamination leaving the abattoir. The technology of irradiation could deal with much of the residual contamination on key foods such as chilled/frozen chickens (which still carry much bacterial contamination in the shops). Even in the home, the simple incorporation by manufacturers of thermometers in fridges would provide consumers with a source of information they simply lack at present and contribute to greater awareness of hygiene issues.

It is hoped that the full report will help Parliamentarians find a route through the food safety maze and assist their contribution to the current debate.