Foodborne disease and the home

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This leaflet has been put together to provide background information on foodborne diseases with particular reference to the home. This briefing material has been produced for those who work in healthcare professions, the media and others who are looking for background understanding of foodborne disease and/or those who are responsible for informing the public about foodborne diseases in the home.

What is food poisoning?

Any disease of an infectious or toxic nature caused by or thought to be caused by the consumption of contaminated food.

It is important to note that not all gastrointestinal disease is caused by consumption of contaminated food or water. A significant proportion of gastrointestinal infections occur by person to person transmission via hands and surfaces or by inhalation of infected vomit.

A key aspect, as stated in the 2003 WHO World Health Report, is that “foodborne illness is almost 100% preventable”.

What are the main pathogens that cause foodborne outbreaks?

The main microbial causes of food poisoning are bacteria (e.g. Salmonella, Campylobacter, Escherichia coli O157, Clostridium spp., Staphylococcus aureus and Bacillus cereus) and viruses (e.g. norovirus).

In England and Wales, Campylobacter spp., Salmonella spp., Clostridium perfringens, verocytotoxin producing Escherichia coli (VTEC), norovirus and Listeria monocytogenes are estimated to account for 85% of foodborne disease.

How does the food we buy become contaminated?

Raw foods of animal origin as purchased for consumption in the home are the most likely foods to be contaminated, i.e. raw meat and poultry, raw eggs, unpasteurised milk, and raw shellfish:

- Foodborne pathogens in raw meat and poultry frequently originate from the gastrointestinal tract of the animals from whom the meat is produced.
- The surfaces of the meat become contaminated during handling and preparation for retail sale. In some cases the animal is perfectly healthy e.g. cows who carry E. coli 0157 are themselves “healthy”.

International Scientific Forum on Home Hygiene
(www.ifh-homehygiene.org)
There are many opportunities for meat or poultry to become contaminated when it is slaughtered and prepared for sale.

Animals can also transmit foodborne pathogens to humans via their produce e.g. milk, eggs

Filter feeding shellfish (e.g. oysters, mussels and clams) may be contaminated if they are harvested from sewage-contaminated waters

Vegetables or other farm produce can be contaminated if they are grown or washed in polluted water.

Food can become contaminated by an infected food handler who is involved in preparation of food for retail sale

Food can become contaminated in shops/supermarkets by cross contamination from other contaminated foods. Cross contamination can occur via hands, surfaces and cloths where hygiene standards are poor

An infected family member or a person who is a carrier e.g. of Salmonella, may act as the primary source of infection in the home. People who are infected can continue to shed the organism in their faeces for a time after recovery

Through domestic pets. Domestic cats and dogs can act as reservoirs of Salmonella and Campylobacter. In the United States, it is reported that 10-27% of dogs may carry Salmonella and up to 39% of dogs may carry Campylobacter.

Some facts and figures

Studies confirm that Salmonella and Campylobacter are present in retail poultry in many/most countries across the world, although the rates of infection (the percentage of samples which are contaminated) vary significantly from one country to another:

- The European Community Summary Report on foodborne infections states that Salmonella and is most commonly found in fresh poultry and pork meat, where 5.6% and 1.0% of samples were found positive. Campylobacter were most commonly detected in fresh poultry meat where on average 35% samples were positive.
- A UK study showed that Salmonella and Campylobacter can sometimes be isolated from the outside of retail poultry packaging.
- In the United States, more than half of raw chicken is estimated to be contaminated with Campylobacter.
- A survey of retail poultry in Bangkok and Nairobi revealed Campylobacter contamination rates of 40 and 77%.
- A study showed that 0.4%-0.8% of raw meat products purchased from UK butchers were positive for E. coli O157.

How to prevent food poisoning in the home?

The four key principles of food hygiene are: keep clean - prevent cross contamination, separate raw and cooked foods, cook foods thoroughly, store foods correctly:

Keep clean – prevent cross contamination

Good food hygiene means preventing cross contamination. This means stopping germs from spreading from people, pets, pests and contaminated food or water, into food which is being prepared for eating
• Preventing cross contamination means making cooking utensils, hands, hand and food contact surfaces, and cleaning cloths and sponges hygienically clean at the times that matter – before and after use
• Wash hands after handling food which may be contaminated and disinfect using an alcohol handrub or sanitiser
• Hygienically clean all food contact surfaces, utensils and cloths after handling and preparation of raw foods using a disinfectant cleaner**. Hygienically clean all contact surfaces, utensils and cloths before handling and/or preparing ready to eat foods.
• Cloths and sponges become contaminated when they are used to wipe up spills from food, and bacteria can multiply with time once on damp cloths and sponges. Afterwards the cloths and sponges serve as a vector for further spread of pathogens to the hands of the user, to the surfaces wiped and then to many articles throughout the kitchen.

Separate Raw and Cooked Foods
• Food poisoning organisms can move from contaminated foods to other foods by direct contact. Ensure that raw foods are kept separate from cooked foods

Cook food thoroughly
• Good food hygiene means cooking food thoroughly to kill pathogenic organisms. Food can be made safe by heating it to a certain temperature for a sufficient amount of time

Store food properly
• Foods must be stored at the right temperature e.g. hot foods kept hot, chilled foods kept cold. Store food in a refrigerator or freezer.
• Neither freezing nor refrigeration will inactivate bacteria, which means that on transferring these foods to room temperature they may become heavily contaminated again if left at warm temperatures. Also:
• Wash any foods such as fruit and vegetables to be eaten raw thoroughly under clean running water.

The “WHO 5 keys to food hygiene" gives guidance on food hygiene in developing countries includes a fifth principle:

Use safe water and raw materials
It is not possible to say which of these factors is the most common cause of food poisoning. Some UK data on foodborne IID outbreaks in the home in the UK suggests that:

• 39% of outbreaks are due to inappropriate storage of food.
• 31% of outbreaks are due to inadequate cooking.
• 20% of outbreaks are due to cross-contamination or contamination from an infected food handler.
The purpose of cooking food is to reduce the numbers of pathogenic bacteria or viruses to a level insufficient to cause disease. Both home-cooked foods and purchased cold foods such as cold meats should contain only small numbers of human pathogens that are insufficient to cause disease. However, if left in warm or ambient temperatures and moist conditions, overnight organisms can multiply and the food can become highly contaminated by the next day.

- After heating, food must spend the minimum amount of time between 30°C–45°C.
- If not eaten immediately, food must be cooled immediately to prevent the potential growth of bacteria.
- Freezing prevents bacteria from growing and refrigeration will delay it.
- Neither freezing nor refrigeration will inactivate bacteria, which means that on transferring these foods to room temperature they may become heavily contaminated again if left at warm temperatures.

In the kitchen, micro-organisms can be transferred from one food to another food by using the same chopping board or knife to prepare both without washing the surface or knife in between. A food that is fully cooked can become re-contaminated if it touches other contaminated raw foods or drips and spills from raw foods.

Cloths and sponges become contaminated when they are used to wipe up spills from food, and bacteria can multiply with time if they are present on damp cloths and sponges. Afterwards the cloths and sponges serve as a vector for further spread of pathogens to the hands of the user, to the surfaces wiped and then to many articles throughout the kitchen.

For example:
- A UK study has shown that during the preparation of a meal in a domestic kitchen using a contaminated chicken almost 1 in 5 (17%) of hands and hand and food contact surfaces become contaminated with *Salmonella* or *Campylobacter*
- In a US study of 23 patients infected with *E. coli* O157, 80% of the cases were thought to have originated from consumption of hamburgers in the home. Food preparers in those homes were significantly less likely to report washing their hands or work surfaces. The transmission was believed to have occurred more often when the hands of food preparers were allowed to cross-contaminate other food and utensils
- An outbreak of norovirus at a wedding reception affecting 50% of guests was due to cross-contamination of potatoes from a contaminated sink, into which the food handler had previously vomited.

Good Food hygiene practice in the home is described in more detail in:
**How to wash hands:**

Handwashing “technique” is very important. Rubbing with soap and water lifts the germs off the hands, but rinsing under running water is also vital, because it is this process which actually removes the germs from the hands. The accepted procedure for handwashing is:

- Ensure a supply of liquid soap, warm running water, clean hand towel/disposable paper towels and a foot-operated pedal bin.
- Always wash hands under warm running water.
- Apply soap.
- Rub hands together for 15–30 seconds, paying particular attention to fingertips, thumbs and between the fingers.
- Rinse well and dry thoroughly.

In situations where soap and running water is not available an alcohol-based hand rub or hand sanitiser should be used to achieve hand hygiene:

- Apply product to the palm of one hand.
- Rub hands together.
- Rub the product over all surfaces of hands and fingers until your hands are dry.

Note: the volume needed to reduce the number of germs on hands varies by product. In high risk situations where there is an outbreak in the home, handwashing followed use of an alcohol rub/sanitiser should be encouraged.

One very simple thing which people can do which can significantly reduce the risk of disease is to avoid putting their fingers to their mouth.

**Disinfectants and disinfectant cleaners:**

Use a disinfectant or disinfectant/cleaner such as a bleach-based product, which is active against all types of organisms (bacteria and viruses). For more details on choosing the appropriate disinfectant, consult the IFH information sheet “Cleaning and disinfection: Chemical Disinfectants Explained”. Also consult the manufacturers’ instructions for information on the “spectrum of action”, and method of use (dilution, contact time etc). For bleach (hypochlorite) products, use a solution of bleach, diluted to 0.5% w/v or 5000ppm available chlorine. Household bleach (both thick and thin bleach) for domestic use typically contains 4.5 to 5.0% w/v (45,000-50,000 ppm) available chlorine. In situations where “concentrated bleach” is recommended a solution containing not less than 4.5% w/v available chlorine should be used. Bleach/cleaner formulations (e.g. sprays) are formulated to be used “neat” (i.e. without dilution). It is always advisable however to check the label as concentrations and directions for use can vary from one formulation to another.

**How common is food poisoning?**

**In the developed World:**

The 1990s saw rapid increases in the incidence of food poisoning in the developed world, and finally a call to action to reverse this trend. Although this has largely been achieved, levels of foodborne disease remain unacceptably high:
• The European Community Summary Report reported a total of 5,710 foodborne outbreaks in 2006 for their European region.

• In a 2003 report the WHO concluded that about 40% of reported foodborne outbreaks in the WHO European region over the past decade were caused by food consumed in private homes.

• UK data shows that the number of food poisoning notifications reached a peak in 1997/1998 and has since declined, but remains in excess of 70,000 per year. Although the number of cases recorded is in the thousands, the true burden of food poisoning is likely to be millions of cases per year, as most cases go unreported. According to the UK Food Standards Agency, up to half of the annual 9.4 million cases of IID are food poisoning, equating to 4.7 million cases per year.

• The European Community Summary Report cites campylobacteriosis as the most reported animal infection transmitted to humans. In 2005, reported Campylobacter infections increased by 7.8% compared to the previous year. It is also predicted that about 1% of the inhabitants of Europe will be infected with Campylobacter every year. On the other hand, Salmonella infections fell by 9.5% in 2005 to an incidence of 38.2 cases per 100,000 (176,395 reported cases). Campylobacteriosis and Salmonellosis are still cited as the most commonly reported zoonotic diseases.

• For verotoxigenic E. coli (VTEC), 4,916 cases were reported, compared to 3,217 in 2005, the difference being mainly due to reports from the Czech Republic which accounted for 92% of the increase. For the first time in Europe, foodborne viruses were the second most frequent cause. The number of viral outbreaks is assumed to have been severely under-reported in the previous years.

• Increases in reported cases of listeriosis from EU Member States have occurred over the past 5 years. In 2006, listeriosis was reported in 23 EU Member States and was the fifth most common zoonotic infection. Even though listeriosis occurs infrequently (0.3 cases per year per 100,000 of the population), it is characterised by a high case-fatality rate which can exceed 30%.

• In the USA, Foodnet reported a total of 17,883 laboratory-confirmed cases of infection in the 10 FoodNet surveillance areas. The number of cases and incidence per 100,000 population were reported as follows: Salmonella (6,790; 14.92), Campylobacter (5,818; 12.79), Shigella (2,848; 6.26), Cryptosporidium (1,216; 2.67), E. coli O157 (545; 1.20), E. coli non-O157 (260; 0.57), Yersinia (163; 0.36), Listeria (122; 0.27), Vibrio (108; 0.24), and Cyclospora (13; 0.03). In 2007, outbreak-associated infections accounted for 86 (15.8%) of E. coli O157 cases and 364 (5.4%) of Salmonella cases ascertained, similar to proportions in previous years. In their 2007 report, CDC assessed overall that, although significant declines in the incidence of certain foodborne pathogens have occurred since 1996, these declines all occurred before 2004. Comparing 2007 with 2004–2006, the estimated incidence of infections caused by Campylobacter, Listeria, Salmonella, Shigella, STEC O157, Vibrio, and Yersinia did not decline significantly, and the incidence of Cryptosporidium infections increased.

• In Australia in 2006, OzFoodNet reported 115 foodborne disease outbreaks giving an overall rate of 5.6 outbreaks per million of the population. These outbreaks affected 1,522 persons, hospitalised 146 persons but did not result in any deaths. This corresponds to a rate of 5.6 foodborne disease outbreaks per million of the population in 2006. This compares with rates of outbreak reporting in other developed countries.

• New Zealand reported a rate of 35 foodborne outbreaks per million of the population for 2006. The most frequently notified aetiological agents were Campylobacter (15,492 notifications) and Salmonella (8,331 notifications).
Salmonella notifications increased in 2006 by 5.2% when compared to historical reports. Other agents included Listeria, Shiga-producing E. coli, Clostridium perfringens intoxication, and one outbreak each of Staphylococcus aureus and Bacillus cereus, outbreaks of Shigella and one outbreak of Vibrio cholerae (3 people) were also recorded. The most common settings where food was prepared in outbreaks were in restaurants (41%), and private residences (13%).

In developing countries:

In developing areas, it is often difficult to establish whether a disease outbreak is waterborne or foodborne or involves direct faecal/oral transfer. Most disease that is spread by water is also spread through faecal contamination or person-to-person contact or in contaminated food. Relatively few countries in the developing world have surveillance programmes which publish data on foodborne disease, which means that comprehensive data on the burden of foodborne disease is not available. This is particularly true in Africa and the Middle East where very few countries have surveillance programmes. By contrast all Central/South American and Caribbean countries have some form of notification system. The situation is improving and it is hoped that by 2020 a surveillance network will cover most countries.

It is likely that the proportion of infections which are foodborne (relative to other modes of spread e.g. faecal oral transmission not involving food) is lower in developing countries compared with developed countries because of the frequent and more varied opportunities for other modes of transmission, and because the zoonotic agents (particularly Salmonella and Campylobacter) which are especially associated with foodborne infections in developed countries are less important relative to other enteric pathogens. The overall rates of foodborne infection, however, are likely to be higher in developing compared with developed countries. Because keeping food hot or cold is usually not practical, pathogens may be able to grow in home-prepared foods and those sold in food service operations and street vendors.

A major concern in developing countries is babies and young children. Although breast feeding is recommended and has been shown to reduce enteric infections, women in low income families may not produce enough milk, making supplemental weaning foods necessary.

- It is estimated that Enterotoxigenic E. coli, Enteropathogenic E. coli, Shigella, Vibrio cholera and parasites are the main problems in developing countries, but it is uncertain how many cases are attributed to food. Salmonella is still the most important agent, with S. enteritidis and S. typhimurium being of most concern.
- Campylobacter is one of the most frequently isolated bacteria from stools of people infected with diarrhoea in developing countries. Major sources of Campylobacter are food and environmental contamination:
- Campylobacteriosis is considered to be a particular burden in the developing world, partly because Campylobacter-associated diarrhoea and bacteraemia occur in HIV/AIDS patients.

Other “facts about” sheets giving information on food poisoning

1. UK National Electronic Library on Infections (NELI) [http://www.neli.org.uk/IntegratedCRD.nsf/NeLI_Home1?OpenForm]


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**Further Information**


6. Centre for Diseases Control and Prevention. Preliminary FoodNet data on the incidence of infection with pathogens transmitted commonly through food – 10 states, 2007 April 11, 2008 / 57(14);366-370. Available at: [http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5714a2.htm].


