



When the bad bugs bite

WHAT KINDS OF BUGS LIVE IN OUR FOOD, AND WHAT DETECTIVE WORK MUST A PATHOLOGIST DO TO FIND THEM? **BIANCA NOGRADY** INVESTIGATES.

Debbie: ... How can we all have died at the same time?

The Grim Reaper: (pointing with a skeletal finger) The salmon mousse!

Geoffrey: Darling, you didn't use tinned salmon did you?

Angela: I'm most dreadfully embarrassed...

Monty Python managed to make light of it in this sketch from *The Meaning of Life*, but in reality, food-borne illness is no laughing matter.

An estimated 5.4 million cases occur in Australia each year, causing around 18,000 hospitalisations and 120 deaths.¹ It leads to 2.1 million lost days of work,

1.2 million medical consultations and 300,000 antibiotic prescriptions.

And it can be very hard to see the funny side when you are curled into the foetal position wracked with stomach cramps, vomiting and diarrhoea.

The culprits behind this mayhem are pathogenic bacteria, viruses and parasites.

In total, approximately 290 different organisms have been identified as being potential causes of food-borne illness. Many of these pathogens are ubiquitous in our soil, water, animals and even in our own bodies, but it's when they turn up where they are not supposed to that trouble starts.

The symptoms vary according to the pathogen, but most of us have experienced the unpleasantness of a dose of food-borne illness – vomiting, nausea, diarrhoea, fever, abdominal cramps and headache.

The term 'gastroenteritis' is often used when talking about food-borne illness.

Gastroenteritis simply means inflammation of both the stomach and the colon, says microbiologist Dr Gary Lum, Royal College of Pathologists of Australasia (RCPA) Vice-President and Chair of the college's Microbiology Advisory Committee.

"What it means is you've got vomiting and diarrhoea."

“Tracing the cause of illness can be quite complex, and trying to link illness to a particular organism in a specific food vehicle requires good detective work and often a lot of luck” – Dean Mahoney

Most gastroenteritis is caused by food-borne pathogens – and these are more often viral pathogens such as rotavirus and norovirus – but gastroenteritis can also occur as a result of a reaction to a new food or medication. Some food-borne pathogens only cause inflammation of the colon alone, called enteritis, which leads to diarrhoea but not vomiting.

Long term problems

While most food-borne illness runs its course within a day or so, some patients experience longer-term clinical problems. These include jaundice, irritable bowel syndrome, reactive arthritis and haemolytic uraemic syndrome, where toxins from the bacteria lead to acute renal impairment.

Pregnant women are particularly vulnerable as infection with pathogens such as *Listeria* can cause miscarriage, premature delivery or infect the fetus.

Public health enemy number one and two of the food-borne pathogen community would most likely be the bacteria *Salmonella* and *Campylobacter*, according to Associate Professor Graeme Nimmo, clinical microbiologist with the Queensland Health Pathology Service.

“Food poisoning from *Salmonella* and *Campylobacter* don’t have high mortality, but their numbers are large and there would be considerable morbidity in terms of lost work, ill-health and personal discomfort,” Professor Nimmo says.

Salmonella – named in 1885 after American veterinary pathologist Daniel Elmer Salmon – is a bacterium found in animal faeces.

There are a number of different *Salmonella* species, one of which causes typhoid fever.

Thankfully, typhoid is rare in Australia; however, other non-typhoidal species of

Salmonella – commonly found in undercooked poultry, raw egg desserts, mayonnaise, sesame seed paste and sprouts – were responsible for around 81,000 cases of food-borne illness in Australia in 2000.¹

Campylobacter is most closely associated with chicken meat, according to Mr Deon Mahoney, Principal Microbiologist with Food Standards Australia New Zealand.

“It’s a real battle because about 80% of chicken meat is contaminated with *Campylobacter*,” Mr Mahoney says. Backyard chooks, petting zoos and visiting farms are also sources of the bacteria.

Campylobacter was blamed for approximately 208,000 cases of food-borne illness in 2000.

But these two pathogens are just the tip of the iceberg.

Host of other culprits

Other bacteria associated with food-borne illness in Australia include *Listeria monocytogenes*, *Staphylococcus aureus*, *Clostridium perfringens* and *Aeromonas*.

Then there are the viral causes of food-borne illness. These pose an extra hazard because they are not only transmitted through food, but can also spread from person to person. Norovirus is one of the most common known causes of gastroenteritis in the developed world, and was linked to around 446,000 cases of illness in Australia in 2000. It is often associated with cruise liners, not only because close quarters increase spread of the disease, but also because illness outbreaks on cruise liners are often tracked and monitored more closely than outbreaks on land, leading to increased reporting.

Another virus, hepatitis A, is often contracted from eating contaminated

seafood. A major outbreak of hepatitis A in 1997 was traced to oysters from Wallis Lake in NSW.

There are also, of course, the parasites, such as *Cryptosporidium* and *Giardia*, but one of the most notorious food-borne pathogens, particularly in Australia, is *Escherichia coli*.

It is one of the main species of bacteria found in animal and human intestines, and plays a fundamental role as one of our essential gut flora. However, some strains can be deadly. In 1995, the enterohaemorrhagic strain *E. coli* O157:H7 caused the Garibaldi outbreak in South Australia which hospitalised 35 people, including 22 children, and claimed the life of a young girl. This outbreak caused such public outcry that it prompted the creation of new uniform national food safety standards.

But not all food-borne bacteria are bad. Many yoghurts and milk products contain ‘friendly’ bacteria such as *Lactobacillus acidophilus*, *Streptococcus salivarius* and *Bifidobacterium*, which are not only part of the yoghurt culture process, but play benevolent roles in the human body, hence the name ‘probiotics’. These probiotics are claimed to offer a range of health benefits, from treating thrush to restoring and maintaining healthy gut flora. While the medical evidence is mixed on whether these claims are true, probiotics certainly do no harm, unlike their pathogenic colleagues.

An intricate trail

Food-borne illness is a problem that governments take seriously.

In 2000, the federal government established OzFoodNet – a collaborative initiative of state and territory health authorities with the sole purpose of investigating outbreaks of food-borne illness.



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– Dr Gary Lum

“That’s just one faeces sample, and we get something like 40,000 a year,” Dr Robson says.

If this process, which can take around 60 hours, identifies a notifiable disease, the state or territory health department is notified and the sample forwarded to the Public Health Laboratory Network for specialised typing.

Typing is an essential step in the process of identifying outbreaks of food-borne illness and tracing them back to the cause.

“The importance is not so much the diagnosis, but the type of each isolate because if we know that an isolate is the same from multiple people then we know there is an outbreak,” Dr Lum says.

Once an outbreak has been confirmed, the next step is to trace the isolate back to its source.

Most people who experience a dose of food-borne illness assume that it was caused by something in the last meal they ate, but Mr Mahoney says it can be far more complicated.

“Tracing the cause of illness can be quite complex, and trying to link illness to a particular organism in a specific food vehicle requires good detective work and often a lot of luck,” he says.

“It’s usually multi-factorial, and can be a conspiracy of a whole lot of things that go wrong at one time.”

Take, for example, a recent outbreak of salmonellosis that affected about 300 people in Sydney and was traced back to a food outlet.

“It was probably traced back to eggs that were in a mayonnaise that sat around

The process of such an investigation starts when a faecal sample is sent to a pathologist such as Dr Jennifer Robson, microbiologist and infectious diseases physician at Sullivan Nicolaides Pathology in Brisbane. The pathologist’s role is to quickly analyse the sample to discover what, if any, pathogen is to blame. But it’s far from a straightforward procedure.

“One of the things that is difficult to appreciate is how complicated faecal processing is,” Dr Robson says. “To get out these pathogens from the billions of flora that are in normal faeces, we need 6–7 different selective agar plates (petri dishes containing a substance to cultivate micro-organisms) and with every sample, we look at it under the microscope and look for red cells and white cells to see if there is inflammation.”

The sample is then examined and put through an enzyme-linked immunosorbent assay to look for parasites or viral pathogens, and put on the specialised agar plates to culture for the most common bacterial causes.

Normally, the plates will indicate the presence of *Salmonella*, *Campylobacter*, *Aeromonas*, *Yersinia* and *Shigella*, but if the patient has consumed seafood recently, the pathologist will also plate for the bacteria *Vibrio parahaemolyticus*.

Finally, the sample might also undergo polymerase chain reaction (PCR) testing for shiga toxin – the toxin produced most commonly by *Shigella* and some strains of *E. coli*.

for a long period of time,” Mr Mahoney says.

But that was just part of the picture. While the eggs may have been the initial source of the pathogen, the mayonnaise wasn't acidic enough to suppress growth of the bacteria – a side-effect of the modern palate's evolving preference for sweeter, less acidic foods.

The mayonnaise might have been left for a long time on a bench, providing the perfect conditions for a pathogen to multiply.

Another complicating factor in tracing the source of an outbreak of food-borne illness is that the many different pathogens that could be responsible have different incubation periods.

“That is problematic for us,” Mr Mahoney says.

If someone suddenly becomes ill with violent vomiting within four hours of eating something, it can be relatively easy to pinpoint the source.

“But if it's something else, if it's got an incubation period of 36–72 hours it can be really difficult to trace back to what you ate.”

A further complication is that people who suffer from food poisoning don't always report it to authorities. “Most of us, when we get ill, we curl up in bed and don't go anywhere,” Mr Mahoney says.

Most food-borne illness is self-limiting, so often people will just ride it out rather than leave the safety of the toilet to seek medical help.

But sometimes, all the pieces of this complex puzzle fall into place, and an outbreak of illness is traced to a particular source. The Garibaldi outbreak in South Australia, for example, was traced to a contaminated batch of Garibaldi garlic mettwurst.

While high-protein foods such as mettwurst, chicken and eggs are usually thought to be the most common source of contamination, Mr Mahoney says increasing numbers of outbreaks are being traced to fresh horticultural produce. The United States has recently experienced significant outbreaks of food-borne illness caused by *E. coli*-contaminated spinach and lettuce. Australia has also suffered outbreaks traced to contaminated batches of fresh sprouts and rockmelons.

A dose of perspective

Thankfully, large food-borne illness outbreaks such as the Garibaldi incident are relatively rare here.

“Australia's got a fairly good track record when it comes to hygiene standards and food practices in the restaurant and food industry,” Dr Lum says.

“So long as people meet proficiency testing standards and meet the education standards and qualifications necessary to work in these environments, then I think we're doing about as well as we could.”

However, in NSW, the performance of local councils on conducting inspections of food premises has been recently exposed to scrutiny.

A series of articles published in *The Sydney Morning Herald* raised concerns that the level and quality of inspections by

councils, who are not legally obliged to carry them out, was putting food safety standards at risk. While some councils took food inspection seriously, others conducted no inspections at all, the reports said. And until recently, none of them made the results of their inspections public.

However, some state governments, including NSW, have now decided to 'name and shame' food premises that have been prosecuted for breaches of the Food Act.

Mr Mahoney says it's important, though, to keep the statistics on food-borne illness in perspective.

“When you consider that there are 21 million Australians, assume people eat three meals a day by 365 days, there are a lot of meals out there that aren't contaminated, that don't make people sick.”

How to avoid food-borne illness

- KEEP HOT FOOD HOT (ABOVE 60°C) AND COLD FOOD COLD (BELOW 5°C).
- THAW FROZEN FOOD IN THE REFRIGERATOR OR THE MICROWAVE, NOT AT ROOM TEMPERATURE.
- COOK FOOD THOROUGHLY AND REHEAT TO STEAMING HOT (ABOVE 75°C) BEFORE SERVING.
- KEEP RAW AND COOKED FOOD SEPARATE, USING SEPARATE CHOPPING BOARDS, UTENSILS AND PLATES, AND WASH HANDS AFTER HANDLING RAW FOOD.
- THOROUGHLY WASH RAW VEGETABLES BEFORE PREPARATION AND EATING.
- STORE FOOD AND LEFTOVERS IN COVERED OR SEALED CONTAINERS.
- AVOID HANDLING FOOD IF YOU ARE ILL.
- KEEP YOUR KITCHEN AND UTENSILS CLEAN.
- WASH AND DRY YOUR HANDS PROPERLY WHILE COOKING.
- IF IN DOUBT, THROW IT OUT.

Some home truths

While outbreaks traced to restaurants or food producers garner considerable media coverage, Dr Lum says many outbreaks also occur because of consumers mishandling food in their own environment.

One statistic suggests up to 20% of outbreaks can be blamed on consumers, rather than commercial premises.²

“Probably the worst situations occur when you get gatherings of people or family at social get-togethers, and people just don’t realise how important it is to keep food properly,” Dr Lum says. “Instead of proper refrigeration, they will put a bag of prawns on ice but won’t cover the container.

“In a situation where you’ve got large groups of people, particularly if they are senior Australians or people who are ill or immunocompromised, that’s the last situation where you want poor food handling.”

But sometimes the crime has been committed before the food even arrives in the country.

While the Australian Quarantine and Inspection Service regularly screens imported food – particularly higher-risk foods such as oysters – sometimes a contaminated product can slip under the radar.

Dr Robson cites one case where three women contracted cholera, caused by the bacterium *Vibrio cholerae*, from whitebait that had been purchased from their local fish market but which came from Indonesia.

Thankfully, that outbreak was limited to just three people, who all happened to be taking a particular medication that suppressed acid production in the stomach and therefore made them more vulnerable to the infection.

While contamination can come from any number of sources, and may even be endemic in a particular product such as chicken, it is when food is kept in suboptimal conditions that bacteria and viruses have the chance to flourish.

“The very basic thing is the danger zone from 5°C to 60°C,” Dr Robson says. “Food held for any length of time should be kept below 5°C or greater than 60°C.”

Other risky practices include using the same utensils and chopping boards for raw and cooked foods, not adequately washing raw vegetables before serving, not storing foods properly in sealed or covered containers, and not cooking or heating food adequately.

But in the heat and throng of a busy commercial or domestic kitchen, it can sometimes be hard to follow all the rules to the letter.

“I’m not totally fastidious,” Dr Robson admits, although she says she is certainly more aware of the importance of not leaving food on the sideboard and always putting it in the fridge.

“You can forget those things if you don’t have a knowledge of what those bacteria do and how they grow.” 🔥

References:

1. *Hall G, Kirk M. Foodborne Illness in Australia. Canberra: Australian Government Department of Health and Ageing, 2005.*
2. *Food Safety Information Council. Food Poisoning Bacteria <http://www.foodsafety.asn.au/publications/factsheets/foodpoisoningbacteri2249.cfm>*

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