transmissible diseases, in particular *Neisseria gonorrhoeae* and the surveillance and molecular biology of antimicrobial resistance. Dr Dillon has extensive academic and public sector administrative leadership experience, has led several national and international scientific organisations, and has consulted nationally and internationally in the area of STIs and public health. Dr Dillon has authored numerous publications with a special focus on international trends in antimicrobial resistance, molecular typing of bacterial pathogens and the cell biology of *Neisseria gonorrhoeae*. She is a Fellow of the Canadian Academy of Health Sciences.

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Foodborne disease associated with travel

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The most important determinant of developing foodborne disease is travel destination. The risk is proportional to regions where there is a high level of unsanitary water supply, lack of food hygiene, lack of food safety regulation, fluctuating electricity supply and lack of education. In medium to high risk regions a travel kit, designed to prevent, minimise or treat the effects should be carried.

After a decade of comprehensive work gathering data to estimate the world burden of foodborne disease the World Health Organization (WHO) has produced a report in which it has calculated that 600 million people develop foodborne disease after eating contaminated food each year. The report also determined which regions and countries had the highest incidence and which foodborne pathogens caused the majority of outbreaks[1]. This has great significance on the varying degrees of danger of developing a foodborne disease when travelling in these regions because the most important determinant of risk is travel destination. Risk also depends on the season of travel[2].

Diarrhoeal disease represents more than 50% of global foodborne disease[1]. Traveller's diarrhoea (TD) is defined as the passage of three or more loose or unformed bowel actions accompanied by at least one of nausea, vomiting, and abdominal cramps, and may be further complicated by fever or blood in stools[2]. Depending on the destination and season of travel, the chance of developing TD when travelling can range from 30% to 70%[2].

According to the US Centers for Disease Control and Prevention (CDC) there are generally three grades of risk of developing TD[2]. The general division can be seen in Table 1.

The GeoSentinel network, the global surveillance network established in 1995 between the International Society of Travel Medicine and the CDC, has categorised the risk of travellers developing microbial gastrointestinal infections into very high, high, medium, moderate and low risk regions and has analysed the specific microbial pathogens causing gastrointestinal infections in each region[3]. Travellers to regions with high and very high morbidity due to foodborne disease were 200 and 800 times more likely to develop a gastrointestinal infection, respectively, than travellers to low or moderate morbidity such as Northern America and Europe[3].

The number of people travelling from developed to high risk regions such as Africa, the Americas and Asia increased by 60% from 2000 to 2007, and it is estimated this will continue to increase at a rate of 6% per year[3]. Currently over 100 million travellers from non-tropical regions will visit a developing country each year and 60% of travellers who visit tropical and subtropical regions will develop diarrhoea and health problems[1,3].

The risk of developing foodborne illness when travelling is proportional to regions where there is a high level of unsanitary water supply, lack of food hygiene allowing cross contamination, lack of food safety regulation when producing and storing food, fluctuating electricity supply for effective refrigeration, and lack of education and literacy[1].

Table 2 shows the general percentages of microbial pathogens that account for TD[2]. The symptoms of TD are commonly nausea,

vomiting and diarrhoea but depending on the infective agent may be more severe with fever and bloody diarrhoea. The most common bacteria associated with TD are *Campylobacter jejuni, Salmonella* spp.*, Shigella* spp. and enterotoxigenic *E. coli*[3]. Other pathogenic *E. coli* are also common. The main intestinal virus causing TD is Norovirus. The main protozoal foodborne pathogen causing TD is *Giardia*[2] from contaminated water used to prepare food. Other protozoa are less common. In regions where the tradition or normal practice is to eat raw or undercooked meat, poultry and eggs, drink raw milk and eat fresh produce grown using contaminated unsanitary water supplies, there is a high risk of developing the above diarrheal diseases. Infection with the tapeworm (*Taenia solium*) occurs from eating raw or undercooked pork. Some pathogens are much more common in low-income countries. These include typhoid fever and foodborne cholera. Several foodborne pathogens may cause more serious illness affecting sites outside the gastrointestinal tract including systemic, neurological, muscular, and long-term disease sequelae affecting the kidney, liver, brain, bone and skin. Travellers who are old and young, pregnant women and those with weakened immune system may be more susceptible to serious disease[1]. Some of these will be discussed further in information on specific regions, below.

The WHO African, South-East Asia and Eastern Mediterranean regions have the first, second and third highest burden of foodborne disease in the world respectively which will have major consequences for risk when travelling. The majority of cases are TD, caused by typical bacterial and protozoal agents and Norovirus. Tapeworm is also prominent, however some interesting facts have emerged from the WHO foodborne disease burden statistics in these regions that also have significance for travellers[1].

Half the global population who die of hepatitis A infection or typhoid live in the WHO South-East Asia region so both diseases must also be considered when travelling there. Hepatitis A is also prevalent in the Eastern Mediterranean region due to faecal contamination of food. This region has more than half the global cases of brucellosis and travellers could be infected from eating raw or under-pasteurised dairy products from infected cows, sheep and goats with poor domestic health regimes[1].

Table 1. Three grades of travel destination risk[2]

Risk	Region
High	Africa, Asia (not Singapore), Middle East, Mexico, Central and South America
Intermediate risk	Eastern Europe, South Africa, and some of the Caribbean islands
Low risk	United Sates, Canada, Australia, New Zealand, Japan and countries in Northern and Western Europe

Table 2. The general percentages of microbial pathogens that account for Travellers Diarrhoea[2]

Microbial foodborne pathogen	Approximate percentage of TD
Bacterial pathogens	80–90%
Protozoal pathogens	10%
Intestinal viruses	5–8%

Unlike other regions diarrhoeal disease is not the dominant foodborne disease in the WHO Western Pacific region. This area has a high incidence of liver cancer resulting from the ingestion of mouldy grain contaminated with aflatoxin. This region also has a high rate of foodborne disease due to ingestion of parasites. Most of the world's population infected with Chinese liver fluke is in this region[1]. As this parasite is contracted by eating raw or undercooked fish this should be avoided when travelling in this region.

In Central and South America, in addition to TD, toxoplasmosis and tapeworm are also important[1]. The risk of hepatitis A and foodborne amoebiasis, cysticerosis, brucellosis, infection with *Mycobacterium bovis* and listeriosis, which causes complication in pregnancy and serious systemic illness in susceptible people, have been associated with travel infections in Mexico[4].

The WHO European region has the lowest burden of foodborne disease. In first world countries non-typhoidal *Salmonella* is an issue, as it is in all regions. *Campylobacter* is also an important pathogen[1]. However, Norovirus is five times more common. One of the most frequent causes of this virus in first world countries often relates to cruise ships. Between 2012 and 2016 there were 45 gastrointestinal outbreaks on cruise ships reported to the CDC of which 41 were attributed to Norovirus[5]. Because Norovirus symptoms include vomiting, often projectile vomiting, the close quarters of cruise ships favour the rapid spread of this virus via aerosols and poor food hygiene. However, the incidence of Norovirus transmission on cruise ships is diminishing since improved sanitation and food safety and hygiene regulations and strict quarantine of infected passengers has been implemented[6].

Vaccination to hepatitis A, typhoid and cholera are available and should be considered when travelling to regions at risk of these diseases[7]. A travel kit, designed to prevent, minimise or treat the effects and symptoms of TD should be carried by travellers to medium and high risk regions. It should contain an alcohol based hand sanitiser. Often a probiotic or capsules of bovine colostrum, which can be bought over the counter, is used as a daily preventative, although studies have not proved their efficacy[2]. Anti-motility agents, such as loperimide, help reduce the frequency of bowel movements and allow travel to continue. However, the CDC does not recommended using this treatment if the general foodborne disease symptoms of TD advance to fever and bloody diarrhoea[2]. It is important for a travel kit to include dehydrated sachets of oral rehydration salts for oral hydration therapy, to reduce lost fluids and electrolytes. Oral rehydration is one of the most important treatments of TD. An antibiotic is often included in the kit, as prescribed by a medical practitioner, due to the frequency of TD's being caused by bacteria, however, travellers may find it very difficult to distinguish between the symptoms of various foodborne disease, so inadvertent use of antibiotic therapy is not recommended. Carrying a treatment for parasites such as *Giardia* is also important[2].

When travelling in high risk countries many factors, such as restaurant hygiene, are out of the traveller's control. Although the 'boil it, cook it, peel it, or forget it' rule is still highly recommended in high and medium risk regions, the hygiene of kitchens and cross contamination in food preparation areas are often unseen by travellers unsuspectingly enjoying a meal in a local or traditional restaurant. Avoiding raw or undercooked meat, fish, poultry and dairy products, exercising care when selecting food to eat, and timely use of prophylactics and medications will decrease risk and give the traveller a better chance of enjoying a trip free of foodborne pathogen health issues.

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Biography

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