

SETTING THE BASELINE FOR THE AGENCY'S FOODBORNE DISEASE TARGET : MEASURES OF FOODBORNE DISEASE IN THE UK

Introduction

1. The Food Standards Agency has set itself the target of reducing the incidence of foodborne disease by 20% by April 2006. However, there is no single measure of foodborne disease. The purpose of this report is to summarise current information on foodborne disease and related conditions in the UK, together with the trends over recent years. It will describe a number of ways of estimating the number of cases of foodborne disease and discuss the measurement the Agency proposes using to assess progress in meeting its target.
2. The Centres for Disease Control (CDC) in Atlanta have produced a (single figure) estimate of foodborne illness in the USA. The PHLS Communicable Disease Surveillance Centre (CDSC) is currently preparing a paper for publication that uses a similar approach to derive an overall figure for the UK. The methodology is described in this report, together with the reasons why such an approach cannot be used at this stage to set the baseline for measuring the Agency's target.
3. This report also focuses on routinely published data, mainly relating to the number of cases but including death notification data. It does not deal with other aspects of the burden of illness such as admission to hospital, hospital bed-days and complications. The CDSC paper will cover most of these.

What is foodborne disease?

4. For the purposes of the target, **foodborne disease** is defined as disease due to consumption of food contaminated with microorganisms or their toxins.
5. The term **infectious intestinal disease** (IID) is used to describe gastrointestinal symptoms (diarrhoea, vomiting, abdominal pain) due to microorganisms or their toxins. Only a proportion of cases are foodborne. There are other routes of transmission, such as person-to-person spread and direct contact with animals or environments contaminated with animal faeces. It is relatively easy to obtain

robust data on IID; it is impossible to determine the proportion of cases that are foodborne, however promptly or completely those cases are investigated

Surveillance systems

6. The main sources of data on human foodborne disease and other infectious intestinal disease are:
 - The statutory notification system
 - Reports of Intestinal Infectious Disease made to the Royal College of General Practitioners' Weekly Returns Service
 - Laboratory reporting of the major foodborne pathogens
 - Reports of outbreaks to the national surveillance centres
7. Further information on these systems, including their advantages and disadvantages, is appended at A. Data for 2000 from each of these systems and trends over recent years is presented below.

Mortality

8. In 1999, 476 deaths were notified to the Office of National Statistics as due to IID in England and Wales. However, only 25 of these were attributed to salmonellosis and only 2 to *E. coli*. The majority of cases were categorised as due to "intestinal infections due to other organisms". It is difficult to assess what proportion of these might have been the result of foodborne disease.
9. The overall figures for deaths due to IID have not shown any significant trends upwards or downwards in recent years. Deaths due to *Salmonella* have fallen markedly over the last three years in parallel with the decrease in the number of cases.

The Infectious Intestinal Disease (IID) study

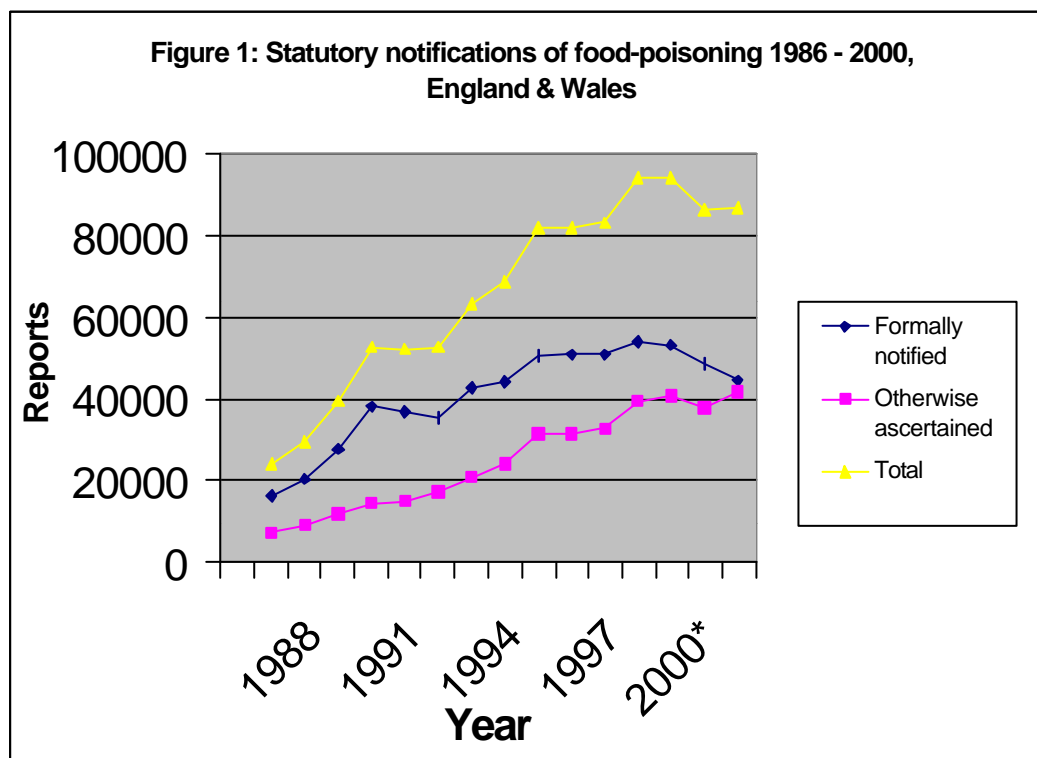
10. In 1994-95 a large study was carried out in England to investigate the number of cases of IID, both those occurring in the community and those presenting to GPs, to determine their microbial aetiology and to determine the degree of under-reporting through routine laboratory surveillance. The study estimated that 9.4 million people suffered from IID each year of which 1.5 million consulted their

doctor. Target organisms were detected in only 1/3 cases in the community, although the yield was greater among those who saw a doctor (55% with a target organism). Although the study does not, nor could it, determine the proportion of cases of IID that were foodborne, it has provided extremely useful data to help interpret information from routine surveillance systems.

Statutory notifications

11. This data reflects notifications by medical practitioners of cases of food poisoning, or suspected food poisoning. Notifications are made to local public health officials and collected centrally by the Public Health Service in England and Wales, by the Common Services Agency in Scotland and by the Department of Health, Social Services and Public Safety in Northern Ireland.

12. In 2000, a provisional figure of **86,616** cases of food poisoning was reported in England and Wales through the statutory notification system. Of these, 44,619 were statutorily notified and 41,997 were ascertained by other means. This figure is very slightly higher than the number of cases notified in 1999 (86,316), but both figures are about 8% lower than the number of cases notified in 1998. Trends in notifications since 1986 are shown in figure 1 below.



13. The trends in Scotland over recent years have mirrored those in England and Wales, with notifications falling from 10,177 in 1997 to 8,577 in 1999. In contrast, there has been a continuing upward trend in Northern Ireland with notifications increasing from 1,534 cases in 1997 to a provisional figure of 2,273 cases in 2000. The total UK figure decreased from 105,612 notifications in 1997 to 96,926 in 1999. It is not possible to add the data from Scotland and Northern Ireland to figure 1 because data is not broken down into cases that are statutorily notified and those that are ascertained by other means.

RCGP sentinel surveillance of IID

14. This data is provided for England and Wales by sentinel general practices. The practices report all cases of IID, irrespective of presumed causality, to the Royal College of General Practitioners' Research Unit in Birmingham.

15. In 2000, the mean weekly incidence was just under 36 per 100,000. This gives an annual estimate for England of about **0.9 million** cases. The incidence has been falling since 1989. In 1994 and 1995, the mean weekly incidence, averaged for the two years, was about 58 cases per 100,000, giving an annual estimate for England of just under 1.5 million cases. This compares well with estimates from the IID study. Since 1994, there has been a 40% decrease in the incidence of cases of IID seen by general practitioners in the sentinel practices.

Laboratory reports

16. The IID study showed that the most common organisms isolated in cases of IID were Norwalk-like viruses (NLVs), rotaviruses, *Campylobacter*, *Salmonella*, *Clostridium perfringens* and enteroaggregative *E.coli*. Of these, the majority of cases of *Campylobacter*, *Salmonella* and *Clostridium perfringens* are likely to be foodborne. Only a minority of NLV infections and few if any rotavirus infections are foodborne. Little is known about the epidemiology of enteroaggregative *E. coli*.

17. The study also showed that laboratory reporting identified a significant proportion of all cases of *Salmonella* (1 in 3) and *Campylobacter* (1 in 8) but identified very

few cases of NLV infection (1 in 1500). This is reflected in figures from the laboratory reporting system in that the most commonly reported gastrointestinal pathogens are *Salmonella* and *Campylobacter*.

18. In 2000, a total of **16,987** isolates of *Salmonella* and **62,867** isolates of *Campylobacter* were reported from laboratories in the UK (provisional figures). The trends in incidence of these two organisms over recent years have been very different. Whilst reports of *Salmonella* have fallen by more than 50% over the last three years, reports of *Campylobacter*, which have risen steadily over the last decade or more, have shown no sign of falling, although there is a suggestion that they have levelled off. The trends since 1986 are illustrated in figure 2 below.

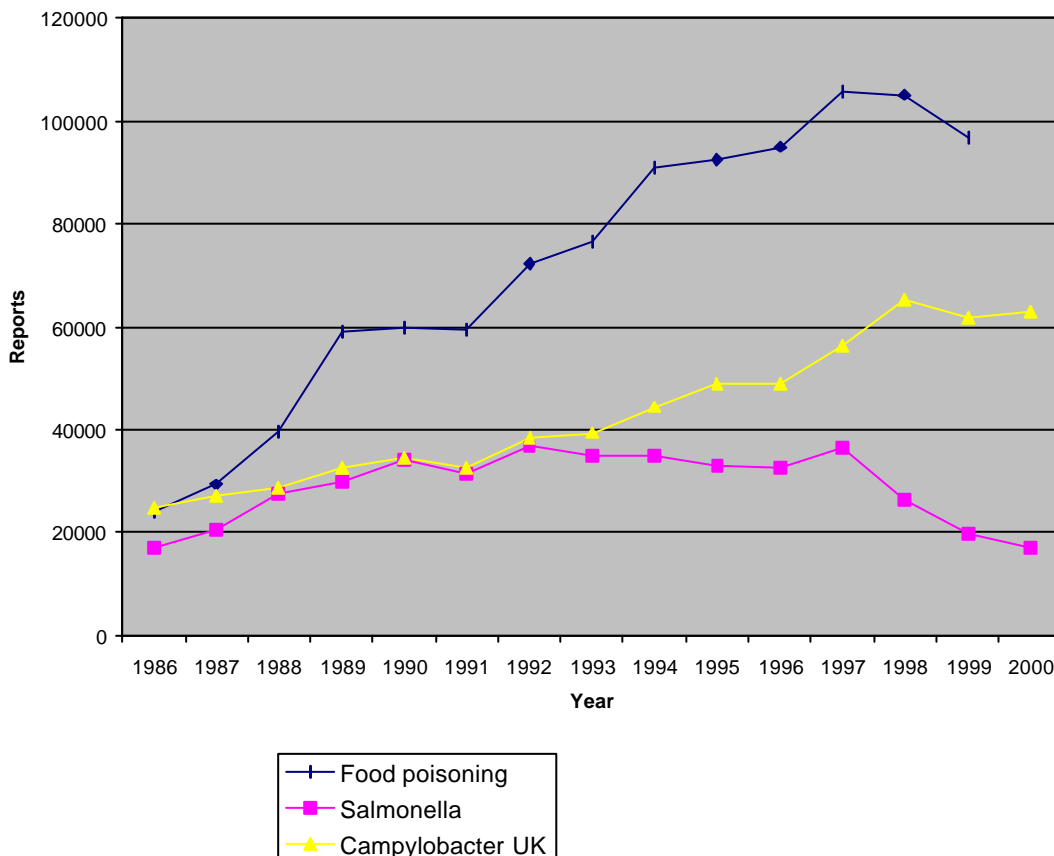


Figure 2: Laboratory reports of *Salmonella* and *Campylobacter* 1986 – 2000, together with statutory notifications of food poisoning (UK data)

19. Although *Clostridium perfringens* was reported almost as often as *Salmonella* in the IID study, the number of laboratory reports is very low (just over 100 reports a year). This probably reflects a lack of detection of sporadic cases and an under-reporting of outbreaks. The provisional total of reports in 2000 was **166** cases and there were 10 outbreaks.

20. *E. coli* O157 and *Listeria monocytogenes* are other important causes of foodborne disease, not because they cause many cases, but because they cause severe disease and death. In 2000, there were **1160** reports of *E. coli* O157 and **113** reports of *Listeria monocytogenes* from UK laboratories (provisional figures). There is little indication of any trend up or down for either of these bacteria in recent years. Recent data on *E. coli* O157 suggest that the annual figures are fluctuating between 1100 and 1400 cases a year.

Outbreaks

21. In 2000, there were 778 general outbreaks (outbreaks involving people living in more than one household) of IID in the UK. Of these, 130 (17%) were considered to be foodborne or mainly foodborne. *Salmonella* was identified in 43 outbreaks (33%), *E. coli* O157 in 9 (7%), *Clostridium perfringens* in 4 (3%) and *Campylobacter* in 9 (7%).

22. For the purpose of comparison, figures from 1995-1996 (England and Wales only) are shown in Table 1. This table also lists the number of outbreaks of viral IID, illustrating the small proportion of these outbreaks that are foodborne. In this period, 22% of outbreaks were considered to be foodborne or mainly foodborne. *Salmonella* was identified in 51%, *E. coli* O157 in 4%, *Clostridium perfringens* in 11% and *Campylobacter* in 3%.

Table 1: Outbreaks by mode of transmission, 1995-1996 (Public Health Laboratory Service data) – selected pathogens

| | All outbreaks | Foodborne/mainly foodborne |
|--------------------------------|---------------|----------------------------|
| Total | 1568 | 341 |
| <i>Salmonella</i> | 233 | 174 |
| <i>Clostridium perfringens</i> | 47 | 36 |

| | | |
|----------------------|-----|----|
| VTEC O157 | 19 | 12 |
| <i>Campylobacter</i> | 12 | 9 |
| Norwalk-like viruses | 680 | 21 |
| Rotavirus | 54 | 0 |
| Unknown | 379 | 42 |

23. The main food vehicles associated with outbreaks in 2000 were poultry (15 outbreaks) red meat (10 outbreaks), salads and vegetables (6 outbreaks), and desserts (5 outbreaks).

24. Again, for the purposes of comparison, information on the main vehicles associated with foodborne infection over the period 1992-1999 (again, for England and Wales only) is shown in the chart below.

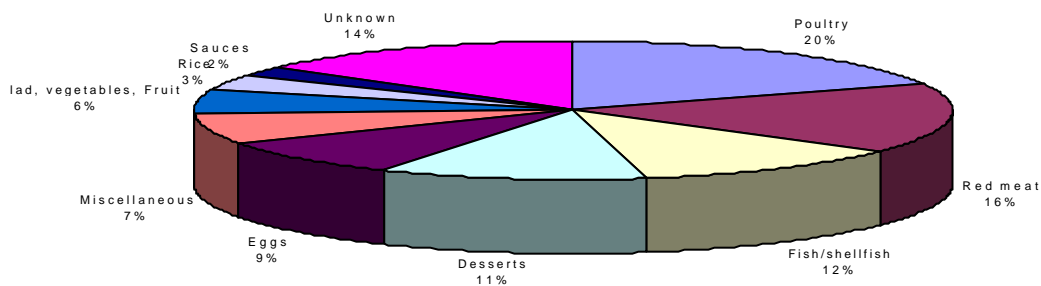


Figure 2: General foodborne outbreaks of IID reported to CDSC by vehicle of infection. England and Wales 1992-1999

Other ways of estimating the incidence of IID

25. Current systems cannot provide information on cases that are not seen by the doctor or reported to local Environmental Health Officers. This can only be ascertained by community-based studies. **Telephone surveys** and **market research questionnaires** have been used to obtain simple data on the incidence of symptoms of IID. However, there are a number of pitfalls in interpreting data from this type of survey. For example, in the Agency's Consumer Attitudes Survey, carried out between October and December 2000, 14% of respondents

claimed to have experienced a bout of diarrhoea and/or vomiting during the previous year which they attributed to food eaten in this country. This would give a figure of about 8.3 million cases a year in the UK, which is remarkably similar to the figure for all IID in the community obtained from the IID study, taking account of a probable fall in the number of cases since the mid 90s. It suggests that most people who have an attack of IID automatically attribute it to food.

26. A further complicating factor in this type of study is recall bias. Retrospective studies of this sort have been found to give a figure three times that obtained when cases are identified prospectively as they occur, as happened in the IID study. Moreover, the information provided by such surveys is very limited. A much greater wealth of information has been provided by **special studies** such as the IID study, which identified cases prospectively and linked symptoms to a questionnaire and microbiological investigations.

27. Other indicators of diarrhoeal disease in the community, notably **the purchase of anti-diarrhoeal medicines**, have helped in the detection of outbreaks, for example in the Milwaukee outbreak of cryptosporidiosis in 1992. However, the role of such indicators for routine monitoring has not been evaluated and this approach has not been used in the UK.

Estimating the total burden of foodborne disease

28. In 1999, CDC Atlanta calculated that the total number of cases of foodborne disease in the US was 76 million (www.cdc.gov/ncidod/eid/vol5no5/mead.htm). To calculate this number, the authors started with the total number of laboratory reports of each foodborne pathogen from sentinel laboratories. They multiplied this to give an estimate of all laboratory reports and then multiplied that figure by the estimated level of under-ascertainment of cases in the community. This produced an estimate of the total number of cases due to each pathogen in the community. For each pathogen, they then estimated the proportion of cases that were likely to be foodborne and these figures were added up to give a figure for all cases of foodborne disease due to known pathogens. From data on the incidence of acute diarrhoeal disease they then calculated the number of cases due to unknown pathogens and estimated the proportion of these cases that was likely to be foodborne. Further details are given in annex B.

29. Whilst recognising the many assumptions that have to be made in order to calculate the final figure, the basic approach does attempt to make use of the best data on individual organisms to make an assessment of the overall burden of foodborne disease. The PHLS Communicable Disease Surveillance Centre (CDSC) has used a similar approach to estimate the overall number of cases of foodborne disease in the UK. In the UK, laboratory data is available from the whole country, not just from sentinel laboratories. The IID study provides a firm foundation for calculating the level of under-ascertainment. For some organisms, case control studies help to provide an estimate of the proportion of cases that are foodborne and, where this is not possible, outbreak data is generally available. CDSC have provided the Agency with a report of their calculations and they are now turning this into a paper for publication in a peer-reviewed journal.

Setting the baseline for the Agency's foodborne disease target

30. The CDSC paper may ultimately give the Agency a single figure for foodborne disease. However, because the validity of the approach has not yet been debated in epidemiological circles, it would not be appropriate to use it as the baseline for the Agency's foodborne disease target. Moreover, whilst it may eventually provide the best estimate of the total burden of foodborne illness, it will always remain an estimate.

31. However, since the true number of cases of foodborne disease is unknowable, in setting a baseline, we are not necessarily looking for an absolute figure, but for a reliable way of measuring trends. The agreed way of measuring progress towards meeting the target is therefore to use laboratory reports of the main foodborne pathogens. The IID study helped to demonstrate the reliability of laboratory reports as a source of information on the major bacterial foodborne pathogens: *Salmonella*, *Campylobacter* and *E. coli* O157. Laboratory reporting is also thought to be a good indicator of listeriosis, because of its severity. Although laboratory reports probably identify a smaller proportion of cases of *Clostridium perfringens* it is suggested that reports of this organism should also be included because it is an important cause of foodborne outbreaks and was a significant cause of illness in the IID study.

32. The CDSC report mentioned in paragraph 29 indicates that the five proposed index organisms account for over 80% of the estimated cases of foodborne disease seen by GPs where a pathogen is detectable. One other possible candidate for inclusion on the list is NLVs, which were the most common cause of illness in the IID study. However, laboratory samples currently give a poor indication of the number of infections due to these viruses. Few samples are examined by electron microscopy and, when they are, in many cases the virus is no longer detectable by the time a patient consults the doctor. Developments in laboratory methodology over the next few years may change this position, necessitating a review of the baseline. However, on the basis of outbreak data, it is thought that, whilst NLVs make a large contribution to cases of IID, their contribution to foodborne disease is far more modest (about 10% of NLV outbreaks are thought to be foodborne and, according to the CDSC paper, only 4% of cases of foodborne disease are due to NLV).

33. At its meeting in May 2001, the Agency Board endorsed the proposal that laboratory reports of the five main bacterial foodborne pathogens (*Salmonella*, *Campylobacter*, *Clostridium perfringens*, *E. coli* O157 and *Listeria monocytogenes*) should be used to monitor achievement of the foodborne disease target. It has also been agreed that, where possible, cases acquired abroad should be excluded. For the year 2000, this gives a figure of **81,280** cases in total, and **65,253** cases, if those thought to have been acquired abroad are excluded. A detailed breakdown of the figures for the year 2000 is appended at C.

Annex A : Routine surveillance systems

1. This annex outlines the main features of routine surveillance systems, together with their pros and cons. Table 2 below summarises the pros and cons of these systems, and of other possible approaches to the surveillance of foodborne disease.

Table 2: Surveillance systems: their advantages and disadvantages

| System | Advantages | Disadvantages |
|--------------------------|---|---|
| Statutory notifications | Single figure Labelled as “food-poisoning” | Based on subjective judgement of the notifying physician Under-reporting |
| RCGP sentinel system | All IID reported | No data from Scotland or N Ireland No microbiology required Practices not a random sample |
| Laboratory reports | Microbiological confirmation Good ascertainment of the major bacterial pathogens | Not all pathogens tested for/ reported Vulnerable to changes in practice, e.g. GP consultation, sampling, laboratory testing |
| Outbreak reports | Epidemiological information Microbiological confirmation | Few cases (ca. 5%) are part of outbreaks Under-reporting |
| Repeat IID study | Provides data on cases of IID in the community Microbiological confirmation | Cannot be sustained on a routine basis |
| Telephone surveys | D&V in the community | No microbiological confirmation Over-estimation (recall bias) |
| Sale of anti-diarrhoeals | D&V in the community | An indirect measure (used in countries with poor surveillance systems for flagging outbreaks) |
| CDC approach | Single figure Comprehensive | Robustness of the estimate only as good as the data available Even with good surveillance, based on many assumptions Not yet established scientifically |

Statutory Notifications

2. The statutory notification system requires medical practitioners to notify all cases of food poisoning or suspected food poisoning to the proper officer of the Local Authority. Reports from medical practitioners are supplemented by reports from other sources, such as outbreak investigations, and these sources now account for almost as many notifications as those obtained from medical practitioners.
3. The statutory notification system is recognised as being a poor way of ascertaining the true incidence of food poisoning. It is based on clinical suspicion only and requires no laboratory confirmation of the diagnosis. It also relies upon a subjective judgement by the doctor regarding the cause of the symptoms. There is, moreover, evidence of a general under-reporting of notifiable diseases.
4. On the other hand, it is the only figure that comes with the label "food poisoning".

The Royal College of General Practitioners' Weekly Returns Service (WRS)

5. The WRS is a sentinel system involving volunteer general practices, covering about 1% of the population of England and Wales. Participating practices are required to report a list of infections, including infectious intestinal disease (IID), on a weekly basis.
6. The GP sentinel surveillance system provides a reliable figure for the number of cases of IID seen by GPs in the sentinel practices. It does not involve subjective judgement about the cause of the symptoms.
7. However, like the statutory notification system, no microbiological confirmation of the diagnosis is sought. Like all sentinel systems, it suffers from the potential problem of being unrepresentative of the general population, and it is confined to England and Wales.

The Laboratory Reporting System

8. The laboratory reporting system is a voluntary system. When pathogens are isolated from stool samples or blood cultures or, in some cases, when infection is

diagnosed on the basis of antibody tests, laboratories report these results to national surveillance centres in England, Scotland and Northern Ireland.

9. This system provides microbiological confirmation of the clinical diagnosis of IID and data on trends in individual organisms. Reporting of some pathogens (such as *Salmonella* and *Campylobacter*) is very good.
10. However, there are a number of potential disadvantages. Viral infections are very poorly reported through this system. Whilst surveillance of a selected group of the main foodborne bacteria may be considered a reasonable indicator of overall trends in foodborne disease, routine tests are not available for all potential foodborne pathogens. Hence, it is difficult to derive an overall estimate of "foodborne disease". Moreover, this system records only those cases in which a sample has been tested and a pathogen identified. Finally, since the system is voluntary, not all laboratories take part, although it should be pointed out that the level of participation is high and it is by no means certain that a statutory requirement for laboratories to notify their positive results would yield a significant amount of additional information.

Reports of Outbreaks

11. National surveillance centres also have systems for recording **outbreaks**. It is generally only outbreak cases for which the route of transmission can be established and thus outbreak reports provide key information on trends in foodborne disease.
12. However, outbreak cases probably account for fewer than 5% of all cases of foodborne disease. Moreover, outbreak reporting is known to be patchy and smaller outbreaks in particular, may tend to be under-reported.

Annex B Assessing the total amount of foodborne disease: the CDC model

1. The United States estimate of foodborne disease is based on information from multiple sources. There is one active surveillance system, the Foodborne Diseases Active Surveillance Network (FoodNet), and a number of passive surveillance systems, including the National Notifiable Disease Surveillance System, the Public Health Laboratory Information System and the Foodborne Outbreak Disease Surveillance System.

FoodNet

2. FoodNet was established in 1996 and currently collects data from selected sites covering about 10% of the population (the system has expanded this year to cover about 11% of the population).
3. FoodNet collects laboratory data on 9 foodborne diseases. Thus it does not include all foodborne diseases, and collects data only for those cases that visit their doctor and have a positive stool sample. The best comparator in the UK is therefore the laboratory reporting system. Whilst this system does not actively prompt laboratory notifications, data from the IID study shows that laboratories do notify a very high proportion of positive results. Moreover the UK system collects data from the whole population.
4. FoodNet estimates are based on a relatively low number of samples. In 1999, among the population covered by FoodNet, there were 4533 reports of *Salmonella* (14.8/100,000), 3794 reports of *Campylobacter* (17.3 per 100,000) and 530 reports of *E coli* O157 (2.1/100,000). This compares with figures for the whole UK of 19,801 reports of *Salmonella* (36/100,000), 61713 reports of *Campylobacter* (112/100,000) and 1429 reports of *E coli* O157 (2.6/100,000).
5. Data from the USA suggests that the FoodNet figure for *Salmonella* underestimates the true incidence in the community by a factor of 38, giving an

estimate for the population of 562/100,000. In the UK, the underestimate, based on the IID study, is 3.2, giving a rate of 115/100,000. The data that is available therefore suggests that, whilst the rate of infection measured by laboratory reporting appears to be higher in the UK, the incidence of disease in the community as a whole is probably several times lower. The differences in the amount by which laboratory reports underestimate infection in the community may in part be explained by the different health-care systems. In a privatised system such as that in the USA, patients may be less likely to seek primary care attention and, because patients have to pay for samples themselves, fewer may have samples sent to the laboratory.

Estimates of foodborne disease

6. Data based on FoodNet estimates were combined with information from passive surveillance of sporadic and outbreak cases for the full range of foodborne pathogens to give an estimated total of 38.6 million cases of foodborne disease due to a known pathogen in 1997. The figures reflect a general assumption that the degree of under-reporting for pathogens causing non-bloody diarrhoea is 38-fold, for pathogens typically causing bloody diarrhoea 20-fold, and for pathogens that typically cause severe illness, 2-fold. With the exception of the *Salmonella* extrapolation mentioned above, these figures are not based on organism-specific data from the USA and are thus fairly arbitrary.
7. A further set of assumptions was then made about the proportion of infections with each organism that was likely to be foodborne. In general, the estimates of the proportion of foodborne disease for individual pathogens is much greater than the figures based on UK outbreaks summarised in table 2 of the main paper. For example, *Salmonella* is estimated to be 95% foodborne, *Campylobacter* to be 80% foodborne and Norwalk-like virus infection to be 40% foodborne.
8. A final set of assumptions is made to estimate the number of cases caused by unknown pathogens. This starts with an estimate of cases of IID. The overall rate of diarrhoeal disease in the FoodNet population in 1996-97 was 0.75 episodes per person per year. To this was added an estimate of cases with vomiting but no

diarrhoea, based on two individual studies from Tecumseh, Michigan and from Cleveland, giving a total estimate of 0.79 episodes of IID per person per year. This compares with 0.19 found in the IID study in England. It is not clear whether or not the rate of diarrhoeal disease was based on prospective ascertainment (the method used in the IID study in England) or on retrospective recall. If the latter method was used, it might explain in part the difference, since retrospective recall has been shown to overestimate the true incidence of diarrhoeal disease. However, the rate of illness in the population does seem to be higher in the USA.

9. The population rate was then extrapolated to the population of the USA to give an estimated total of 211 million episodes of IID. 38.3 million of these had already been accounted for (see paragraph 6). The proportion of cases with a known pathogen estimated to be foodborne was 36%. This percentage was then applied to the rest of the cases to give a total estimate of 76 million cases of foodborne illness a year.

Annex C Measuring the target

Provisional figures for the year 2000

All cases

| | UK | England & Wales | Scotland | N.Ireland |
|--------------------------|-----------|----------------------------|-----------------|------------------|
| <i>Salmonella</i> | 16,987 | 14,844 | 1,723 | 420 |
| <i>Campylobacter</i> | 62,867 | 55,376 | 6,482 | 1,009 |
| <i>E. coli</i> O157 | 1,147 | 896 | 197 | 54 |
| <i>Clostridium perf.</i> | 166 | 124 | 32 | 10 |
| <i>Listeria</i> | 113 | 98 | 11 | 4 |
| Total | 81,280 | 71,338 | 8,445 | 1,497 |

Cases not thought to have been acquired abroad

| | UK | England & Wales | Scotland | N.Ireland |
|--------------------------|-----------|----------------------------|-----------------|------------------|
| <i>Salmonella</i> | 13,122 | 11,456 | 1,338 | 328 |
| <i>Campylobacter</i> | 50,773 | 43,415 | 6,359 | 999 |
| <i>E. coli</i> O157 | 1,035 | 790 | 196 | 49 |
| <i>Clostridium perf.</i> | 166 | 124 | 32 | 10 |
| <i>Listeria</i> | 113 | 98 | 11 | 4 |
| Total | 65,209 | 55,883 | 7,936 | 1,390 |